Determining the Prevalence of Bitter Tasters in a Sample of College Smokers

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Social smoking is a growing trend among college students, characterized by occasional smoking, lack of nicotine dependence, and less intention to quit. Bitter taste phenotype (BTP), one's ability to test bitter, may help tailor appropriate oral nicotine replacement therapy (NRT) to help students quit. Research questions examined differences in BTP and nicotine dependence among regular and social smokers. A bitter taste test determined ability to taste bitter. Carbon monoxide (CO) breath levels and salivary cotinine were used as biomarkers of smoking. A final sample of 22 revealed that 14 (63.6%) subjects considered themselves "social smokers." Prevalence of bitter tasters was 59.1%, with 45.5% being categorized as medium tasters, 13.6% as supertasters, and 40.9% as nontasters. BTP was significantly and inversely correlated with smoking status; specifically, average number of cigarettes on a weekday (Kendall's tau b = -.402), and percentage smoked with others (Kendall's tau b = -.434). The trend of nontasters having a higher nicotine dependence score than bitter tasters was observed, although results were insignificant. As there is limited research about smoking habits of college students, understanding students' social smoking, oral NRT use, and BTP will aid in determining the most effective cessation products and programs.

Introduction

College students are a unique group within the smoker population. The pattern of social smoking continues to be a college trend about which very little is known, and thus very little can be done to structure programs that will truly help social smokers quit. Although research has proven that oral nicotine replacement therapy (NRT) is extremely effective, college students may not be open to cessation solutions if they do not believe that they have a smoking addiction. In addition, students who find oral NRT offensive to the taste may also have one less option to help them quit. Thus, the concept of bitter taste phenotype (BTP) can be used to help identify college smokers who would not be good candidates for oral NRT products by identifying those students who find bitter taste offensive. Because there is such a large gap in the extant research about the smoking habits of college students and the best means to help them quit, this study aims to analyze how the pattern of social smoking, the use of oral NRT, and bitter taste phenotype can affect the course of smoking in the college student.

Determining the Prevalence of Bitter Tasters in a Sample of College Smokers

Cigarette smoking is the largest preventable cause of morbidities and

mortalities in the United States (Carmona, 2005). Not only does smoking cost more than 438,000 lives per year, but costs from tobacco use also include a $92 billion loss in productivity and $75.5 billion in medical expenses per year (Carmona, 2005). While approximately 20.8% of all Americans smoke (Centers for Disease Control and Prevention (CDC), 2007), tobacco use among young adults (ages 18-24) continues to increase, with smoking prevalence being approximately 28.5% among college students according to the Harvard School of Public Health Alcohol Study (Rigotti et al., 2000). In the past, college students have been found to have relatively low smoking rates, partly because studies have shown that increased education is strongly correlated with non-smoking behaviors.

However, since a previous increase in smoking among high school students has begun to move into the young adult age group, smokers are now becoming a larger portion of the college student population. In addition, tobacco companies have focused on marketing towards their youngest legal targets, and more efforts have been made to influence students to start using tobacco products (Rigotti et al., 2005). By encouraging smoking cessation, health care professionals such as nurses could save America billions of dollars in health care costs and productivity loss. This is why it is extremely important to implement interventions and programs that will truly help clients quit smoking.

Unfortunately, more than half of college students in one study denied being smokers despite current smoking behavior (Levinson et al., 2007). This makes it extremely difficult for student health centers and cessation programs to identify smokers and provide the necessary resources to help students quit. College smokers evade many "smoker" assessment tools, smoking cessation advertisements and campaigns, and addiction programs that do not address the issue of denial and identity. Social smoking continues to be a growing trend within the college student population, a pattern which is characterized by occasional smoking at parties or other social events, lack of nicotine dependence, and less intention to attempt to quit. Social smoking will need to be understood in order to give students the resources they need to quit.

According to the Cochrane Database of Systematic Review, a smoker is 50-70% more likely to be successful at quitting if that client uses nicotine replacement therapy (Stead et al., 2008). By replacing tobacco with Nicotine Replacement Therapy (NRT), the goal of NRT is to increase nicotine levels in the blood, decrease withdrawal, and eliminate cravings that result from lack of tobacco in the addicted client (Lemone and Burke, 2008). The DHHS Tobacco Guidelines state that by recommending NRT to the client and explaining the proper use, right dosage, and side effects of each available NRT, a clinician can greatly increase a client's chances of quitting. In addition, self-initiated use, ease of use, sensory stimulation, and behaviors involved in administration are factors that also affect the success of NRT (Fiore et al., 2008).

The bitter taste of nicotine can be a potential barrier to the success of those who are using oral NRT and are tasters of bitter. By identifying those clients who will most likely find oral NRT products offensive to the taste, clinicians can select other products that might increase compliance and prevent the trial and error approach to smoking cessation. Moreover, those who cannot taste bitter may be at a greater risk for nicotine addiction for cigarette use. The concept of Bitter Taste Phenotype (BTP) can be used to personalize smoking cessation programs to the client's taste perceptives.

