TOBACCO USE AND SUICIDE RELATED OUTCOMES

By

Jonathan P. Troost

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Epidemiology - Doctor of Philosophy

2014

ABSTRACT

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There is a growing body of evidence which suggests that tobacco cigarette smoking (hereinafter, simply 'smoking') is an independent predictor of suicide as well as suicidal behaviors such as suicidal ideation (thinking about committing suicide), suicidal planning, and suicide attempts. Such evidence is by no means overwhelming and the possibility of this being a causal association has yet to be determined. Still, many contributors in this area have proposed that cigarette smoking could affect suicide and suicide related outcomes through biological effects on serotonin metabolism. If nicotine and/or other chemicals found in tobacco are indeed an etiologic link between cigarette smoking and suicide, then one would expect other types of tobacco use to predict suicide and suicidal behaviors as well. Using US nationally representative cross-sectional data from the National Survey on Drug Use and Health (NSDUH) and longitudinal data from the National Epidemiological Study on Alcohol and Alcohol-Related Conditions (NESARC) I will test for the independent effects of cigarette smoking and smokeless tobacco use on subsequent suicide related outcomes with the hypothesis that cigarette smoking will predict suicidal behaviors while smokeless tobacco use will not. This is under the assumption that the possible causal effects of cigarette smoking on suicide risk have nothing to do with either the combustion of tobacco, the efficiency or speed with which nicotine or other agents would reach the brain, or other pharmacological differences between smoking tobacco and using smokeless tobacco. I will also challenge the smoking-suicide hypothesis by controlling

for mental health co-morbidities using data from the Collaborative Psychiatric Epidemiology Surveys (CPES), in the US.

Summary:

A consistent finding within this dissertation is that smokeless tobacco use does not appear to alter the estimated risk of suicide related outcomes while cigarette smoking does. Also, while a considerable proportion of the relationship between cigarette smoking and suicide is explained by the presence of mental disorders, this work suggests smokers are still at increased odds of suicide regardless of their mental health. An important implication of these findings is that quitting cigarette smoking could potentially decrease one's risk of suicide. This dissertation found no evidence of those who recently quit smoking to be at a higher risk for suicide related outcomes, but future studies should build on this work by tracking changes in suicide risk in the proximal weeks and months following smoking cessation. Studies on non-United States or Western populations are also needed as the evidence in favor of a positive association between cigarette smoking and suicide is currently western-centric, and if a true biological association exists, one would expect to observe it in all countries where smokers are found

ACKNOWLEDGEMENTS

I would like to thank my dissertation committee members: Drs. James C. Anthony, Naomi Breslau, Qing Lu, and Carlos Rios-Bedoya.

In addition to the members of the dissertation guidance committee, I would also like to acknowledge the following individuals in the Department of Epidemiology & Biostatistics for their input on dissertation content, support and general advice during my graduate education: Mat Reeves, Brian Fairman, Catalina Lopez and David Barondess as well as Nancy Bieber for her constant assistance as the department's Graduate Secretary. I would also like to acknowledge the following funding from the National Institute on Drug Abuse which was integral to funding my graduate education: NIDA T32DA021129; K05DA15799.

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CHAPTER 1: INTRODUCTION AND AIMS

Before a thorough review of the literature and detailed description of the methodology, I will briefly describe this dissertation work. There is a growing body of evidence which suggests that tobacco cigarette smoking (hereinafter, simply 'smoking') is an independent predictor of suicide as well as suicidal behaviors such as suicidal ideation (thinking about committing suicide), suicidal planning, and suicide attempts. Such evidence is by no means *overwhelming* and whether or not this is a causal association has yet to be determined. Still, many contributors in this research topic have proposed that cigarette smoking could affect suicide and other suicide related outcomes through its biological effects on serotonin metabolism.

This dissertation will challenge the 'smoking-suicide' hypothesis in the following ways:

(1) If nicotine and/or other chemicals found in tobacco are indeed the etiologic link between cigarette smoking and suicide, then one would expect other types of tobacco use to predict suicide and suicidal behaviors as well. Using US nationally representative cross-sectional data from the National Survey on Drug Use and Health (NSDUH) and longitudinal data from the National Epidemiological Study on Alcohol and Alcohol-Related Conditions (NESARC) I will test for the independent effects of cigarette smoking and smokeless tobacco use on subsequent suicide related outcomes with the hypothesis that cigarette smoking will predict suicidal behaviors while smokeless tobacco use will not. This is under the assumption that the possible causal effects of cigarette smoking on suicide risk have nothing to do with either the combustion of tobacco, the efficiency or speed of which nicotine or other

agents would reach the brain, or other pharmacological differences between smoking tobacco and using smokeless tobacco.

(2) Smokers are more likely to have mental health comorbidities (such as major depression and bipolar disorder) which are known, important causes of suicide. Previous research assessing if the observed relationship between cigarette smoking and suicide is in fact confounded by mental disorder status has been met with mixed results. I will test for the effects of cigarette smoking on suicide related outcomes while controlling for the diagnosis of several mental disorders using data from the Collaborative Psychiatric Epidemiology Surveys.

CHAPTER 2: BACKGROUND

More deaths are caused by suicide each year than from liver, colon and stomach cancers combined. An estimated 1 million people commit suicide in the world each year, accounting for 2% of all deaths.(WHO) Suicide rates have increased by 60% in the past 45 years, and it is the second leading cause of death among those 10-24 years old.(Mathers & Loncar, 2006) Additionally, non-fatal suicide attempts are a burden by themselves. In the United States specifically, half a million individuals require medical care after a suicide attempt at an average cost of $33,000 per year.(E.K. Moscicki, 1995)

Smoking has been shown to be associated with an increased risk of suicide in epidemiological studies since the monumental British Doctors study first published in the 1970s.(Doll & Peto, 1976; Doll, Peto, Boreham, & Sutherland, 2004) Around the same time, Friberg et al., found a two-fold increase of completed suicide among current smokers vs. never smokers using data from a Swedish twin registry.(Friberg, Cederlof, Lorich, Lundman, & De Faire, 1973) Similar results were found within the Nurses' Health Study in the US. This study was helpful because of its large sample and ability to control for possible confounding variables such as chronic disease history. Cigarette smoking predicted completed suicide during follow-up, and a strong dose-response between number of cigarettes smoked at baseline and suicide was also found.(Hemenway, Solnick, & Colditz, 1993)

Given the limitations of the observational data, not all were convinced of a causal association at that time. Dr. George Davey-Smith provided an analysis on cigarette smoking and completed suicide using data from the Multiple Risk Factor Intervention Trial (MRFIT) in the US. Despite finding results in favor of an association that was consistent with the other studies on

this topic up until this point, he concluded that “it is improbable that cigarette smoking is a direct contributory cause of suicide”. Davey-Smith found a consistent relationship between cigarette smoking and suicide as well as cigarette smoking and homicide, and argued they were both explained by an omitted confounding variable (or a set of confounding factors). Davey-Smith suggests that while suggested biological mechanisms between smoking and suicide were plausible, they were not likely: “A hypothesis that an exposure can cause a disease cannot be said to have been very strongly challenged by the requirement that it should be biologically plausible”.(G. D. Smith, Phillips, & Neaton, 1992)

Still, prospective studies on the topic continued to find a significant relationship between smoking and completed suicide. Scandinavian population based studies, as well as a follow-up study of Harvard Alumni in the US found dose-dependent relationships between baseline smoking and suicide during follow-up.(Paffenbarger, Lee, & Leung, 1994; Rantakallio, Laara, & Koiranen, 1995; Tverdal, Thelle, Stensvold, Leren, & Bjartveit, 1993) A very strong dose-response between cigarette smoking and suicide was found by Miller et al., using data from the Health Professionals Follow-up Study in the US.(M. Miller, Hemenway, & Rimm, 2000) The same group of investigators found consistent results in a US study of active duty Army soldiers.(M. Miller, Hemenway, Bell, Yore, & Amoroso, 2000)

Leistikow et al., studied this relationship using a nationally representative sample of adults in the US and found a three-fold increase among heavy smokers (those who smoke >25 cigarettes/day) compared to never smokers.(Leistikow, Martin, & Samuels, 2000) Also, unlike the Davey-Smith et al., contribution, this study found a specific relationship between cigarette

smoking and suicide, and smoking did not predict homicide or accidental injury as strongly as suicide after statistical adjustment.

A notable limitation of the studies discussed this far is that they had limited ability to control for background confounding variables that might influence which individuals both become cigarette smokers and complete suicide. These studies had adjusted for basic descriptive variables such as age, sex, race, marital status, and education as well as prior chronic disease diagnosis (cardiovascular disease, cancer, diabetes). Important omitted variables would include previous mental disturbances.

Another Finnish population study on this topic addressed this limitation by adjusting for symptoms of depressed mood, stress and anxiety, and psychotropic medication prescription. After statistical adjustment, the authors still detected a two-fold increase in suicide risk when comparing current smokers to never smokers. (Tanskanen et al., 2000) In addition, while the authors do not clearly explain their rationale of this, they made a stratification by type of suicide (violent vs. non-violent) and found no difference in relative risk estimate across the two groups. Another Finish cohort study on cigarette smoking and completed suicide found relatively similar results after adjusting for alcohol use, social class, school performance, other drug use, and hospital treated psychiatric disorders, although the smoking-suicide relationship was only found in men.(Riala et al., 2007)

Iwasaki et al., conducted a prospective study on this topic among Japanese men. These researchers categorized their smoking exposure variable as the number of ‘pack-years’ at baseline (where a ‘pack-year’ would indicate a year of smoking 1 pack/day). This study found

little evidence in favor of a statistically significant association. Specifically, the only statistically significant finding was that those with 60+ pack years at baseline were at a 2.1-fold increase compared to those who had never smoked. This study also adjusted for list of important confounding variables such as psychological stress, history of chronic disease and psychiatric medication.(Iwasaki, Akechi, Uchitomi, & Tsugane, 2005) As indicated above, few studies on this topic have been conducted outside of the US or Scandinavia. A prospective general population study in China failed to detect even a crude (unadjusted) association between cigarette smoking and suicide. (Rebholz et al., 2011)

It is of interest that these negative findings are from Japan and China, where tobacco smoking is a highly prevalent behavior, especially among men. One might suspect that tobacco smoking is not a strong source of social stigma where smoking prevalence is as large as it is in Japan or China. Nonetheless, the idea that social stigma attached to smoking might translate into depressed mood and suicide-related outcomes has not received substantial support. To illustrate, studying smokers in the United States, where smokers often face stigma, Martini, Wagner, and Anthony (2002) speculated that some of the low mood effects of tobacco smoking might be attributable to feelings of social stigma (e.g., those associated with having failed to quit when there is considerable social pressure to quit), and found odds of depression to be greater among current smokers and to be lower among former smokers, with declining odds across a gradient of elapsed time since last smoke. The research team turned to Chile, where smoking prevalence among adolescents is above 50%, and there is little stigma attached to smoking. Even so, in a low stigma environment, they found predicted associations consistent with the tobacco-depression association (Caris, unpublished).