Review of Literature

A review of existing literature was conducted on Medline, Pubmed, and Cochrane Database of Systematic Reviews in order to determine studies that pertained to the clinical question of interest. Topics of interest included social smoking patterns, oral nicotine replacement therapy, bitter taste phenotype, and the role each topic plays in the college student smoker.

College and the Social Smoker

At The Ohio State University alone, 38.6% of students smoked cigarettes within the past year (The Ohio State University Office of Student Affairs, 2007). According to Wechsler and colleagues, half of current college smokers in the 1997 Harvard Public Health Alcohol Study tried to quit (Wechsler et al., 1998). One could assume, then, that college campuses would give health care professionals rich opportunities to implement interventions, disseminate health information, and provide smoking cessation programs in an effort to stop tobacco use and its harmful health effects on future generations of smokers.

Yet Levinson and colleagues reported that more than half of students in their study denied being smokers despite current smoking behavior (Levinson et al., 2007). This makes it extremely difficult for health professionals and cessation programs to identify college smokers and provide the necessary resources to help students quit. In addition, these "deniers" smoked infrequently, felt they were not addicted to cigarettes, had nonsmokers as friends, preferred dating nonsmokers, and smoked for other reasons than relief of stress (Levinson et al., 2007). According to Moran and colleagues, only one third of college smokers reported smoking every day, and only 18% were considered nicotine

dependent, as defined by less than 30 minutes to the first morning cigarette (Moran et al., 2004). These smoking patterns are not typical of regular adult smokers; these patterns also pose a potential barrier for college smokers to admit they have an addiction, and thus seek out help accordingly.

College students are a unique population in the fact that many students do not consider themselves smokers, yet they smoke socially. The term "social smoker" is not completely definitive; however, in Moran's study, social smokers were defined as those who smoked with others more frequently than they smoked by themselves (Moran et al., 2004). Moreover, social smoking is also correlated with the college trend of smoking occasionally. Only 19% of regular smokers had a social smoking pattern, whereas 71% of occasional smokers defined themselves as social smokers. Over half of the smokers in Moran's study smoked mainly with other people, which is indicative of social smoking. In addition, Moran found that these occasional, social smokers had a lower frequency and intensity of smoking, were not as dependent on nicotine, had less intention to quit, and did not attempt to quit (Moran et al., 2004).

Social smoking is strongly associated with alcohol consumption, which is also commonly found in college social settings and is consistent with the college lifestyle. The co-occurrence of smoking and drinking among college students cannot be ignored: results from a recent national survey of approximately 11,000 students from over 120 colleges found that over 98% of current smokers drink, while less than 7% of those who do not drink, smoke (Weitzman and Chen, 2005). This national survey also found that freshman who began binge drinking in college had much higher odds of smoking, especially female students (Weitzman and Chen, 2005). The co-occurrence of these substances and the social settings in which they occur is another unique circumstance that cessation programs will have to address when helping college students quit.

By not considering themselves smokers, college smokers evade many "smoker" assessment tools, smoking cessation advertisements and campaigns, and addiction programs that do not address the issue of denial and identity. Because there are so few research studies available about the trends of social smoking within the college student population, doubt should be cast upon how really effective programs and resources are at reaching out to a group about which there is very little knowledge. More research is needed to understand the psychosocial implications for social smoking, as it is still not clear whether social smoking is a gateway pattern towards regular smoking habits and subsequent nicotine addiction. More attention needs to be given on how cessation interventions can be tailored to this unique group.

Oral Nicotine Replacement Therapy

According to the Cochrane Database of Systematic Review, a smoker is 50-70% more likely to be successful at quitting if that client uses nicotine replacement therapy (Stead et al., 2008). The aims of the meta-analysis conducted by Stead in 2008 were to compare NRT and placebo in helping smoking cessation, and to compare the various forms of NRT and their respective success rates. They also investigated the influences of dosage, form, timing, counseling, and clinical setting on the client during smoking cessation, and whether combinations of different therapies could increase success in quitting. The researchers searched the Cochrane Database Tobacco Addiction Group trials register to find 132 trials that fit the criterion of a randomized controlled trial in which placebo was compared to NRT or different doses of NRT. 111 trials with over 40,000 participants were chosen for meta-analysis to find that NRT greatly increased the chances of successfully quitting; the risk ratio of abstinence for any NRT to placebo was 1.58 (Stead et al., 2008).

When comparing different forms of NRT, the risk ratio (RR) for nicotine gum was 1.43; for the patch, 1.66; for the inhaler, 1.90; for the lozenge, 2.00; and for the nasal spray, 2.02 (Stead et al., 2008). In addition, Stead (2008) found that combining the passive form of the patch with the more self-initiated oral forms of NRT, such as the nicotine gum, was more effective than any single type of NRT. These results were found "largely independent of the duration of therapy, the intensity of…support provided, or the setting in which the NRT was offered" (Stead et al., 2008, p. 2). In summary, the Cochrane review by Stead (2008) recommends use of any NRT product, and the evidence to support this claim seems to be extensive.