Other prior studies have considered the effect of cigarette smoking on suicidal related behaviors (instead of completed suicide) which are known to predict completed suicide.(E.K. Moscicki, 1995) Recent epidemiological studies have addressed this question in with mixed results. Kessler et al., showed that the increased risk of suicide attempts among smokers can be explained by background psychiatric disorders influencing the risk of starting to smoke.(Kessler et al., 2007; Kessler, Borges, Sampson, Miller, & Nock, 2009) Conversely, two other recent studies using US nationally representative data compare current smokers vs. former smokers effectively holding constant factors that influence initiation of smoking.(Berlin, Covey, Donohue, & Agostiv, 2011; Clarke et al., 2010; Clarke el al., 2008) These studies find that current smokers are more likely to attempt suicide than those who have quit. A large prospective study by Breslau et al., found an increased risk (RR=1.7) of suicide attempts among currently daily smokers relative to never daily smokers. There was no increased risk among former daily smokers.(Breslau, Schultz, Johnson, Peterson, & Davis, 2005)

When limiting the outcome to specifically completed suicide, a recent meta-analysis of prospective studies suggests cigarette smoking to be a significant predictor of suicide. The magnitude of this association was an estimated relative risk of 1.8 for current vs. never smokers and an estimated 1.3 for former vs. never smokers. There was also a significant dose response between number of cigarettes smoked per day and subsequent suicide.(Li et al., 2012)

Biological mechanism:

Many contributors have begun describing possible biological mechanisms that would account for a relationship between smoking and suicide. While such a mechanism is currently

unclear, smoking is thought, by some, to affect suicide risk because of monoamine oxidase inhibitors, such as nicotine, found in tobacco.(Berlin & Anthenelli, 2001; Fowler, Logan, Wang, & Volkow, 2003)

Monoamine oxidase is an enzyme found in the outer mitochondrial membranes of most cells in the human body which is responsible for, as its name implies, the oxidation (in this case, breaking down) of amines. (Singer & Ramsay, 1995) There are two subtypes of monoamine oxidase, MAO A and MAO B. While both types are known to oxidize dopamine, tryamine and octopamine(Youdim & Riederer, 1993), MAO has been shown to preferentially oxidize norephinephrine and serotonin(Johnston, 1968) while MAO B oxidizes phenethylamine.(Knoll & Magyar, 1972)

Early human studies on this topic compared platelet levels of MAO B across smokers and non-smokers. Oreland et al., was the first to find a significantly lower level of MAO B in smoking women than in non-smoking women.(Oreland, Fowler, & Schalling, 1981) These investigators also demonstrated that there was no difference in MAO levels between non and former smokers and this was later replicated in an independent sample. (Norman, Chamberlain, & French, 1987). A large study part of the Collaborative study on the Genetics of Alcoholism later indicated a dose-dependent decrease of MAO B levels in current smokers where MAO B levels decreased as number of cigarettes smoked per day increased. (Saccone et al., 1999)

Differences in monoamine oxidase B levels were also detected when measuring brain levels instead of platelet levels using positron emission tomography techniques. Specifically, brains of living smokers have an estimated 40% decrease in level of monoamine oxidase

(Fowler, Volkow, Wang, Pappas, Logan, MacGregor, et al., 1996). Former smokers, however, do not differ in levels of monoamine oxidase B compared to never smokers, which is further evidence suggesting that this difference is indeed a pharmacological effect and not due to genetic factors.(Norman, et al., 1987) Smoking induced changes in serotonin levels would be thought to affect suicide risk because lower serotonin levels are a strong predictor of suicide. (Pandey, 1997)

Fewer studies have been done on MAO A between smokers and non-smokers because of difficulties in measurement. However, results appear consistent with MAO B, and cigarette smokers have decreased levels of MAO A compared to non-smokers. (Fowler, Volkow, Wang, Pappas, Logan, Shea, et al., 1996; Geracioti et al., 1999)

As shown above, most research of this type has focused on cigarette smoking. Although there is evidence that there are monoamine oxidase-inhibiting functions of raw tobacco plant extracts, (Berlin & Anthenelli, 2001) it is unclear if the same clinical differences in MAO levels are observed among smokeless tobacco users. Still, intravenous exposure to nicotine has been shown to decrease serotonin and its metabolites in animals.(Bang & Commons, 2011; Kenny, File, & Rattray, 2001) Similar results have emerged when intravenously exposing non-smoking individuals to nicotine.(Newhouse et al., 1988) Smokers and smokeless tobacco users have also been shown to have lower levels of serotonin in their cerebro-spinal fluid compared to nonsmokers (Berggren, Eriksson, Fahlke, Blennow, & Balldin, 2007; Berggren, Fahlke, Eriksson, & Balldin, 2003) although smokeless tobacco users and non-tobacco users did not differ with respect to platelet MAO B activity.(Berggren, et al., 2007)

There are other common harmful chemicals found in both cigarettes and smokeless tobacco. The following carcinogens currently have no suggested biological mechanisms in which influence suicide and suicide related behaviors however, it is important to consider the common constituents of the two products including: benzene, formaldehyde, ammonia, acetone, arsenic, nitrosamines, polonium 210, and cadmium. Also, certain chemicals are found in cigarette smoke but not in smokeless tobacco: hydrogen cyanide, carbon monoxide and tar.(NCI, 1992) Of course, there are thousands of chemicals found in cigarette smoke not found in smokeless tobacco. On one hand, this greatly complicates and seems to limit the idea of testing for an effect of smokeless tobacco on suicide—it seems like the two types of tobacco products are too different. However, it is important to remember that the currently hypothesized model for smoking causing suicide is through nicotine and its effects on serotonin regulation.

In addition to proposed biological pathways involving serotonin and MAO activity, nicotine is also thought to alter suicide risk by its activation of the hypothalamic-pituitary-adrenal(HPA) axis in the brain (Rohleder, 2006). Animal studies have demonstrated that nicotine alters HPA in a dose-dependent fashion (McKlveen, 2010), and clinical studies have shown that dysregulation of the HPA axis is associated with an increased risk of suicide attempts among depressed patients (Jokinen, 2007).

There is an important inconsistency in the literature on this topic with respect to mental comorbidities. As described earlier, in some studies controlling for mental illnesses, such as

major depression, accounts for the observed association between cigarette smoking and suicide, however, this is not always the case.

In addition to mental illness, I believe social support is another important possible confounding variable in the relationship between cigarette smoking and suicide. Social solidarity was first shown as an important predictor of suicide in Durkheim's classic studies on suicide published in 1897. Durkheim's work showed lower rates of suicide in individuals with a greater degree of social integration (for example, non-married individuals were at a greater risk of suicide compared to married individuals and Protestants living in mostly Catholic areas were more likely to commit suicide than Catholics).(Durkheim, 1951) Contemporary research has expanded this concept of solidarity within in a community to a broader concept of social support, which refers to a network of family, friends and other persons surrounding an individual who provide emotional support. A commonly used definition of social support is "the presence of others or the resources provided by them, prior to, during and following a stressful event"(Sarason, 1985)Prior research has demonstrated that social support is a modifiable risk factor of suicide.(Berkman, Glass, Brissette, & Seeman, 2000) Social support is also known to be associated with cigarette smoking in two main ways: lower levels of social support increases the risk of starting to smoke, and also decreases the risk of smoking cessation after smoking initiation.(Lakon, Hipp, & Timberlake, 2010; Romano, Bloom, & Syme, 1991)

To the best of my knowledge, no prior study on the relationship between cigarette smoking and suicide has adjusted for social support. This dissertation will aide in this area.

As stated in the introduction, this dissertation will aide in the assessment of a causal relationship between cigarette smoking and suicide. Below is a chapter by chapter description of the main aims:

Chapter 3: This chapter will challenge the biological relationship between tobacco use and suicide by considering the effects of smokeless tobacco on suicidal behavior risk. This will be a novel contribution as the effects of smokeless tobacco on suicide risk have never been studied. The use of the nationally representative, prospective NESARC data will help in identifying newly-incident cases of suicidal behavior as another limitation of many previous studies has been the inability to control for previous suicidal behaviors.

Chapter 4: This chapter will be similar in scope to chapter 3 in that it will consider the effects of cigarette smoking and smokeless tobacco use on suicide related behaviors. Unlike the longitudinal NESARC data in chapter 3, this chapter will use multiple years of cross-sectional data from the National Survey(s) on Drug Use and Health. Combining data from the 2008-2010 surveys will result in a large sample, capable of generating relatively stable estimates on a rare outcome.

Chapter 5: This chapter will focus on the associated between cigarette smoking and provide a stronger ability to control for psychiatric comorbidities as well as differences in social support. This will be an important contribution as it will add a detailed assessment of mental illness. Data for this chapter are from the Collaborative Psychiatric Epidemiology Surveys (CEPS) which is a collection of three large, mental health focused cross-sectional surveys in the United States collected between 2001 and 2003.

Finally, before describing the study details, I would like to draw the reader's attention to an important limitation in the interpretation of findings. These chapters each have a greater ability to *confirm* or *corroborate* prior evidence than they do to *refute* it. As an example, if chapters 3 and 4 find that smokeless tobacco use and cigarette smoking both predict suicide related outcomes, then the interpretation is fairly simple: tobacco use might play a biological role in suicide because we now see multiple types of tobacco predicting suicide related outcomes. However, if smokeless tobacco does not predict suicide related outcomes, the interpretation is not as easy. While I might like to argue this is evidence against a smoking and suicide hypothesis, it is important to remember that cigarette smoking might play a biological role in suicide due to factors found in cigarettes or cigarette smoke that are not found in smokeless tobacco.

I admit this is an important limitation of this dissertation, but still, one could argue this is present at some degree in most research. For example, almost all results that are in the same direction with what has already been published are easier to interpret and discuss than those that are different.

CHAPTER 3: A PROSPECTIVE COHORT STUDY ON THE EFFECTS OF TOBACCO USE ON SUICIDE RELATED OUTCOMES

Chapter 3 Aim:

This chapter will challenge the biological relationship between tobacco use and suicide by considering the effects of smokeless tobacco on suicidal behavior risk. This will be a novel contribution as the effects of smokeless tobacco on suicide risk have never been studied. The use of the nationally representative, prospective NESARC data will help in identifying newly-incident cases of suicidal behavior as another limitation of many previous studies has been the inability to control for previous suicidal behaviors.

Chapter 3 Methods:

Data and participants

The National Epidemiologic Survey on Alcohol and Alcohol Related Conditions (NESARC) is a nationally representative longitudinal study focused on alcohol use the in the United States. From August 2001 to September 2003, 43,093 individuals were gathered as the Wave 1 sample. The U.S. Bureau of Census executed the field work and data collection for the National Institute on Alcohol Abuse and Alcoholism. Interviews were conducted within a respondents home using a computer assisted personal interview to improve validity.(Grant & Kaplan, 2005; Grant, Kaplan, Shepard, & Moore, 2003)

As mentioned earlier, the target population was nationally representative. Specifically, it was representative of adult (18 years or older) U.S. citizen and non-citizens living in the country (including the District of Colombia, Alaska and Hawaii). All non-institutionalized persons were eligible. This included those living in households, boarding houses, rooming houses, non-

transient hotels/motels, shelters, facilities for housing workers, college quarters and group homes. The sampling approach used a multi-staged, complex survey approach where first a census defined, county-based primary sampling unit (PSU) was selected, followed by a selection of an eligible housing unit within each PSU and finally a selection of an individual within each household. Young adults (those 18-24 years old) were oversampled. The household response rate of 89% multiplied by the person response rate of 93% gave an overall response rate of 81%.(Grant & Kaplan, 2005; Grant, et al., 2003)

Assessment of exposure: tobacco variables

Tobacco use status was determined at the baseline wave 1 interview. Participants were asked if, in their lifetime, they had smoked 100 or more cigarettes, if they had used snuff 20 or more times and if they had used chewing tobacco 20 or more times. A person who had met any of these thresholds was considered a lifetime tobacco user. For each tobacco product, if a participant was a lifetime user, they were also asked more detailed questions about their use such as their age of first use and if they are a never, former or current user. Current users were those who had used within the past year, and former users were those who had used at some point in their life but not in the past year.

Assessment of the outcome: suicide-related outcome variables

Suicide related outcomes were assessed as part of a structured interview for Major Depression. All participants were asked if they had “ever had a 2 week period where they felt sad, blue depressed or down most of the time” and if they “ever had a 2 week period when they didn’t care about things they usually cared about”. Any participant who said yes to either of these questions screened positive for Major Depression and was administered the entire

depression module. Within this module, all participants were asked if "during the time when your mood was at its lowest or when you enjoyed or cared the least about things, did you attempt suicide?" They were also asked if they had thought about committing suicide. Those who had attempted suicide were treated as suicide attempters and those who had thought about committing suicide were treated as having suicidal ideation.

The same module was asked again in the wave 2 interview. When participants were asked the depression screening items, they were asked specifically if they had either of these experiences since their last interview. Those who had were asked about suicide attempts and suicidal ideation in the 2-3 year period since their last interview. By combining information from the two waves, it was possible to exclude those who had previous suicide attempts or ideation from the sample (because they are not at risk for becoming incident cases) and follow-up on who becomes a new case of suicide attempt or ideation. (The specific numbers and proportions will be discussed in the results section.)

Data analysis

The analysis tested the extent to which baseline cigarette smoking and smokeless tobacco use predicted first suicide attempt or ideation during the 2-3 year follow-up period. This was tested by a weighted logistic regression adjusting for the complex survey design features in Stata v.12.0. There were 3 main outcomes of interest. (1) First suicide attempt. (Among those with no previous suicide attempt as of wave 1, what proportion attempt suicide by wave 2?) (2) First suicidal ideation. (Among those with no previous suicidal ideation as of wave 1, what proportion developed suicidal ideation by wave 2?) (3) First suicidal behavior.

(Among those with no history of suicide attempt or ideation as of wave 1, what proportion had either a suicide attempt or ideation by wave 2).

Univariable models for cigarette smoking and smokeless tobacco use were fit using 'never user' as a reference. Then the estimates were adjusted for sex, race/ethnicity (categorized as Non-Hispanic White, Non-Hispanic Black, Non-Hispanic American Indian/Alaskan native, Non-Hispanic Asian/Native Hawaiian/Pacific Islander or Hispanic), age (18-24, 25-34, 35-44, 45-64, 65+) and education (less than high school, high school/GED, some college, college or more). Also, cigarette smoking and smokeless tobacco use were included in the same model (so the estimates for cigarette smoking are adjusted for smokeless tobacco use and vice versa).