Products that involve oral use include the nicotine gum, lozenge, and inhaler. By replacing tobacco with Nicotine Replacement Therapy (NRT), the goal of NRT is to increase nicotine levels in the blood, decrease withdrawal, and eliminate cravings that result from lack of tobacco in the addicted client (Lemone and Burke, 2008). By decreasing withdrawal symptoms, the gum can lighten the emotional distress of the client and help to continue his/her abstinence of tobacco (Niaura et al., 2008). The DHHS Treating Tobacco Use Guidelines stated that by recommending NRT to the client and explaining the proper use, right dosage, and side effects of each available NRT, a clinician can greatly increase a client's chances of quitting. The clinical use of the following oral NRT products is listed below:

The nicotine gum should be used every 1-2 hours for the first 6 weeks, and can be used for up to 12 weeks. The gum should be chewed intermittently until flavor emerges, then "parked" within the cheek so that the nicotine can be

absorbed for the next 30 minutes into the oral mucosa. Heavy smokers requiring more than 25 cigarettes per day should be given the higher 4 mg dose. Clients may experience mouth and jaw soreness as well as dyspepsia. The nicotine inhaler can be given for up to 6 months, using the recommended 6-16 cartridges a day. The inhaler deposits nicotine in the oropharynx, which is then absorbed by the mucosa. The inhaler should be kept at a temperature higher than 40°F. Side effects include local irritation of the mouth and throat. The nicotine lozenge should be used every 1-2 hours with a minimum of 9 lozenges per day being used. These should be dissolved in the mouth without chewing or swallowing of the medication. During the twelve week therapy, the dosage should be decreased to one lozenge every 2-4 hours at 7 weeks, and every 4-8 hours at 10 weeks. The higher 4 mg dose should be used for clients who smoke within 30 minutes of waking. Side effects include nausea, hiccups, and heartburn (Fiore et al., 2008).

The DHHS Treating Tobacco Use Guidelines state that the strength of the evidence to support the success of the nicotine gum and inhaler is a Grade A on a rating scheme of A-C. This was the highest strength of evidence rating on the scale; the rating requires multiple well-designed randomized clinical trials, directly relevant to the recommendation, which yielded a consistent pattern of findings. Meta-analysis was performed on each NRT product except for the nicotine lozenge, which only had one sufficient study. The risk ratio (RR) for the gum was 1.5 and for the inhaler 2.1. However, because relapse is so common, it is extremely important that clinicians make follow-up appointments with their clients and continue encouragement (Fiore et al., 2008).

In nursing, care is always individualized and holistic, keeping in mind that the nursing process should be tailored to each patient's situation and needs in order to improve the care of the nurse and the compliance of the patient. Unfortunately, this is rarely the case with smoking cessation programs and products, as clients usually try over-the-counter products or recommended programs by trial and error (Schneider et al., 2007). This is not only time consuming and costly, but also very discouraging to the client. In addition, it drastically reduces the likelihood of successfully quitting. While there are numerous studies that support the effectiveness of oral NRT, there are practically no research studies available that determine the success of various oral NRT products within the college student population. Thus, more research is needed to determine how health care providers can tailor smoking cessation programs and products to the college student, so that the young adult has a greater chance of being successful on their initial quit attempt.

Bitter Taste Phenotype (BTP)

The overall goal of this study is to determine how health care professionals can use the concept of Bitter Taste Phenotype (BTP) to personalize oral smoking cessation products such as oral Nicotine Replacement Therapy (NRT). According to Enoch and colleagues, 60% of Asian Indians, 70% of Caucasians, 90% of Southeast Asians, and 97% of West Africans perceive PTC (phenylthiocarbamide, a bitter compound) as tasting bitter (Enoch et al., 2001). Scientists have often speculated whether taste sensitivity to PTC would increase the likelihood of aversion to bitter foods such as broccoli, brussel spouts, spinach, cabbage, turnips, other cruciferous vegetables, as well as bitter drugs such as tobacco and alcohol. In addition, the concept that PTC sensitivity gives some people a certain amount of protection from nicotine dependence has been suggested, especially in light of recent genetic evidence.

In one study, three specific single nucleotide polymorphisms found at base pairs 145, 785, and 886 on the PTC gene (hTAS2R38) were proven to create PTC gene haplotypes that have become associated with the chance of becoming a smoker; these single nucleotide polymorphisms create amino acid combinations such as praline, alanine, and valine (PAV); alanine, valine, and isoleucine (AVI), in addition to many others such as AAI, PVI, AAV, etc. which are partly responsible for having the ability or lack thereof to taste bitter (Cannon et al., 2005). In addition, the PAV haplotype was associated with taster status and the AVI haplotype was associated with nontaster status. Finally, the AAV haplotype was connected with having a reduced chance of becoming a smoker and of having a lower motivation to smoke (Cannon et al., 2005). Haplotype status has also been directly linked to the number of fungiform pillae and taste buds an individual has in order to taste bitter. However, because of the wide variance of taste status between individuals who have the same haplotype, geneticists have come to conclude that more than just genes affect how one perceives bitter taste (Hayes et al., 2008).