The other main confounding variables of interest that might affect suicide were major depression and alcohol use disorders (abuse and or dependence). Age of onset data for both depression and alcohol use disorders were collected as part of the interview. Using this information along with age of onset of smokeless tobacco and cigarette smoking, it was possible to adjust for depression and alcohol use disorders that occurred before cigarette smoking and smokeless tobacco use. After the adjustment for socio-economic variables there were two more adjusted models: one for cigarette smoking adjusting for prior depression and alcohol use disorders, and one for smokeless tobacco use adjusting for prior depression and alcohol use disorders.

Also, in an attempt to improve sample size, I also asked how baseline tobacco use predicted the *re-occurrence* in addition to the incidence of suicide related behaviors. For this

step, I re-ran the main analyses in this chapter without excluding those who had baseline suicide related behaviors.

Finally, I tested for the effect of cumulative tobacco use duration defined as the total years of cigarette and smokeless tobacco use. This was calculated by taking the difference of the participant's age at assessment and their age of onset. The hypothesis being that among users those with longer durations of tobacco use will have a higher rate of suicide related outcomes compared to those with shorter durations if tobacco use is indeed acting as a cause. The reader should note that these are not truly duration variables, but instead measure elapsed time since onset since we are uncertain if they smoked every year between the year of onset and the survey year.

Chapter 3 Results:

Figures 3.1, 3.2 and 3.3 each provide a flowchart showing how of the three analysis samples was derived. For example, in Figure 3.1, 43,093 participants completed the Wave 1 interview. 1,157 had a suicide attempt prior to Wave 1. Since they were not at risk for an incident suicide attempt during the follow-up, they were set aside. Among the 41,936 with no history of suicide attempt, 33,687 completed the Wave 2 interview and 8,249 were lost to follow-up. This gave a suicide attempt analysis sample of 33,687 individuals, 143 of which were newly incident suicide attempters.

In Figure 3.2, 43,093 participants completed the Wave 1 interview. 3,655 had a history of suicidal ideation prior to Wave 1. Since they were not at risk for incident suicidal ideation during the follow-up, they were set aside. Among the 39,438 with no history of suicide attempt, 3,551 completed the Wave 2 interview and 7,886 were lost to follow-up. This gave a suicidal

ideation analysis sample of 33,687 individuals, 688 of which had newly-incident suicidal ideation

Finally, in Figure 3.2, 43,093 participants completed the Wave 1 interview. 3,696 had a history of suicidal behavior prior to Wave 1. Since they were not at risk for incident suicidal behavior during the follow-up, they were set aside. Among the 31,520 with no history of suicidal behavior, 31,520 completed the Wave 2 interview and 7,877 were lost to follow-up. This gave a suicidal behavior analysis sample of 31,520 individuals, 702 of which had newly incident suicidal behavior.

Tables 3.1, 3.2 and 3.3 provide a description of each of the analysis samples described in Figure 3.1, 3.2 and 3.3 by covariates of central interest. Briefly, the 2-3 year incidence estimates for suicide attempt, suicidal ideation and any suicidal behavior were 0.4%, 2.1% and 2.2%. Current smokers appeared more likely to make a suicide attempt (0.7% vs. 0.3%), have suicidal ideation (3.6%vs. 1.6%) or any suicidal behavior (3.7% vs. 1.7%) compared to never smokers. A similar trend was observed for smokeless tobacco use: suicide attempt (1.0% vs. 0.4%), suicidal ideation (3.0% vs. 2.1%) and suicidal behavior (3.4% vs. 2.1%). There were marked differences in suicidal behavior between current chewers and never chewers (8.2% vs. 2.1%), but no difference was seen by snuff use.

Table 3.4 provides the unadjusted and adjusted analyses for suicide attempt. Current smokers were at an increased risk relative to never smokers (OR=2.2) while former and never smokers did not differ. This did not appear to change after statistical adjustment. There was no statistically significant association between smokeless tobacco use and suicide attempt, however, this is likely limited by low lower. The point estimate for current vs. never users of

smokeless tobacco was similar to that for cigarette smokers (OR=2.7 unadjusted; OR= 2.8 adjusted). Table 3.5 adjusts the estimates in Table 3.4 by prior depression and alcohol use. This adjustment did not affect the estimate for cigarette smoking, and resulted in a shift away from the null for smokeless tobacco use (OR=3.4).

The results of the suicidal ideation analysis are found in Table 3.6. Prior to statistical adjustment, current cigarette smoking predicted suicidal ideation (OR=2.3). There was no increased risk among former smokers. Also, there was no association between smokeless tobacco use and suicidal ideation. Statistical adjustment did not affect the smokeless tobacco estimates. There was, however, a shift away from the null among former smokers (OR=1.6). Adjusting for depression and alcohol use disorders in Table 3.7 provided little change to the estimates. Tables 3.8 and 3.9 provide the results for the suicidal behavior analysis, but given the considerable weight given to suicidal ideation in this analysis, the results do not differ from Tables 3.6 and 3.7.

I also rephrased the research question to assess occurrence of suicide related outcomes (first occurrence or reoccurrence). This added 1,116 current smokers, 579 former smokers and 1,386 never smokers who were previously excluded due to prior suicide related behaviors. In terms of smokeless tobacco use, this step added 74 current smokeless tobacco users, 127 former smokeless tobacco users and 2,928 never smokeless tobacco users.

Table 3.10 compares shows results for models predicting suicide related outcomes as a function of both cigarette smoking and smokeless tobacco use. This was done for a sample that excludes those who had suicide related behaviors at baseline, and for a sample that did not make this exclusion. In both samples, current cigarette smoking at baseline was independently

associated with each suicide related outcome. Current smokeless tobacco at baseline use was associated with suicide attempts in the first occurrence analysis, but not in the first occurrence/reoccurrence analysis.

Finally, I estimated the effect of elapsed time since cigarette onset and elapsed time since smokeless tobacco use on suicide related outcomes. These models failed to detect a crude or adjusted association between years since onset and suicide related outcomes (ORs=1.0 $p>0.05$).

CHAPTER 4: A NATIONALLY REPRESENTATIVE CROSS-SECTIONAL STUDY ON THE RELATIONSHIP BETWEEN TOBACCO USE AND PAST YEAR SUICIDE RELATED OUTCOMES

Chapter 4 Aim:

This chapter will be similar in scope to chapter 3 in that it will consider the effects of cigarette smoking and smokeless tobacco use on suicide related behaviors. Unlike the longitudinal NESARC data in chapter 3, this chapter will use multiple years of cross-sectional data from the National Survey(s) on Drug Use and Health. Combining data from the 2008-2010 surveys will result in a large sample, capable of generating relatively stable estimates on a rare outcome.

Chapter 4 Methods:

Data and participants

Cross-sectional samples were collected as part of the National Survey(s) on Drug Use and Health (NSDUH). The NSDUH's sampling approach involved a multi-stage probability sampling of non-institutionalized community dwelling US residents aged 12 and older. Individuals living in households as well as those in college dorms, other group home facilities, those living on military bases and those without a permanent place of residence were all included in the sampling frame. Further details of the sampling approach are described elsewhere.(Barondess, Meyer, Boinapally, Fairman, & Anthony, 2010; SAMHSA, 2010b) The study protocol was reviewed and approved by the cognizant institutional review board for protection of human subjects in research.(SAMHSA, 2010a)

The NSDUH is conducted annually and is designed in a way that allows for combining data across multiple years.(Barondess, et al., 2010; Meier, Troost, & Anthony, 2012) Each

survey has used a computer-assisted interview where respondents key in answers using a laptop computer to improve validity. After 2008, the NSDUH began collecting data on suicide related outcomes. To optimize the sample size, I combined data from 2008-2010. The total sample sizes from 2008-2010 were 55,739, 55,772 and 57,837 respectively.

Assessment of exposure: tobacco variables

As described above, I was interested in the extent that tobacco use, that is, use of both cigarettes and smokeless tobacco products, predict suicide related outcomes. Previously validation work has shown strong validity in the NSDUH's self-report tobacco module.(Harrison, Martin, Eney, & Harrington, 2007) Participants were asked 'Have you ever smoked part or all of a cigarette?' Those whose had were asked another set of questions regarding their smoking experience such as 'How long has it been since you last smoked part or all of a cigarette?' with the following possible responses: 'Within the past 30 days', 'More than 30 days ago, but within the past 12 months', 'More than 12 months ago but within the past 3 years' or 'More than 3 years ago'. I classified those who had smoked in the past year as 'current' smokers. Those who had last used more than 12 months ago but within the past 3 years were classified as 'recent quitters'. Those who had last smoked more than 3 years ago were labeled as 'former' smokers. Finally, those who had never smoked were simply 'never' smokers.

Analogous questions were asked regarding smokeless tobacco use. After a brief description of the types of smokeless tobacco, participants were asked 'Have you ever used snuff, even once?' and 'Have you ever used chew, even once?' For both snuff and chew, participants were also asked the recency of use question that were asked to cigarette smokers.

For the main analysis, I combined information about snuff and chew use into simply smokeless tobacco use, however, I considered each substance separately in a secondary analysis.

Assessment of the outcome: suicide-related outcome variables

Given the cross-sectional nature of the data, I was unable to measure completed suicide among participants and instead I focused on the following suicide-related outcomes: suicidal ideation, suicidal plans, and suicide attempts. In addition to these experiences being signs of psychological distress by themselves, they are also strong predictors of future completed suicide,(E. K. Moscicki, 1995) and I considered them worth studying.

All adult participants, those aged 18+, were asked 'At any time in the past 12 months, up to and including today, did you seriously think about trying to kill yourself?' Those who indicated that they had were labeled as having past year suicidal ideation and asked the following question on suicide plans: 'during the past 12 months, did you make any plans to kill yourself?' Those with a positive response were classified as having a past year suicide plan and were asked a final question on suicide attempts 'during the past 12 months, did you try to kill yourself?' To be clear, because the question was only asked to adults, this analysis is limited to persons 18+ despite there being participants aged 12-17 in the sample.

Data analysis

Past year suicide ideation, plans and attempts were treated as separate outcomes in three separate series of logistic regressions. The main predictors of interest were cigarette smoking and smokeless tobacco use, both coded as a categorical variable describing the recency of use in four categories using never users as a reference. Analyses were conducted in

Stata v11 with 'svy' commands to take into the account the complex survey design and weighting in the NSDUH.

After crude associations between both cigarette and smokeless tobacco use and each of the three suicide-related outcomes were estimated, adjustments were made for sex, race (non-Hispanic White vs. other), age (18-25, 26-35 and 35+), income (<$20k, $20k-$49k, $50k-$74k and ≥$75k) and population density (Metropolitan Statistical Area (MSA)>1 million, MSA<1 million, non-MSA).

The other confounding variables of interest included history of major depression and alcohol abuse. I decided to condition on these variables by stratifying instead of adding them to our multi-variable models. I stratified based on past year DSM-IV alcohol abuse and/or dependence as well as past year DSM-IV cannabis abuse/dependence. I stratified on depression in two ways: first, I stratified on whether or not the participant indicated that 'a doctor or other medical professional' had ever told them they had depression. I also stratified based on a structured module to assess DSM-IV Major Depression.

A secondary analysis repeated the above steps but separated smokeless tobacco use into two categories: snuff use and chewing tobacco use.

I also tested for a dose-response between tobacco use and suicide-related outcomes among current users. Here, I regressed the log-odds of past year suicide-related outcomes on the number of days used each type of tobacco in the 30 days prior to the assessment.

The final analysis attempted to tease apart the specific effects of cigarette smoking and smokeless tobacco use on suicide related outcomes by setting aside users of multiple tobacco products. While this analysis was limited by sample size, it was done as follows: (1) test for

differences in the frequency of each suicide related outcome among current, former and never smokers who had all never used smokeless tobacco. Similarly, (2) test for differences in the frequency of each suicide related outcome among current, former and never smokeless tobacco users who had never smoked cigarettes.

NESARC vs. NSDUH

Given the apparent similarities between the NESARC (chapter 3) and NSDUH (chapter 4) surveys, it seems appropriate to provide a brief comparison of methods before presenting the NSDUH results.