Still, studies have shown that within the smoker population, a smaller proportion of PTC tasters is present (in Snedecor's study, 33%), suggesting that a lack of sensitivity to bitter compounds such as nicotine could increase one's chance of becoming addicted to tobacco (Snedecor et al., 2006). Moreover, further research by Enoch and colleagues has shown that in a Plains American Indian tribe PTC taster status differs even within the smoker population (Enoch et al., 2001). The proportion of PTC nontasters to tasters in social smokers was 1:3, whereas the proportion in regular smokers was 1:1 (Enoch et al., 2001). Thus, BTP could be used to determine even the intensity in which one is at

risk for being addicted. By simply screening individuals for bitter taste status, health care professionals can identify those individuals who are at a greater risk for nicotine addiction and can also determine those individuals who are more likely to have an aversion to oral nicotine replacement products. By identifying those clients who will most likely find oral NRT products offensive to the taste, clinicians can select other smoking cessation products that might increase compliance and prevent the trial and error approach to smoking cessation. Thus, health care professionals can personalize smoking cessation programs and products to the client based on bitter taste status.

Currently, there is no research that identifies the prevalence of bitter taste phenotype in college smokers, nor in the differences of bitter-taste status between regular and social smoker groups. Although bitter taste is a gustatory property that has been one of the longest studied in genetic history, recent advances in science continue to promote new findings, which indicate a possible role in smoking behavior. It is known that a significant proportion of college students drink alcohol and smoke; both alcohol and tobacco are bitter to the taste. However, it is not known whether there is a relationship between BTP and the college trend of tobacco and alcohol use. Thus, there is a significant gap in the literature involving bitter taste phenotype in the younger adult population and smoking status.

Aims

College students are a unique group within the smoker population. The pattern of social smoking continues to be a college trend in which very little is known, and thus very little can be done to structure programs that will truly help social smokers quit. Although research has proven that oral NRT is extremely effective, college students may not be open to cessation solutions if they do not believe that they have a smoking addiction. In addition, students who find oral NRT offensive to the taste may also have one less option to help them quit. Thus, the concept of BTP can be used to help identify college smokers who would not be good candidates for oral NRT products by identifying those students who find bitter taste offensive. Because there is such a large gap in the research about the smoking habits of college students and the best means to help them quit, this study aims to analyze how the pattern of social smoking and bitter taste phenotype are related to nicotine dependence in the college student.

Methods

The goal of analysis of the data is to answer several research questions: (1) What is the prevalence of Bitter Taste Phenotype (BTP) among a sample of college smokers? (2) Is there a difference in BTP among regular and social college smokers? (3) Does nicotine dependence differ between regular and social smokers? (4) Does nicotine dependence differ between tasters and non-tasters of bitter?

Design

A cross-sectional survey of a convenience sample of 22 students enrolled at The Ohio State University was used in a descriptive design to determine differences in the prevalence of BTP within regular and social smokers, in the level of nicotine addiction between the regular and social smoker, and in the level of nicotine dependence between bitter tasters and non-bitter tasters within the college smoker sample.

Participants

In order to determine how BTP can be used to personalize smoking cessation for college students, the author recruited a convenience sample at The Ohio State University to determine the prevalence of bitter tasters within the student population. Inclusion criteria for the study included male or female smokers age 18-24 years who attend The Ohio State University and smoke a minimum of 5 cigarettes during the entire weekend, as defined from Thursday to Sunday. Both regular and social smokers were recruited via ads placed in The Ohio State University's newspaper The Lantern, both the hard and online copy, and fliers that were distributed throughout the campus area. Students who responded were then screened and excluded from the study if any throat, mouth, nasal esophageal, or gastrointestinal disorders were present, or if the student was taking any prescription medication other than birth control. Students under the age of 18 were also excluded from the study.

Sample Size

Given that this was a pilot study, and our goal was recruitment of 30 participants, the investigators were able to enroll 22 participants with considerable advertising efforts over a period of eight months.

Procedure

Subjects who met the inclusion and exclusion criteria were scheduled to complete the study components in a one-time, 30 minute face-to-face session at The College of Nursing. At this time, subjects completed a questionnaire including items such as sociodemographic information, smoking history, food preferences, and *The Fagerström*

Test for Nicotine Dependence (Heatherton et al., 1991). Saliva cotinine samples and carbon monoxide (CO) breath samples were collected and used as smoking biomarkers to supplement information obtained with the questionnaire. Finally, subjects completed a bitter taste test using Tepper's BTP protocol (Tepper et al., 2001). In this taste test, subjects rinsed with bottled water before the procedure began, and before and after each taste. Subjects were given a filter paper disk concentrated with 1.0 mol/l NaCl solution first, followed by a PROP (6-n-propylthiouracil, a bitter compound) filter paper disk impregnated with a 50 mmol/l PROP solution. Each disk was placed on the tip of the participant's tongue for 30 seconds. A 60 second wait period was between tests. After each taste, subjects rated intensity by placing a mark on the Labeled Magnitude Scale (LMS) to indicate their perception of the strength of each sample (Tepper et al., 2001).

Instruments

Instruments used to examine research questions include several measures for data analysis. Salivary cotinine levels were analyzed using chemiluminescent immunoassay by J2 Laboratories, Inc. Tucson, Arizona. Cotinine is the major proximate metabolite of nicotine with approximately 70% of nicotine converted to cotinine with a half-life of 18 hours. Thus, the saliva sample can be used to quantify level of cigarette smoking over the past few days: regular smoking status is usually correlated with a cotinine level greater than 100 ng/ml. This method is very accurate as it has a sensitivity of 96-97 percent and specificity of 99-100 percent (Jarvis et al., 1987).

Carbon monoxide (CO) levels were analyzed using the Bedfont Mini-Smokerlyzer (Innovative Marketing, Medford, NJ), which is calibrated with a 50 ppm CO standard per equipment instructions. Participants were instructed to hold their breath for 15 seconds before exhaling completely into the mouthpiece. This method is very accurate as it has 95.8% specificity and a sensitivity of 100%; carbon monoxide results of 8 ppm or more are usually correlated with regular smoking status (Ahijevych et al., 1996).

Sociodemographic information including age, education, marital status, race/ethnicity, and gender was obtained. Smoking history was assessed with the instrument utilized in a previous study completed by Ahijevych and colleagues, which includes questions such as age individual began smoking, current cigarette brand, average number of cigarettes consumed on weekday and weekend day, use of other tobacco products, number of previous serious quit attempts, perception of smoking prevalence among peers, percentage of friends who smoke, as well as cigarette smoke exposure in their residence (Ahijevych et al., 1996). Food preferences were determined using a 40 item list that incorporated foods which elicit a variety of tastes. Specific items included bitter foods such as spinach, radishes, olives, broccoli, red cabbage, dark beer, dark chocolate, and grapefruit. Other items that elicited the salty, sweet, and sour tastes included milk, wine, ice cream, oranges, carrots, corn potato chips, sourdough bread, onions, etc. Hedonic ratings included "like" (coded as "1"), "dislike" (coded as "2"), "do not eat" (coded as "3") and "never tried" (coded as "4"). Based on the Hedonic ratings given by the participant, an ANOVA test can determine trends in food preferences between tasters and non-tasters of bitter. For example, non-tasters have been shown to like cheese, bananas, and spinach significantly more than tasters of bitter (Anliker et al., 1991).

The Fagerström Test for Nicotine Dependence (FTND) is a 6-item instrument that has 4 dichotomous responses (scored 0 or 1) and 2 items with 4 responses scored 0 to 3. Potential total scores range from 0 to 10 with higher scores indicating greater dependence. A score of 5 is considered medium dependence, while 6 and above is classified as high dependence. Significant correlations between plasma cotinine levels and FTND ranging from r=0.33-0.51 in different samples support the validity of the instrument (Heatherton et al., 1991).

The BTP protocol developed by Tepper and colleagues (2001) was used to determine bitter taste status of the subjects through the Labeled Magnitude Scale (LMS). LMS is a quasilogarithmic 100 mm scale with label descriptors from the lowest anchor of "barely detectable" and the highest of "strongest imaginable." Word indicators for intermediate points along the quasilogarithmic scale are weak, moderate, strong, and very strong with numeric values of 6, 16, 28, and 54 mm, respectively. A script of standard oral instructions was used to describe the scale to each participant. Three taster groups were identified and are classified by the following scale: non-tasters with intensity rating of 15 mm or less, medium tasters from 16 mm through 67 mm, and super tasters above 67 mm. When participants gave a borderline rating on PROP, it was compared to the rating for NaCl to clarify group assignment (Tepper et al., 2001).

Human Subjects

The Ohio State University IRB approval was obtained by the investigators for the study.

Data Analysis

Descriptive statistics, including mean, standard deviation,

and ranges, were used for cotinine level (ng/ml), carbon monoxide level (ppm), sociodemographic information, taste preferences, nicotine replacement therapy use, nicotine dependence, and bitter taste status. For research question 1, descriptive analysis determined the total number of bitter tasters; in addition, bitter tasters were examined for trends in age, nicotine dependence, established cotinine levels, oral NRT use, and social smoking patterns. For research question 2, a Chi Square test was used to determine the difference in the proportion of bitter tasters between regular and social smokers in addition to Kendall's tau correlations between BTP and smoking status. For research questions 3 and 4, ANOVA's were conducted to determine differences in nicotine dependence in regular and social smokers, and nicotine dependence by BTP status.