Both surveys use the non-institutionalized, civilian population of the US as a target population, and their sampling frames include group quarters (e.g., college dorms, group homes) in addition to typically conceptualized households. The NESARC sampled adults (age 18 and up) while the NSDUH sampled adolescents as well (age 12 and up) although only those 18 and up are used from the NSDUH here. Both surveys used complex sampling designs with sociodemographic stratifications. Weights were assigned to make the sample representative of the US population, although the specific sampling methods differed. In the NESARC, the PSUs approximated the US Census Current population Survey county-based PSUs, and the second stage consisted of dwelling unit selection. Blacks and Hispanic dwelling units were oversampled. Finally, one person was selected from each dwelling unit.(Grant, et al., 2003) The NSDUH's PSUs were 500,000 area segments (groups of adjacent census blocks). The next stage involved the selection of a dwelling unit from within a selected segments boundaries. Adolescents and young adults were oversampled within each dwelling unit—one third of the sample was

between 12 and 25 years old. Target samples were 3600 for the 8 largest states and 900 in the other states and in D.C.

Grucza et al., have outlined important differences in the two surveys in regards to privacy/anonymity considerations, response rate and diagnostic instrumentation. Namely, that the NSDUH is expected to generate more accurate data because of its use of a computerized self-administration method. Also, data collection was anonymous for the NSDUH, so a participant's name was not linked with their answers. Also, the NSDUH's interviews were conducted by RTI, a private firm, while the NESARC was conducted by the census bureau. (Grucza, Przybeck, & Cloninger, 2007)

I believe these studies complement each other for the sake of this dissertation research. The NESARC data has the advantage of being longitudinal, while the NSDUH has the advantage of better confidentiality and, perhaps, more better validity with respect to the responses from the respondents.

Chapter 4 Results:

The total adult sample size in the NSDUH population from 2008-2010 was 114,048. Table 4.1 shows the distribution of these individuals by tobacco use status and past year suicidal ideation, plans and attempts. 37,186 were never smokers, 43,070 were current (past year), 6,553 had quit smoking between 1-3 years prior to the interview, and 27,239 had quit >3 years prior to the interview. For smokeless tobacco use (combining both snuff and chewing tobacco use) there were 89,789 never smokeless tobacco users, 8,444 current users, 3,227 individuals who had quit using smokeless tobacco 1-3 years prior to the interview and 12,558

who had quit >3 years prior to the interview. Table 4.1 also shows frequencies specifically for snuff and chew users.

Other information in Table 4.1 displays the estimated prevalence of past year suicide related outcomes by tobacco use. For the entire population, 3.8% had experienced suicidal ideation, 1.1% had made a suicidal plan and 0.5% had attempted suicide. These proportions appeared to differ by tobacco use status. For example, the prevalence of past year suicide attempt was 1.0% among current smokers and 0.3% among never smokers and between 0.3% and 0.4% for former smokers. This trend was less clear among smokeless tobacco users where former users who quit 1-3 years prior to the interview had the highest prevalence of suicide attempt at 1.0%, compared to 0.8% for current users, 0.4% for never users and 0.5% for former users who quit >3 years prior to the interview.

Table 4.2 provides a description of the data by other covariates of interest. While males were more likely to be ever users of any type of tobacco compared to females, this was more pronounced for smokeless tobacco than for cigarettes. For examples 74.8% of males and 64.2% of females had smoked a cigarette at some point in their lifetimes while 33.4% of males and only 5.3% had used either type of smokeless tobacco. Those with depression, assessed by either self-report or a structured interview, were more likely to be cigarette smokers, but did not appear to differ in terms of smokeless tobacco use. Those with alcohol use disorder, a known strong predictor of suicide, were more likely to be cigarette smokers, and almost twice more likely to be smokeless tobacco users than those without an alcohol use disorder.

Table 4.3 describes the sample by crossing cigarette smoking status and smokeless tobacco use status. For example, among those who had never used smokeless tobacco, 35,134

individuals had never smoked, 29,243 were current smokers, 4,681 were recent quitters, and 20,731 were former smokers; among those who had never smoked a cigarette, 35,134 were never smokers, 831 were current smokers, 248 were recent quitters and 973 were former users. This table demonstrates there is a reasonable amount of independence between cigarette smoking and smokeless tobacco use in the US. Indeed, the two are related, but not necessarily all smokeless tobacco users smoke cigarettes and vice versa.

Table 4.4 provides crude and adjusted odds ratios for the estimated effects of tobacco use status on suicide related outcomes. Cigarette smoking predicted suicidal ideation before and after adjustment for background variables. Current users had a 4.3 fold increase in odds of suicidal ideation and recent quitters had a 1.5 increase in odds compared to never users. Similar results were found for suicidal plans and suicide attempts: current smokers were between 2-3 times and recent quitters were ~1.5 times more likely to have experienced the outcomes compared to never smokers. Former smokers, who had quit for at least 3 years, did not appear to differ from never smokers in terms of planning and attempts.

The unadjusted estimates in Table 4.4 for smokeless tobacco show a similar trend to those seen for cigarette smoking, albeit at a smaller effect size: current users of either smokeless tobacco had a 1.6-1.9 fold increase in odds, depending on the outcome, compared to never users. Recent quitters were also at increased odds for suicidal ideation and suicide attempts, and former users had increased odds for ideation. However, after statistical adjustment, most of the ORs were shifted toward the null. There was a significant OR of 1.2 for former vs. never smokeless tobacco use, and all others were non-significant (with $p>0.10$).

The next two panels of Table 4.4 provide estimates for chewing tobacco and snuff use separately. Note, the 'smokeless tobacco estimates' panel adjusts for cigarette smoking, the 'chewing tobacco estimates' panel adjusts for cigarette smoking and snuff use and the 'snuff estimates' panel adjusts for cigarette smoking and chewing tobacco use. Similar results were found for chewing tobacco and snuff separately as when they were combined into one exposure: neither type of smokeless tobacco use predicted suicide related outcomes as consistently as cigarette smoking. After statistical adjustment, current chewers were more likely to have suicidal ideation compared to never chewers (OR=1.6) and former snuff users were more likely to have experienced suicidal ideation and suicidal planning compared to never snuff users (ORs=1.4 and 1.5 respectively).

Tables 4.5-4.8 provide stratifications in the unadjusted estimates in Table 4.4 by depression and alcohol use disorders. Table 4.5 stratifies based on the structured interview depression module in the NSDUH. Cigarette smoking predicted all suicide related outcomes in both those with and without lifetime depression, although the estimated effect appeared stronger in the non-depressed (current vs. never OR=1.8 and 2.6 for those with and without depression respectively). Unadjusted smokeless tobacco estimates generally remained unchanged before and after stratification. However, chew use was a stronger predictor of suicidal planning and attempts among those without depression than among those with depression. Table 4.6 stratifies the estimates by depression status, as in Table 4.5, but here depression was assessed by a self-report item ("has a doctor, nurse or other health professional ever told you that you have major depression?"). The results are not appreciably different from those found in Table 4.5.

Table 4.7 stratified the unadjusted estimates in Table 4.4 by whether or not the participant had a current alcohol use disorder (DSM-IV Alcohol Abuse or Alcohol Dependence). Cigarette smoking results were similar to those in the depression stratifications. Current smoking predicted suicidal ideation, and this estimated effect was stronger in those without an alcohol use disorder compared to those with one; current smoking also predicted suicidal planning among those without an alcohol use disorder, and suicide attempts in both those with and without alcohol use disorders. The estimates for smokeless tobacco use were noticeably attenuated after stratification after stratification by alcohol use disorder status: the only evidence of smokeless tobacco predicting suicide related outcomes was a 1.3 fold increase in odds of suicidal ideation in former users compared to never users without an alcohol use disorder, and a 2.1 increase in odds of suicide attempt in recent quitters compared to never users without an alcohol use disorder. When separating the estimated effects of chewing tobacco and snuff, chewing tobacco had a slightly more consistent relationship with suicide related outcomes than snuff.

Other results consider a possible dose-response relationship between tobacco use and suicidal outcomes. Specifically, if either the reported number of days smoked or days used smokeless tobacco in the 30 days prior to the assessment predicted past year-suicide related outcomes. Table 4.8 shows the weighted mean number of days used each tobacco product and its standard error by each suicide related outcome. A series of regressions tested for the effects of the number of days an individual used cigarette, chew or smokeless in the 30 days prior to the interview on the log-odds or suicidal ideation, plans and attempts. These regressions were also stratified by depression and alcohol use disorders. The *p*-values of these regressions are

shown in Table 4.9. The only consistent dose-response trend was an inverse association between snuff use and suicidal ideation.

Finally, Table 4.10 examines the effects of tobacco use on suicide related outcomes among those who are either exclusive cigarette smokers, or exclusive smokeless tobacco users. While the results of the smokeless tobacco analysis is limited by the small number of smokeless tobacco users who had never smoked and had suicide related outcomes, the *p*-values in the footnote indicate that cigarette smoking consistently predicted suicide related outcomes, while smokeless tobacco use did not. To be clear: among those who had never used smokeless tobacco, cigarette smoking was a significant predictor of suicidal ideation, plans and attempts; among those who had never smoked a cigarette, smokeless tobacco was not a significant predictor of said suicide related outcomes.

Realizing the relatively small sample of smokeless tobacco users who had never smoked a single cigarette, I modified this analysis by excluding current users (instead of ever users) or each respective tobacco type. These results are shown in Table 4.11 where one can see that cigarette smoking predicted all suicide related outcomes among those who were not currently using smokeless tobacco, and there was no evidence that smokeless tobacco use altered the occurrence of suicide related outcomes among those who were not current smokers. (Significance tests from a logistic regression are displayed in the footnote.)

As a final exploratory step, I tested for effect modification between cigarette smoking and smokeless tobacco on each suicide related outcome. This involved crossing recency of cigarette smoking by recency of smokeless tobacco use. For the estimated effects of tobacco on suicidal ideation, current cigarette smokers (*p*=<0.01) and recent quitters (*p<0.01*) were at an

increased odds of suicidal ideation, and there was a significant subgroup variation effect of current smokeless tobacco use was smaller in those who had quit smoking 1-3 years prior. For suicidal planning, current cigarette smokers (p=<0.01) and recent quitters ($p<0.01$) were at an increased odds of suicidal ideation, and there was a significant subgroup variation term showing former cigarette smokers who had quit for at least 3 years and quit using smokeless tobacco 1-3 years prior were at a lower odds for suicidal planning than other former cigarette smokers (although this estimate was very imprecise and difficult to interpret). For the effect on suicide attempts, current cigarette smokers and recent quitters were at an increased odds for suicide attempt, and there was no subgroup variation by smokeless tobacco use. Also, there was no evidence in these models that smokeless tobacco use is associated with an increased odds in suicide attempt. and none of the smokeless tobacco or interaction terms were significant. (These data are not shown in a table).

Given the small number of significant interactions terms (2/27) it is possible they are due to chance, and both are non-significant after a Bonferroni correction for multiple comparisons. With that in mind, I still explored the significant interaction term between former smoking and current smokeless tobacco use on suicidal ideation using the following estimated coefficients from the model: change in log odds of +0.51 for former smoking, +0.50 for current smokeless tobacco use and -0.95 for the interaction term. A current smokeless tobacco user/recent cigarette quitting does not differ from a never tobacco user in terms of occurrence of suicidal ideation (OR=1.06). I compared to this to someone who had recently quit using smokeless tobacco but was still smoking cigarettes using the following coefficients: +0.91 for current smoking, -0.70 for former smokeless tobacco use (1-3 years prior) and +0.90 for their

interaction. This type of tobacco user would still be at an increased risk compared to a never tobacco user (OR=2.96). This is all under the large assumption of these interaction terms being of value, for which there is very little evidence in this analysis. However, the results suggest that someone who is both a current smoker and a current smokeless tobacco user would see a great reduction in their risk of suicidal ideation if they were to quit smoking, but they would see no change in risk if they were to quit using smokeless tobacco.

CHAPTER 5: THE RELATIONSHIP BETWEEN CIGARETTE SMOKING AND SUICIDE RELATED OUTCOMES: WHAT CAN WE ATTRIBUTE TO MENTAL HEALTH AND SOCIAL SUPPORT?

Chapter 5 Aim:

This chapter will focus on the associated between cigarette smoking and provide a stronger ability to control for psychiatric comorbidities as well as differences in social support. This will be an important contribution as it will add a detailed assessment of mental illness. Data for this chapter are from the Collaborative Psychiatric Epidemiology Surveys (CEPS) which is a collection of three large, mental health focused cross-sectional surveys in the United States collected between 2001 and 2003.