Results

A final sample of 22 participants was used for the study. The cohort consisted of fifteen (68.2%) male and seven (31.8%) female subjects; 20 subjects were of Caucasian/European American descent (91%); 1 subject was African American (4.5%), another was Asian/Pacific Islander (4.5%), and 2 subjects (9.1%) were of Hispanic/Latino ethnicity. Subjects ranged from 18-22 years of age, with a mean age of 19.3 ±1.4 years. Education included 1-4 years of college, with an average of 1.7 ±0.9 years at The Ohio State University. All subjects were single and never married. Smoking status results revealed smoking histories ranging from 0.25-5.00 years, with an average of 2.3 ±1.3 smoking years. The age of first cigarette ranged from 12-22 years, with an average age of 16.1 ±1.8 years when initiating smoking. Surprisingly, 27.3% had not even smoked 100 cigarettes within their lifetime. Twelve (54.5%) participants reported that their smoking had increased since attending college, while 7 (31.8%) stated it had decreased and 3 (13.6%) stated it had stayed the same. Before starting college, the majority (54.5%) stated they had smoked 10 or fewer cigarettes per month, with 36.4% stating they smoked 21 or more cigarettes per month, and 9.1% stating that smoked between 11-20 cigarettes per month prior to college.

Average number of cigarettes smoked per weekday ranged from 0-10 cigarettes, with a mean of 3.3 ±2.9 cigarettes smoked per weekday. Average number of cigarettes smoked per entire weekend (as defined from Thursday night to Sunday) ranged from 2-40 cigarettes, with a mean of 15.5 ±9.8 cigarettes smoked per entire weekend. Other forms of tobacco were used within the last 30 days by 14 (63.6%) participants. Specifically, snuff/dip was used by 13.6% of the sample, cigar by 13.6%, and hookah/waterpipe tobacco by 50% of the sample. Use of hookah/waterpipe tobacco ranged from 0-15 days out of the past 30 days, with a mean of 3.1 ±4.1 days; use of hookah/waterpipe tobacco on those days ranged from 1-6 products, with a mean of 1.9 ±1.5 products smoked. Ten (45.5%) subjects smoked 21 or more days out of the past 30 days, while 4 (18.2%) smoked 11-20 days and 8 (36.4%) smoked 10 or fewer days. During those days, the majority (68.2%) smoked 3-8 cigarettes, with 13.6% smoking 9 or more cigarettes and 18.2% smoking 0-2 cigarettes. For cigarette use, 9 (40.9%) used menthol cigarettes; 8 (36.4%) used light cigarettes, 1 (4.5%) used ultralight cigarettes, and 1 (4.5%) used 100 mm cigarettes. All others (n=5, 22.7%) used non-menthol, regular cigarettes, and the preferred brand was Marlboro (59.1% had used), with the second choice being Camel (40.9% had used). Cotinine levels for the group ranged from 9-208 ng/ml, with a mean of 71.09 ±77.36, median of 27.00 ng/ml; moreover, CO levels ranged from 2-19 ppm, with a mean of 7.5 ±5.1 ppm, median of 6.5 ppm.

Addiction ratings (scale 0-100, with 100 indicating severe addiction) ranged from 0-90, with a mean addiction rating of 41.1 ±32.2, median of 25.00. Only 6 (27.3%) participants smoked within one hour upon waking; for these participants, time to cigarette ranged from 15-50 minutes, with a mean of 31.6 ±13.6 minutes. In addition, only 1 person (4.5%) stated they found it difficult to refrain from smoking where it is banned, and only 2 persons (9.0%) stated they smoked in bed during days they were so ill. Ten (45.5%) thought they could give up any cigarette easily. None met the dependence criteria for the FTND scale: scores ranged from 0-4, with a mean score of 0.86 ±1.3. Yet thirteen (59.1%) participants felt it would be very difficult (n=6, 27.3%) or fairly difficult (n=7, 31.8%) to quit for good. Furthermore, 15 (68.2%) participants had tried to seriously quit in the past, with a mean of 3.4 ±6.0 quit attempts initiated unsuccessfully. Twelve (54.5%) participants stated that they had tried to quit within the past year, and 10 (45.5%) planned to quit within the next year.

Despite the many quit attempts initiated by participants, only 2 (9.0%) participants had used NRT therapy during their attempts. One participant had chosen only the mint nicotine lozenge for smoking cessation, and the other had used the both plain nicotine gum and mint lozenge for cessation. When asked to describe their experiences with oral NRT, participants had mixed views; comments included "the lozenge helped, especially when driving" and "the products tasted terrible and were not useful." The participant with positive comments was able to successfully quit while on oral NRT (5 pieces per day for a total of 28 days), while the participant with negative comments did not appropriately use the products (2 pieces per day was used for a total of 4 days) and did not successfully quit. BTP was not

associated with likeability of the oral NRT products used by these two individuals. However, inappropriate use could be contributed to aversive bitter taste, thus decreasing regular use of the products.