Chapter 5 Methods:

Data and participants

The data for this chapter were drawn from the Collaborative Psychiatric Epidemiology Surveys (CPES). This was a combination of the National Comorbidity Survey Replication (NCS-R), and the the National Latino and Asian American Study (NLAAS). Each of these cross-section samples were gathered from 2001 to 2003 in an effort to better understand the prevalence, correlates, risk factors and suspected causes of mental illness in the US. The target population of non-institutionalized adults (those over 18) was interviewed either face to face or over the phone. (S. G. Heeringa et al., 2004; Pennell et al., 2004) Interviewers were trained to administer the Mental Health Composite International Diagnostic Interview (WMH-CIDI, which is a tool used to diagnose mental illness according to DSM-IV criteria.(Kessler & Ustun, 2004)

Multi-stage probability sampling was done at several levels: PSU of US metropolitan statistical areas, single counties and groupings of countries. This step was followed by the

sampling of census blocks within metropolitan statistical areas. Afterwards, households were selected from census blocks, and then finally a person was selected within each household. The assessment uses a two-part design to limit the burden on the respondent. At baseline, all individuals are screened for having any mental illness. All those who screened positive for asked to take the second part of the interview several weeks later. A 25% enrichment sample of those who were not screened positive for mental illness were also asked to take the part II interview. Weighting factors adjusted for this imbalance in the analysis.

Assessment of exposure: tobacco variables

While these surveys were mental health focused, there was a brief assessment of cigarette smoking status. Participants were asked if they "were a current smoker, an ex-smoker or if they had never smoked." They were also given "only smoked a few times" as a response option. These individuals were treated as former smokers for the sake of this analysis.

Assessment of the outcome: suicide-related outcome variables

Questions regarding suicidal behavior were asked the part II interview. Participants were asked if they had ever 'seriously thought about killing themself'. Those who responded that they had were designated as having suicidal ideation and were asked the following question about suicidal plans: 'have you made a plan to kill yourself?' If participants had made a suicidal plan, they were asked whether they had ever attempted suicide. Protocols for the NCS-R and for the NLAAS were the same except participants in the NLAAS were able to indicate that they had made a suicide attempt unconditional on if they had suicidal ideation or had made a suicide plan.

The following lifetime diagnoses were treated as confounders in this analysis: bipolar disorder (I and II), major depression, dysthymia, alcohol use disorder (alcohol dependence with or without abuse), substance use disorder (substance dependence with or without abuse), conduct disorder, post-traumatic stress disorder, generalized anxiety disorder and panic disorder. In addition, to diagnosed mental illness, I was also interested in controlling for differences in social support, as higher levels of social support have been shown to possibly protect against smoking onset and possibly increase the likelihood of smoking cessation (Lakon, et al., 2010; Romano, et al., 1991)

To measure this, I used 12 questions on social support asked to all participants:

(1) How often do you talk on the phone or get together with relatives who do not live with you?

(2) How much can you open up to relatives who do not live with you if you need to talk about your worries?

(3) How much can you open up to relatives who do not live with you if you need to talk about your worries?

(4) How often do your relatives make too many demands on you?

(5) How often do your relatives argue with you

(6) How often do you talk on the phone or get together with friends?

(7) How much can you rely on your friends for help if you have a serious problem?

(8) How much can you open up to your friends if you need to talk about your worries?

(9) How often do your friends make too many demands on you?

(10) How often do your friends argue with you?

(11) When you have a problem or worry, how often do you let your partner worry about it?

(12) When you have a problem or worry, how often do you let someone (else) know about it?

Respondents answered each of these items with Likert scale, ordinal responses. I combined this information into factor scores using an exploratory/confirmatory factor analysis method (details explained in the analysis section).

Data analysis

History of suicidal ideation, plans and attempts were treated as separate outcomes in separate series of logistic regressions. The main exposure variable of interest was smoking status, current, former or never.

For each outcome, the first steps involved unadjusted estimates for the effect of smoking on suicide related outcomes. The next steps involved adjustment for the descriptive characteristics: age, sex, race, income and education. Estimates were then adjusted by history of mental illness.

Social support variables were created according to a factor analysis. I considered this an appropriate analysis because of the latent nature of 'social support'. Each of these 12 items asks the participant about having a network of friends and relative that they are comfortable with talking about their worries and how well they get along with the individuals in this network. Another option would be to use a principal components analysis, however, such an analysis would neglect the possible inter-factor correlations.

For the first step, I first conducted an exploratory factor analysis using a geomin rotation in Mplus version 5.0. I divided the sample into random exploratory and confirmatory halves. The exploratory factor analysis helps in this context because I was uncertain about the number of factors. I hypothesized that there would be two factors: one that primarily loaded the items asking about relatives, and another onto the items about friends. To do this, I used the NLAAS as the exploratory sample and the NCS-R as the confirmatory sample. Given the relatively small number of items (12) I decided to test for 1-4 number factor solutions. Anything much larger would limit the number of items per factor. Ordinal responses to each item were coded so that a higher score represented a higher level of social support. The specific responses for each item can be found in table 4.3.

Once the number of factors had been determined, all significant loadings (at $p<0.05$) were used in a confirmatory factor analysis using the NCS-R sample. Factor loadings that were significant at this level were used for estimating social support scores. This was done on the entire sample. Social support scores were then used as a covariate when estimating the association between smoking and suicide related outcomes.

As a final exploratory step, I considered the finding in chapter 5 were cigarette smoking was a stronger predictor of suicide in those without major depression than in those with it. For each mental disorder and each suicide related outcome, I ran a logistic regression with terms for smoking, mental disorder and the interaction between the two. These models asked whether the effects of cigarette smoking on the occurrence of suicidal outcomes might vary with respect to whether the person had a mental disorder. Using evidence from chapter 5, I

approached this work with the hypothesis there would be a diminished effect of smoking on suicide in those with a mental disorder (or at least those with depression).

Chapter 5 Results:

In total, there were 13,931 individuals in the combined NCS-R and NLAAS sample. This analysis was limited to those who had taken the second part of the interview, as this was where most of the relevant questions were asked. The total sample size for this study was 10,341. Table 5.1 provides a brief description of the nationally representative sample. Prevalence estimates of current and former smoking were comparable to other studies (24.3% current and 27.3% former).

Table 5.2 shows the proportions of suicide related outcomes and mental disorder status by smoking status. Those with suicidal ideation, planning and attempts were more likely to be current smokers than those without (38.8% vs. 22.4%, 45.2% vs. 23.5% and 50.1% vs. 23.4% respectively). Similar results were seen for mental disorders. For example, 61% of those with Bipolar II were current smokers while only 24.2% of non-Bipolar II cases were current smokers.

Table 5.3 provides a list of each social support item along with the response proportions. The items were coded so that a high number represents a high level of social support and a low number represents a low amount. Items were fairly well-distributed although the distributions are left skewed (clustering towards higher levels of support). Tables 5.4 and 5.5 contain the same information in Table 5.3 with Table 5.4 showing responses for the exploratory sample and table 5.5 containing responses for the confirmatory. There were little to no differences between samples with respect to marginal response patterns.

Table 5.6 contains estimates from a series of weighted logistic regressions predicting suicide related outcomes as a function of smoking status and socio-economic descriptive characteristics: sex, age, race, income and education. There were significant unadjusted effects of smoking on suicide related. ORs for the estimated effect of current relative to never smokers were 2.4 for ideation, 2.7 for plans and 3.8 for attempts. Former smoking also predicted suicide attempts (OR=1.4). Adjusting for sex, age, race, income and education had little effect on the results.

Table 5.7 shifts to adjustment for mental disorder status. Here, before moving to a multivariable model with more than one mental disorder, I first looked at how adding each mental health diagnosis altered the OR between cigarette smoking and suicide related outcomes For example, the estimates in the first three rows labeled “Bipolar I” are the effect of smoking on suicide related outcomes adjusting for Bipolar I diagnosis. Current cigarette smoking remained a significant predictor of each suicide related outcome after independently adjusting for each mental disorder; no single diagnosis accounted for the observed association between smoking and suicidal outcomes. Adjustment for alcohol use disorder resulted in the greatest attenuation of the ORs (1.8, 1.9 and 1.8 for the estimated association with current smoking on ideation, plans and attempts respectively).

Multivariable models with each diagnosis are shown in Table 5.8. After adjusting for all mental disorders, current cigarette smoking continued to predict each suicide related outcome (OR=1.4 for ideation and plans, OR=2.0 for attempts). Consistent with previous findings, bipolar disorder had the strongest effect on each suicide related outcome.

The model fit indices for the factor analysis of social support are found in Table 5.9. Fit indices are best with the 4-factor solution, although the CFI and TLI suggest good fit is also found with the 3 factor solution. Also, the RMSEA of the 3-factor solution (0.081) was almost in the acceptable range (<0.08). The Kaiser rule would also suggest the 3 factor model due to the eigenvalues being <1 in the 4 factor solution.(Lance & Vandenburg, 2008) I also considered factor interpretability in determining the number of factors. EFA factor loadings are found in table 5.10. The single factor solution had mostly positive loadings with the strongest loadings on "How much can you open up to relatives who do not live with you if you need to talk about your worries?", "How much can you open up to relatives who do not live with you if you need to talk about your worries?", "How much can you rely on your friends for help if you have a serious problem?" and "How much can you open up to your friends if you need to talk about your worries?". This seemed reasonable as each of these items reflected having someone, a friend or a relative, from which the individual can seek help from. There were also some moderately strong negative loadings on items asking about demands and arguing with friends and relatives. (Note: since all items are coded so that a higher value=higher social support, this would mean individuals with a high score on this factor tend to have someone to talk to about their problems but also that they argue frequently with those same individuals).

In the second factor solution factor 1 appeared to be similar to the single factor in the one factor solution. The second factor had positive loadings for arguing and demand variables. In this solution, a high amount of factor 1 seems to represent a high amount of support from family and friends, while a high amount of factor 2 seems to represent a low amount of stress (demands and arguments) from friends and family.

The 3-factor solution appears to separate factor 1 into 2 categories: factor 1, those who have a high amount of support from their friends and family, and factor 2: those who have a high amount of support from their friends. Here, factor 3 represents those who might not have a high degree of support from friends or family, but they tend not to argue or feel demands from their friends and family. The 4-factor solution is difficult to interpret because of a mono item factor. Because of this in combination with the fit statistics, I chose to use the 3-factor solution.

Table 5.11 shows the results from the CFA using all items with significant loadings in the EFA. Factor structure in the EFA was supported by the CFA. (Although I considered dropping the factor 1->item 12 loading. While it is still statistically significant, it is very low and loads better onto another factor. Given the small amount of factor correlation, I decided to retain it.)

The distributions of factor scores are shown in table 5.12. There is a fair amount of variation in each of the three scores by smoking status where never smokers have higher levels of support than current smokers.

The effects of social support on suicide related outcomes are displayed in table 5.13. Factors 1 and 3 were protective of suicidal ideation, plans and attempts. Interestingly, factor 2 had no effect on these outcomes. Adjusting for these scores had little effect on the association between cigarette smoking and outcomes.

Table 5.14 summarizes most of the model results in this chapter and adds a final set of models that controls for descriptive characteristics, mental disorder status and social support (Model V and Model VI. Model VI is the same as Model V, but instead of adding a term for each mental disorder, instead I added a term for total number of disorders). Although there was a

noticeable attenuation in the effect size current smoking continued to predict suicidal ideation (OR=1.4), suicidal plans (OR=1.3) and suicide attempts (OR=1.8) To put this in perspective, the independent effects of cigarette smoking on suicide attempts comparable to the independent effects of substance use disorder, alcohol use disorder, conduct disorder, PTSD, generalized anxiety disorder or dysthymia on suicide.

Finally, Table 5.15 explores the idea that smoking might be a stronger predictor of suicide related outcomes in those without a mental disorder than in those with a mental disorder (subgroup variation). This table shows the ORs for a product term between current smoking and mental disorder status. For example, an OR>1 would suggest that the effects of cigarette smoking on suicide are stronger in those with a given mental disorder, and an OR<1 would indicate that said effects are smaller in those with a mental disorder. For suicidal ideation, significant ORs<1 were found for major depression, dysthymia and post-traumatic stress disorder, for suicidal plans, significant ORs<1 were found for major depression and post-traumatic stress disorder, and there were no significant interactions for suicide attempts.

CHAPTER 6: DISCUSSION, LIMITATIONS, & FUTURE RESEARCH

The main results can be summarized succinctly: (1) In the NESARC longitudinal analyses, tobacco cigarette smoking at baseline predicted newly-incident suicidal ideation (SI) and attempts (SA) while baseline smokeless tobacco was an independent predictor of suicide attempts (but not SI). (2) In addition to a general confirmation of NESARC longitudinal results via cross-sectional analyses with other independently gathered data, the cross-sectional NSDUH analyses disclosed that cigarette smokers who have never used smokeless tobacco were still at increased odds for suicide related outcomes, but smokeless tobacco users who had never smoked cigarettes were not. (3) In the cross-sectional CPES analysis with detailed control of mental health status and social support, cigarette smoking had an independent association with suicide related outcomes. In sum, the results partially support the smoking hypothesis under study; some results seem to contradict what has been hypothesized.

I will start by a description of the results that support tobacco cigarette smoking as a possible cause of suicide related outcomes. First, in all three analyses (the NESARC, the NSDUH and the CPES), being a current cigarette smoker predicted suicidal ideation, plans and attempts after covariate adjustment. These odds ratio (OR) estimates for suicide attempt ranged from 1.8 in the CPES analysis to 2.8 in the NSDUH analysis. The ORs for the estimated effect of current smoking on suicidal ideation and suicidal plans remained statistically significant (with $p<0.05$) after covariate adjustment in all analyses, but were not as strong as the ORs for current smoking and suicide attempts. In the CPES analysis, these were fairly small (OR=1.4 for ideation and 1.3 for attempts), however, they were still statistically significant (with $p<0.05$). These estimates are consistent with published estimates from other studies. Also, current cigarette

smoking predicted suicide related outcomes after stratification by mental disorder status with due consideration of social support levels. This work supports the idea that there is an association between being a current smoker and having an increased risk of suicide related outcomes, and that this association is independent of diagnosable mental disorders and levels social support. Although I can still speculate that sub threshold mental illnesses could still act as a confounder (e.g., controlling for depression as a continuous covariate instead of a categorical covariate might drive the smoking-suicide association toward the null.)

In some of these analyses, the adjusted OR estimates for the effect of cigarette smoking on suicide attempts were modest (e.g., 1.8). Some readers might not be impressed by the magnitude of this association, and this judgment is somewhat justifiable. It is a relatively small OR. I would note that this estimate comes from a model adjusting for many important confounding variables. Also, it may be important to compare the 1.8 value to the other ORs calculated in the modeling process. Although not shown in a table, , other OR estimates were found when the log odds of suicide attempts was regressed on bipolar I status (OR=3.4, bipolar II status (OR=2.6), major depression (OR=2.5), dysthymia (OR=2.0), alcohol use disorder (OR=1.5), conduct disorder (OR=1.5), substance use disorders (OR=1.8), post-traumatic stress disorder (OR=1.9), and generalized anxiety disorder (OR=2.2). When compared to these estimates, I judge the 1.8 estimate for current smoking to be a bit more impressive.

Other evidence presented here somewhat contradicts the idea that being an active cigarette smoker might cause suicide or suicide related outcomes. Although not true in every modeling step, former smoking also tended to predict suicide related outcomes, although at a lesser extent than current smoking. The strongest evidence on former smoking is from the

NESARC analysis where, after covariate adjustment, current smoking predicted suicidal behavior with an OR of 2.0 while former smoking also did with an OR of 1.6. Similar results were found in the NSDUH analysis, with ORs of ~2.7 and ~1.5 respectively.

As described in the introductory background material, one of the prominent prior suggestions about the biological mechanism for this association is through differences in MAO levels due to smoking. However, once an individual stops smoking, their MAO levels return to normal.(Norman, et al., 1987) Therefore, if the transient MAO level is the central mechanism, it does not make sense within this model that someone who has not smoked a cigarette for years would remain at increased risk of suicide. A more complex mechanism must be at play, perhaps one with cigarette smoking serving as a marker for an underlying suicide ideation/attempt diathesis, or with an influence on transient monoamine pathways, followed by more durable pathological process not well indicated by transient MAO levels.

In this context, it may be noteworthy that the CPES analysis showed a null association between former smoking and suicide related outcomes—achieved after a more complete control of mental health status and social support. Also, after these adjustments, the estimates for cigarette smoking were greatly reduced (about half the size of the unadjusted estimates). One interpretation is that *some* of the observed association between current smoking and suicide and *all* of the association between former smoking and suicide might be attributable to mental disorders and perhaps levels of social support (as measured via self-report items). Perhaps this would explain why former smokers had increased odds of occurrence of suicide related outcomes in the other two analyses, which did not adjust for these covariates. Still, it is important to consider that the appropriate comparison might be “current smokers vs. former

smokers" instead of "current smokers vs. never smokers". For example, the considerable overlap in confidence intervals of the odds ratios for current and former smokers in chapter 3 shows that current smokers might not always differ from former smokers in terms of suicide related outcomes. In short, being a former smoker should not independently predict suicide related outcomes if cigarette smoking is an actual cause of suicide by its transient effects on serotonin metabolism and MAO pathways. An excess risk of suicide among former smokers is more likely due to characteristics that influence whether someone becomes a smoker, unless there is some type of lasting change induced by smoking, over and above what is manifest in transient MAO pathways.

Also speaking against SI/SA outcomes attributed to smoking, the evidence of these analyses disclosed no clear dose-response relationship, whether when looking at elapsed time since smoking onset or frequency of use among current users. Some experts make a judgment that a dose-response relationship should be established before a causal inference is drawn. These experts might use the absence of dose-response gradients as evidence against a causal relationship.

The general failure to find an association between smokeless tobacco use and suicide related outcomes deserves some discussion. If tobacco induced changes in MAO levels or some other tobacco or nicotine alteration of biological mechanism were indeed responsible for a smoking-suicide relationship, I would expect to find the same relationship among smokeless tobacco users. This evidence is limited by our current biological understanding of the relationship. For example, while smokeless tobacco delivers nicotine at a similar dose compared to smoking cigarettes, nicotine reaches the brain faster when smoked than when absorbed

through the mouth and nose (~10 seconds vs. ~4 minutes) and this variation across tobacco products might alter the effect of tobacco exposure on outcomes.(Benowitz, 2011) Still, there is a possibility that cigarette smoking pharmacologically affects suicide risk through a current unknown mechanism. For example, thousands of chemicals are found in cigarette smoke that are not found in smokeless tobacco. It is completely possible that any of these, or perhaps a combination of these other chemicals, affect the suicide outcomes. If so, there is an explanation for the observed smoking-suicide relationship and the lack of smokeless tobacco-suicide relationship.

The concept of *combination* of chemicals is worth stressing. Perhaps nicotine does play a small, direct role on suicide risk, but this increased risk is not large enough to observe in these studies. Instead the excess risk found in smokers could perhaps be due to an accumulation of many different chemicals—not all of which are also found in smokeless tobacco.

Still, I consider the null findings about the association between smokeless tobacco use and suicide outcomes to be noteworthy and novel. This dissertation research constitutes the first studies ever to explore this relationship.

There is an important limitation of the dissertation research in relation to the outcome variables under study. Beyond my own deep interest in studying “completed suicide” as an outcome instead of SI and SA behaviors, I can perceive a problem with how these suicide related variables generally have been measured. In keeping with contemporary practice, these large, cross-sectional surveys ask individuals if they had ever seriously thought about committing suicide. However, only those who had said yes were asked about suicidal planning, and only those who indicated they had made a suicide plan had were asked about a suicide

attempt. The researchers who designed these assessments assumed these suicidal behaviors followed an ordered hierarchy.(D. C. Miller, 1991) this might be a fair assumption in some types of social sciences research with different outcomes—for example, in the United States, anyone who has attained a college degree generally can be assumed to have attained their high school diploma; anyone who has finished graduate school can be assumed to have also finished high school and has a four year college degree. Previous research has shown this ordered hierarchy is not always the case in suicide outcomes; some attempts are impulsive (e.g., a suicide attempt without a clear period of ideation).(A. R. Smith et al., 2008) In most cases, this trajectory might be accurate and those with suicide attempts have suicidal planning and suicidal ideation (and so forth). However, an estimated 10-20% of suicide attempters do not follow this assumed hierarchy .(Perez, 2005) As mentioned earlier, these suicide attempts are thought to stem more from impulsive characteristics of the person, perhaps in response to an acute stressor. In consequence, this dissertation research misses these types of suicides (i.e., lacks sensitivity to their potential presence).

It is not entirely clear how the omission of these suicide outcomes affected the results. One must consider how they would expect tobacco exposure to influence suicide. For example, if tobacco use were to increase impulsive behavior (which could lead to suicide) one might expect a shift away from the null if these non-hierarchicical suicide attempts had been detected. However, one could also argue that since tobacco users are more likely to be impulsive (i.e., impulsive individuals more likely to start and continue using tobacco) that impulsivity could act as a confounder in the observed relationship.(Acton, 2003; Krishnan-Sarin et al., 2007; Waldeck & Miller, 1997)

This aspect of measurement is especially a limitation in the NESARC analyses in chapter 3. NESARC participants were only asked about suicide related outcomes as part of the depression module, so those who had not reported a two week period of feeling sad, blue or depressed (or a two week period of anhedonia) were not asked about suicide outcomes at all.

As a check on this source of error, I estimated how many suicide related outcomes might have been omitted in the NESARC analyses using data from the CPES project. In CPES data, an estimated 20% of those with suicidal ideation and 15% of those with suicide attempts did not report a two week period of feeling sad, blue or depressed, indicating that a notable fraction of possible outcomes where omitted in the NESARC analyses.

Another important set of possible confounding variables in research on cigarette smoking and suicide outcomes can be found when considering suicide feasibility. When arguing that the consistently observed association between smoking and suicide is a confounded relationship, most investigators suggest it is confounded by factors that influence the desire to commit suicide (e.g., Major Depression, low income, aggression, impulsivity). However, suicide requires both a desire and a means. Factors such as access to firearms are known to increase risk of suicide.(Lewiecki & Miller, 2013) Other factors might include access to harmful chemicals, such as pesticides or pharmaceuticals, which would be lethal when ingested, or living in an area with tall buildings and bridges, which a suicide attempter could jump. Future work should consider these details as well, and clarify whether they are important in relation to ideation and attempts. One might argue that these factors would only affect the relationship between smoking and completed suicide (i.e., “Why would owning a gun affect one’s risk of suicidal ideation, plans and attempts instead of only completed suicide?”). But I would argue

that access to a firearm or other effective means of suicide might also increase risk of other suicidal behaviors as well; an individual with access to suicide means might view suicide as more of a concrete possibility than someone who does not.

There was another limitation with respect to the measure of social support in chapter 5 in which not all items apply to widows, divorcees or those never married, as question 11 refers to their spouse. Similarly, there are questions about relatives not living with the participant which might be interpreted and answered differently by adopted children not living with their biological family. However, this is an example of why it is advantageous to measure constructs such as social support using multi-item scales.

Before discussion of possible implications that might arise from this research, I would ask the reader to suspend judgment about the limitations on this research and imagine if cigarette smoking were indeed a cause of suicide and that smokeless tobacco was not. Some advocates might consider this situation to favor tobacco harm reduction approaches. There is currently a debate over whether cigarette smokers should be encouraged to switch to using smokeless tobacco due to the much larger chronic disease risk found in association with smoking cigarettes versus using smokeless tobacco.(Benowitz, 2011) This is clearly a controversial opinion, and, to the best of my knowledge, is not currently applied by public health officials, but the results of this research might aid in that discussion. Perhaps a better example would be in favor of other FDA licensed nicotine replacement therapy, or even the so-called 'e-cigarettes' with a 100% nicotine formulation, not yet regulated in the United States. If cigarette smoking were to be a cause of suicide, but exposure to nicotine by itself is not, then

nicotine replacement therapies, such as nicotine patches and gum, or nicotine user who exclusively consumes the e-cigarette , would not also increase an ex-smoker's risk of suicide.

Also, if cigarette smoking were to be an established cause of suicide, it would be important for practicing psychiatrists to work with their psychiatric patients and their patient's primary care physician on the role of smoking cessation plans, depending upon the nature and degree of the possibly suicide-associated psychiatric disturbance. However, quitting smoking is a stressful experience (e.g., withdrawal), and in some individuals it might increase suicide risk in the short term. We would need a greater understanding of the effects of smoking cessation attempts on short term mental health to best tailor possible interventions. Still, there is no evidence in this dissertation that suggests quitting smoking will *increase* one's risk of suicide relative to current smoking. I consider this an important finding because one's intuition might tell them that quitting smoking might leave former smokers at an increased risk of suicide. also, a recent study by Capron et al., reported that there is no short term increase in anxiety, depression, or suicidal ideation among those who successfully quit smoking. Future studies should continue to consider the short term effects on smoking cessation, or smoking cessation attempts, on suicide (e.g., "What happens to an individual's suicidal thoughts within the first week without a cigarette?").