Social history revealed that alcohol use occurring on 0-13 days out of the last 30 days, with a mean of 7.0 ±3.9 days of alcohol use out of the last 30 days. On those days, 1-12 drinks were consumed, with a mean of 6.9 ±2.9 drinks being consumed; in addition, drinks per week ranged from 0-36 drinks, with a mean of 13.5 ±2.1 drinks being consumed per week. An astounding portion (77.3%) of alcohol users met the criteria for binge drinking; moreover, 45.2% met the criteria for heavy drinking, and 40.6% for moderate drinking according to the National Institute of Alcohol Abuse and Addiction. Fourteen (63.6%) subjects considered themselves "social smokers," with 11 (50.0%) of subjects smoking at least 75% or more of the time at parties or other social events and 13 (59.0%) smoking 75% or more of the time with others. Moreover, 12 (54.5%) subjects asked for cigarettes while attending these social events; a mean of 4.0 ±6.2 cigarettes was smoked during those times. Ironically, the vast majority (n=16, 72.7%) stated that less than 25% of their friends smoked. While 17 (77.3%) participants thought that 25% of Ohioans smoke, 5 (22.7%) thought that 50% of Ohioans smoke; this is a great misconception, as smoking prevalence for the general population is approximately 20.8%. Misconceptions were not significantly correlated with smoking status.

Seventeen students stated they would try unfamiliar foods (77.3%), with 4 (18.2%) stating they try unfamiliar foods most of the time and only 1 (4.5%) stating they were tried rarely. An ANOVA test was run to determine food preferences based on bitter taste status. Results showed significant differences among bitter taste status for red cabbage ($F= 4.850$, $df= 2,19,21$, $p= 0.020$), horseradish ($F= 4.768$, $df= 2,19,21$, $p= 0.021$) milk chocolate ($F= 4.102$, $df= 2,19,21$, $p= 0.033$), grapefruit ($F= 3.968$, $df= 2,19,21$, $p= 0.036$), cinnamon buns ($F= 4.102$, $df= 2,19,21$, $p= 0.033$), corn potato chips ($F= 4.102$, $df= 2,19,21$, $p= 0.033$), endive ($F= 4.102$, $df= 2,19,21$, $p= 0.033$), and radicchio ($F= 4.102$, $df= 2,19,21$, $p= 0.033$). Post hoc analysis revealed supertasters rated endive and radicchio significantly lower on liking than medium and nontasters; supertasters also rated corn potato chips, cinnamon buns, grapefruit, horseradish, milk chocolate, and red cabbage significantly lower than nontasters.

For research question #1, the prevalence of bitter tasters was 59.1%, with 10 (45.5%) being categorized as medium tasters (coded as "1") and 3 (13.6%) as supertasters (coded as "2"); nine (40.9%) were classified as nontasters (coded as "0"). For research question #2, a Chi square test between BTP and prevalence of smoking at parties did not yield significant results, although a trend was still present for nontasters to be regular smokers. However, bitter taste status was significantly and inversely correlated with smoking status for several measures, such as average number of cigarettes on a weekday (Kendall's tau b = -.402), and percentage that you smoke with others (Kendall's tau b = -.434). For research question #3, nicotine dependence was significantly different between regular and social smokers, as an ANOVA test showed that persons who smoked 75% or more of the time at parties or other social events had significantly different outcomes for various dependence measures. Post-hoc analysis revealed participants who smoked 75% or more of the time at social events differed significantly from those who smoked 50% or less at social events on all measures except for the FTND and cotinine level. Specifically, those who predominantly smoked at parties smoked fewer days out of the past 30 days ($F= 11.075$, $df= 2,19,21$, $p= 0.001$), reported a lower number of cigarettes smoked during weekdays ($F= 6.890$, $df= 2,19,21$, $p= 0.006$), and rated themselves lower on a 100-point addiction scale ($F= 7.220$, $df= 2,19,21$, $p= 0.005$) compared to those who smoked 50% or less at parties. Finally, those who predominantly smoked at parties reported a lower FTND score ($F= 5.125$, $df= 2,19,21$, $p= 0.017$) and cotinine level ($F= 4.386$, $df= 2,19,21$, $p= 0.028$), differing only from those who smoked 25% or less at parties and social events. Interestingly, indicators for increased smoking and nicotine addiction were not significantly correlated with an increase in alcohol intake, which occurs frequently in college social settings. For research question #4, no significant findings resulted in comparison of FTND score, average number of weekday cigarettes, days smoked out of the past 30 days, self-addiction rating, CO level, or cotinine level based on BTP with an ANOVA test. However, the trend of nontasters being higher than bitter tasters on FTND score, average number of weekday cigarettes, days smoked out of the past 30 days, self-addiction rating, CO level, and cotinine level was observed. For instance, nontasters had a mean score of 1.11 ±1.36 on the FTND, medium tasters 0.80 ±1.40, and supertasters 0.33 ±0.58. Nontasters smoked an average of 4.61 ±2.12 cigarettes per weekday, medium tasters 2.75 ±3.38 cigarettes, and super tasters 1.33 ±2.31 cigarettes. Nontasters had an average self-rating of 49.44 ±31.84 on the 100-pt addiction scale, whereas medium tasters rated 36.00 ±33.39, and supertasters rated 33.33 ±36.17. Nontasters had a mean CO level of 7.89 ±4.62 ppm, medium tasters 7.80 ±6.16 ppm, and supertasters 5.33 ±1.53 ppm. Nontasters had a mean cotinine level of 104 ±84.36 ng/ml, medium tasters 50.11 ±71.64 ng/ml, and supertasters 35.33 ±45.61 ng/ml.