Another area for future studies would be to add suicide as an outcome variable of interest in ongoing smoking cessation trials. It would be unethical to randomly assign non-smokers to start smoking, but one could ethically assign current smokers to smoking cessation interventions. Unfortunately, these studies would likely be limited to treatment seeking samples. Still, other ongoing, longitudinal studies collecting data on cigarette smoking could

provide useful analyses by using the within subjects case-crossover approach. In one of these hypothetical studies, investigators would have repeated measures on smoking status (perhaps annually) and assessments of suicide attempt. For each individual who attempts suicide investigators would ask if the patient was smoking or not in a defined time window leading up to the suicide attempt (ideally an interval as fine grained as the month prior to the suicide attempt, but the year prior to the suicide attempt would work as well). They would then compare the likelihood of smoking during this time period, the hazard interval, to the likelihood of smoking at another period in their life. The major strength of this design is that it holds constant important confounding variables about the person because the individual is used as their own control. A limitation here would be that it would not control for time-sensitive confounders that might influence whether someone attempted to quit smoking, successfully quit smoking and also attempted suicide.

This raises another important limitation on research of this topic. The ability and desire to quit smoking are very likely influenced by one's suicidal tendencies. Someone who has thoughts and plans to commit suicide probably is not putting healthy changes like quitting smoking high on their priorities. This problem is actually two-fold: (1) as I stated, suicidal behaviors might decrease one's desire to quit smoking and (2) suicidal behaviors also likely decrease the likelihood of smoking cessation among those who *do* have a desire to quit smoking. This circumstance complicates studies on this topic. As a starting point on this issue, I would suggest more qualitative studies on the relationship between smoking and suicide which focuses on the individual's motivations to quit or continue smoking. Do individuals at a high risk for suicide continue smoking because they feel that the effects of suicide help their mood? Do

they simply not care about quitting smoking because they are unhappy with their lives and are considering suicide? Do they lack the motivation to quit for other reasons? Are they interested in quitting, but their failed cessation attempts give them a feeling of helplessness which increases their suicidal feelings? These motivations are not currently well understood, and a more qualitative investigation on this topic would be helpful.

On a similar note, in the general population of the United States, over half of smokers are interested in quitting smoking and have made a quit attempt in the past year.(Lewiecki & Miller, 2013). From this evidence, one could argue that only 50% of current smokers are smokers because they want to be (i.e., they don't want to quit), while the other 50% are current smokers even though they have no desire to continue to smoke (i.e., they are trying to quit). If cigarette smoking were in fact a cause of suicide with biological and pharmacological or toxicological mechanisms, then it should predict suicide in each of these smoking subgroups. One suspects that these mechanisms of a smoking-suicide association are not altered by the person's thoughts and feelings about smoking.

Another direction for future studies involves studying this relationship outside of the US. As shown in the literature review, most of the evidence on the relationship between cigarette smoking and suicide has been completed in the US or other Western countries. One study in China and one in Japan found little to no evidence of a tobacco-suicide relationship. Outside of this dissertation work, I have provided an outline for a future study on smoking and suicide from a global perspective in the using data from the World Mental Health Surveys Initiative. Such a study would be helpful because the WMH uses a standardized assessment across 21

different countries in the world. Notwithstanding the value of multi-country research on this topic, studies within individual countries on smoking and suicide would also be helpful.

CHAPTER 7: SUMMARY

The relationship between smoking and suicide remains unclear and deserves further study, even though we in the public health community already have identified many reasons to prevent the use of tobacco products and to encourage users to quit. While the tobacco-suicide relationship may not be the most important public health problem today in terms of disease burden, I consider this a noteworthy topic because we generally view most cases of completed suicide as feasibly preventable, and the same can be said about cigarette smoking onsets.

The main contribution of this dissertation is its evidence on smokeless tobacco. It is noteworthy that smokeless tobacco use does not appear to increase suicide outcome risk while cigarette smoking appears to account for an increased risk. In addition, while a considerable proportion of the relationship between cigarette smoking and suicide may well be explained by mental illness status, this work suggests smokers are at increased odds of suicide outcomes such as ideation and attempt, even with common mental illnesses have been taken into account.

APPENDICES

APPENDIX A: Tables and Figures

Figure 3.1 Flow chart identifying newly incident cases of suicide attempts with complete follow-up. Data from the US National Epidemiologic Survey on Alcohol and Alcohol Related Conditions (NESARC), Wave I 2001-2002 (n=43,093), Wave II 2004-2005 (n=34,653).

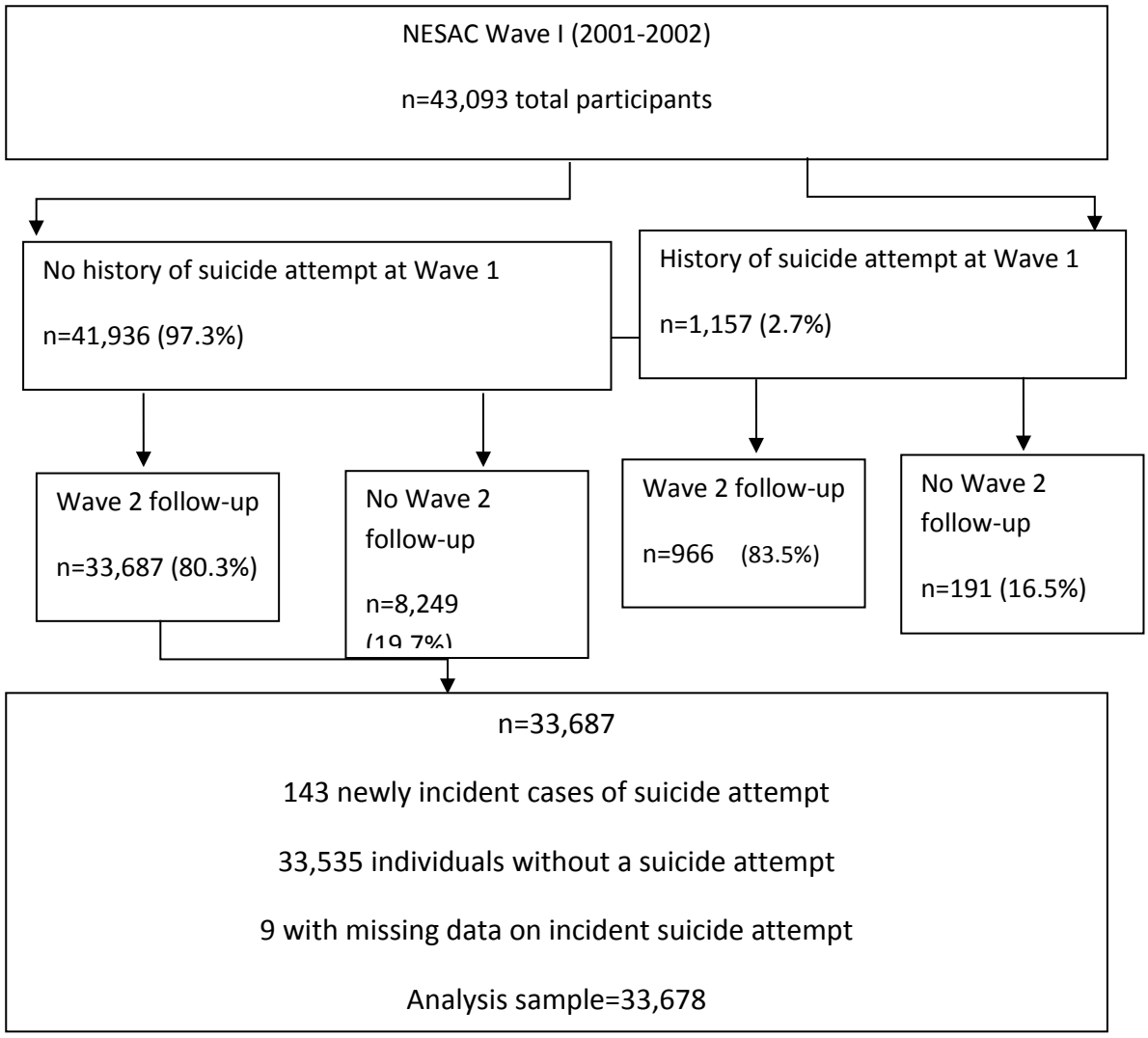

Figure 3.2 Flow chart identifying newly incident cases of suicidal ideation with complete follow-up. Data from the US National Epidemiologic Survey on Alcohol and Alcohol Related Conditions (NESARC), Wave I 2001-2002 (n=43,093), Wave II 2004-2005 (n=34,653).

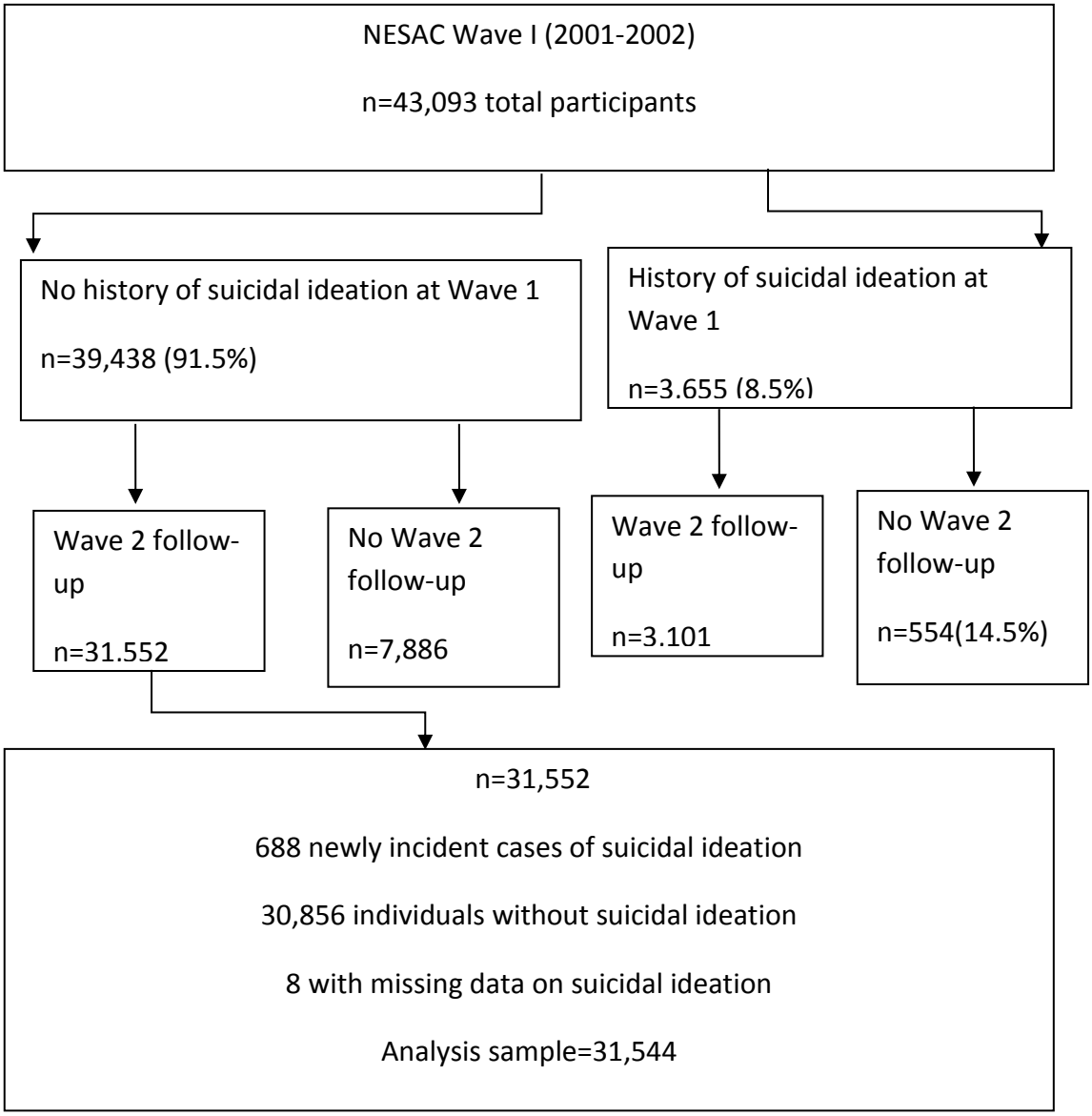

Figure 3.3 Flow chart identifying newly incident cases of suicidal behavior (suicidal ideation and attempts combined) with complete follow-up. Data from the US National Epidemiologic Survey on Alcohol and Alcohol Related Conditions (NESARC), Wave I 2001-2002 (n=43,093), Wave II 2004-2005 (n=34,653).