Discussion

Data analysis revealed results consistent with previous studies regarding college social smoking behaviors. For instance, Weitzman identified the pervasive problem of binge drinking for college smokers (Weitzman, et al., 2005), which accurately describes the astounding portion (77.3%) of alcohol users who met the criteria for binge drinking in this study. The concurrent use of alcohol and tobacco can thus be readily seen in this study, which is congruent with the college lifestyle of frequent partying. Moran found that only a third of college smokers use tobacco every day, and only 18% smoke within 30 minutes of waking up (Moran et al., 2004). Similarly, this study's results showed that while ten (45.5%) subjects smoked 21 or more days out of the past 30 days, only 4 (18.1%) also smoked within 30 minutes of waking up. Moreover, the trend of smoking with a lower intensity was observed, as the majority (68.2%) only smoked 3-8 cigarettes during the days they did smoke. Moran also found that 50% of college students smoked mainly with others (2004), which is consistent with this study's 11 (50.0%) subjects smoking at least 75% or more of the time at parties or other social events and 13 (59.0%) smoking 75% or more of the time with others. Social smokers were not as dependent on nicotine, had less intention to quit, and did not attempt to quit according to Moran (2004); yet Wechsler found that 50% of college students had tried to quit (1998). The current study also identified that paradox, as ten participants (45.5%) thought they could give up any cigarette easily, none met the dependence criteria of the FTND scale, and those who smoked 75% or more of the time at parties smoked fewer days out of the past 30 days, reported a lower number of cigarettes smoked during weekdays, rated themselves lower on a 100-point addiction scale, and had lower cotinine levels. Nevertheless, 15 (68.2%) participants had seriously tried to quit in the past, with a mean of 3.4 ±6.0 unsuccessful quit attempts initiated.

Unfortunately, only 2 (9.0%) participants had used oral NRT therapy during their quit attempts, despite extensive evidence supporting the effectiveness of oral NRT, including the DHHS Treating Tobacco Use Guidelines. In addition, there are practically no research studies available that determine the success of various oral NRT products within the college student population to compare these results. As the use of oral NRT could enhance a smoker's potential for success by 50-70%, it is imperative that college students are educated on reliable methods of smoking cessation. Neither of the two participants utilized oral NRT correctly, as the most products used in one day was five lozenges; the longest any therapy applied 28 days. Yet the DHHS Guidelines specifically state the nicotine lozenge should be used every 1-2 hours with a minimum of 9 lozenges per day, and the gum should be used every 1-2 hours for at least six weeks (Fiore et al., 2008). Clearly, knowledge deficits concerning appropriate use of oral NRT products are apparent in this sample, and need to be eradicated in order for college students to have the best possible chance of quitting.

Although there is no current literature to compare our results for the prevalence of BTP among college smokers, bitter tasters were found to be 59.1% of the sample, a middle ground between the 70% of the general adult Caucasian population who taste bitter and the 50% of regular smokers who taste bitter (Enoch et al., 2001.) A larger sample size would provide increased power and potential to detect significant differences. Although no significant findings resulted in comparison of nicotine dependence based on BTP, nontasters did have higher FTND scores, average number of weekday cigarettes, days smoked out of the past 30 days, self-addiction rating, CO level, and cotinine level than bitter tasters. Although a Chi square analysis did not reveal significant results, nontasters tended to be of regular smoking status. The trend of nontasters to be more dependent smokers suggests that bitter taste does provide somewhat of a protection against tobacco use. This conclusion is comparable to the one found in Snedecor's study (2006). If nontasters tend to be more dependent smokers, then oral NRT would be an appropriate smoking cessation option for these students, as bitter taste would not prevent appropriate use of oral NRT. In contrast, other smoking cessation products would need to be utilized for those bitter tasters to quit smoking effectively. In sum, BTP can have important implications for college students interested in smoking cessation, regardless of taste status.

Conclusion

As college students are a unique group within the smoker population, more insight needs to be gained concerning the pattern of social smoking in order to develop programs that will truly help social smokers quit. Although research has proven that oral NRT is extremely effective, college students may not use effective cessation solutions if they have extensive knowledge deficits regarding appropriate therapies and their recommended use. In addition, students who find oral NRT offensive to the taste may also have one less option to help them quit. The concept of BTP can be used to help tailor smoking cessation programs and products to the individual needs of the college student. Narrowing the large gap in knowledge on the smoking habits of college students will assist in providing students with the best means to help them quit, as the pattern of social smoking, the use of oral NRT, and bitter taste phenotype all interact to affect the

course of smoking cessation in the college student.

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