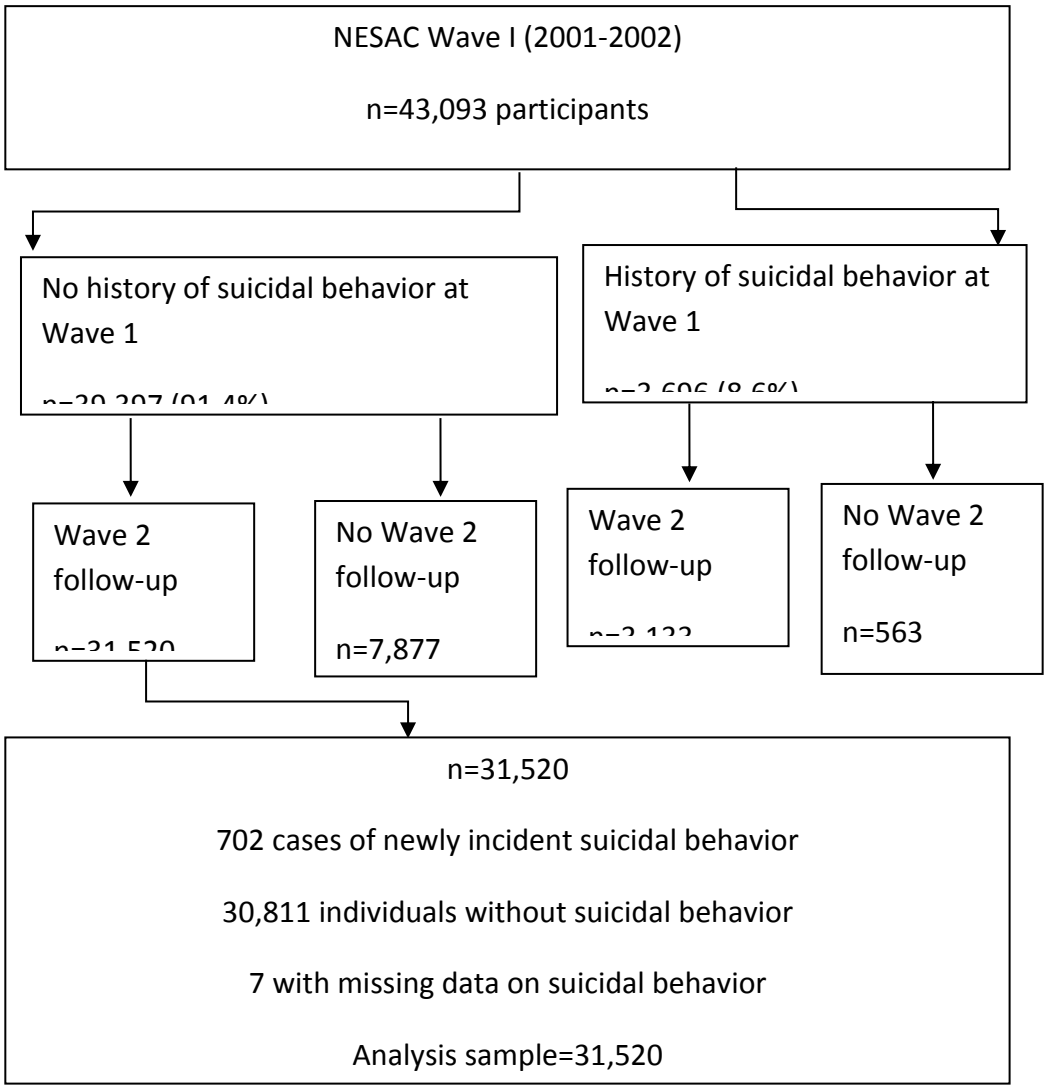

Table 3.1 Distribution of newly incident cases of suicide attempt by covariates of interest. Data from the US National Epidemiologic Survey on Alcohol and Alcohol Related Conditions (NESARC), Wave I 2001-2002 (n=43,093), Wave II 2004-2005 (n=33,687).

	All persons	Newly incident suicide attempt during follow-up	
	n	n	%*
All persons	33,678	143	0.4
Baseline cigarette smoking			
Current	7,469	59	0.7
Former	6,495	21	0.3
Never	19,457	62	0.3
Missing	257		
Baseline smokeless tobacco use[†]			
Current	854	6	0.9
Former	1,176	3	0.3
Never	31,406	133	0.4
Missing	242		
Baseline chewing tobacco use			
Current	396	2	0.9
Former	1,054	3	0.3
Never	31,980	137	0.4
Missing	248		
Baseline snuff use			
Current	588	4	0.8
Former	722	3	0.7
Never	32,122	135	0.4
Missing	246		
Lifetime Major Depression at baseline[§]			
Yes	5,772	51	0.9
No	27,906	92	0.3
Lifetime Alcohol Use Disorder at baseline[§]			
Yes	9,458	49	0.5
No	24,220	94	0.4
Sex			
Male	14,275	44	0.3
Female	19,403	99	0.5

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Table 3.1, (cont'd)

	All persons	Newly incident suicide attempt during follow-up	
	n	n	%*
Race/ethnicity			
Non-Hispanic White	19,590	69	0.3
Non-Hispanic Black	6,420	18	0.3
Non-Hispanic American Indian/Alaska Native	551	7	1.1
Non-Hispanic Asian/Native Hawaiian/Pacific Islander	941	6	0.5
Hispanic	6,176	43	0.8
Age (in years)			
18-24	3,802	32	0.8
25-34	6,055	31	0.6
35-44	7,294	45	0.5
45-64	10,589	30	0.2
65+	5,938	5	0.1
Education			
Less than high school	5,544	39	0.5
High school/GED	9,688	40	0.4
Some college	10,121	46	0.5
College or more	8,325	18	0.2

*Weighted percentage; † Chewing tobacco or snuff use; § Depression and alcohol use disorders were identified using a structured clinical interview. Alcohol Use Disorder included either DSM-IV alcohol dependence with or without abuse.

Table 3.2 Distribution of newly incident cases of suicidal ideation by covariates of interest. Data from the US National Epidemiologic Survey on Alcohol and Alcohol Related Conditions (NESARC), Wave I 2001-2002 (n=43,093), Wave II 2004-2005 (n=31,544).

	All persons n	Newly incident suicide attempt during follow-up n	%*
All persons	31,544	688	2.1
Baseline cigarette smoking			
Current	6,754	252	3.6
Former	6,083	106	2.0
Never	18,450	324	1.6
Missing	257	---	---
Baseline smokeless tobacco use[†]			
Current	802	22	3.0
Former	1,089	31	2.7
Never	29,411	629	2.1
Missing	242	---	---
Baseline chewing tobacco use			
Current	372	15	4.8
Former	985	25	2.1
Never	29,939	641	2.1
Missing	779	---	---
Baseline snuff use			
Current	554	15	2.8
Former	663	17	2.8
Never	30,081	650	2.1
Missing	246	---	---
Lifetime Major Depression at baseline[§]			
Yes	3,959	181	4.6
No	27,585	507	1.8
Lifetime Alcohol Use Disorder at baseline[§]			
Yes	8,445	245	2.8
No	23,099	443	1.9
Sex			
Male	13,526	268	1.9
Female	18,018	420	2.3

(Cont'd on next page)

Table 3.2, (cont'd)

	All persons n	Newly incident suicide attempt during follow-up n	%*
Race/ethnicity			
Non-Hispanic White	18,099	392	2.1
Non-Hispanic Black	6,137	118	2.0
Non-Hispanic American Indian/Alaska Native	484	19	3.8
Non-Hispanic Asian/Native Hawaiian/Pacific Islander	918	21	2.2
Hispanic	5,906	138	2.2
Age (in years)			
18-24	3,511	122	3.2
25-34	5,656	141	2.4
35-44	6,835	180	2.6
45-64	9,784	190	1.9
65+	5,758	55	1.0
Education			
Less than high school	5,263	140	2.6
High school/GED	9,154	202	2.3
Some college	9,377	222	2.4
College or more	7,750	124	1.4

*Weighted percentage; † Chewing tobacco or snuff use; § Depression and alcohol use disorders were identified using a structured clinical interview. Alcohol Use Disorder included either DSM-IV alcohol dependence with or without abuse .

Table 3.3 Distribution of newly incident cases of suicidal behavior (suicidal ideation and attempts combined by covariates of interest. Data from the US National Epidemiologic Survey on Alcohol and Alcohol Related Conditions (NESARC), Wave I 2001-2002 (n=43,093), Wave II 2004-2005 (n=34,513).

	All persons	Newly incident suicide attempt during follow-up	
	n	n	%*
All persons	31,513	702	2.2
Baseline cigarette smoking			
Current	6,740	254	3.7
Former	6,077	110	2.0
Never	18,446	332	1.7
Missing	257	---	---
Baseline smokeless tobacco use[†]			
Current	801	24	3.3
Former	1,085	30	2.6
Never	29,385	642	2.1
Missing	242	---	---
Baseline chewing tobacco use			
Current	371	16	5.4
Former	982	24	2.0
Never	29,912	655	2.1
Missing	248	---	---
Baseline snuff use			
Current	554	16	2.8
Former	661	17	3.0
Never	30,052	663	2.1
Missing	246	---	---
Lifetime Major Depression at baseline[§]			
Yes	3,931	520	4.7
No	27,582	182	1.8
Lifetime Alcohol Use Disorder at baseline[§]			
Yes	8,434	247	2.9
No	23,079	455	1.9
Sex			
Male	13,520	270	1.9
Female	17,993	432	2.4

(Cont'd on next page)

Table 3.3,(cont'd)

	All persons	Newly incident suicide attempt during follow-up	
Race/ethnicity		n	n
Non-Hispanic White	18,087	397	2.1
Non-Hispanic Black	6,132	119	2.1
Non-Hispanic American Indian/Alaska Native	482	20	4.3
Non-Hispanic asian/Native Hawaiian/Pacific Islander	914	22	2.2
Hispanic	5,898	144	2.3
Age (in years)			
18-24	3,509	124	3.2
25-34	5,650	145	2.5
35-44	6,830	182	2.6
45-64	9,770	195	1.9
65+	5,754	56	1.0
Education			
Less than high school	5,259	146	2.6
High school/GED	9,141	202	2.3
Some college	9,361	227	2.5
College or more	7,752	127	1.4

*Weighted percentage; † Chewing tobacco or snuff use; § Depression and alcohol use disorders were identified using a structured clinical interview. Alcohol Use Disorder included either DSM-IV alcohol dependence with or without abuse.

Table 3.4 Unadjusted and adjusted models for the associations between covariates of interest and newly incident suicide attempts. Data from the US National Epidemiologic Survey on Alcohol and Alcohol Related Conditions (NESARC), Wave I 2001-2002 (n=43,093), Wave II 2004-2005 (n=34,653).

	Unadjusted		Adjusted I	
	OR[95% CI]	*p*-value	OR[95% CI]	*p*-value
Baseline cigarette smoking				
Current	2.2[1.4,3.4]	0.770	2.0[1.3,3.1]	0.002
Former	0.9[0.5,1.8]	<0.001	1.6[0.8,3.2]	0.165
Never	1.0(ref)	---	1.0(ref)	---
Baseline smokeless tobacco use[†]				
Current	2.4[0.9,6.3]	0.071	2.7[0.9,8.6]	0.083
Former	0.7[0.2,2.3]	0.504	0.8[0.2, 3.1]	0.783
Never	1.0(ref)	---	1.0(ref)	---
Major depression prior to cigarette onset				
Yes	4.2[1.3,13.7]	0.020		
No	1.0(ref)	---	1.0(ref)	---
Major depression prior to SLT onset				
Yes	N/A			
No	1.0(ref)	---	1.0(ref)	---
Alcohol use disorder prior to cigarette onset				
Yes	2.1[0.5,8.5]	0.302		
No	1.0(ref)	---	1.0(ref)	---
Alcohol use disorder prior to SLT onset				
Yes	0.2[0.1,1.2]	0.071		
No	1.0(ref)	---	1.0(ref)	---
Sex				
Male	0.5[0.3,0.9]	0.010	0.4[0.2,0.7]	0.444
Female	1.0(ref)	---	1.0(ref)	---
Race/ethnicity				
Non-Hispanic White	1.0(ref)	---	1.0(ref)	---
Non-Hispanic Black	0.7[0.4,1.4]	0.373	0.7[0.3,1.3]	0.239
Non-Hispanic American Indian/Alaska Native	3.4[1.3,8.9]	0.011	2.7[1.1,6.7]	0.037
Non-Hispanic Asian/Native Hawaiian/Pacific Islander	1.5[0.5,4.8]	0.472	1.8[.6,5.6]	0.324
Hispanic	2.3[1.4,3.9]	0.002	1.9[1.0,3.4]	0.034
Age (in years)				
18-24	1.0(ref)	---	1.0(ref)	---
25-34	0.7[0.4,1.4]	0.312	0.8[0.4,1.5]	0.510
35-44	0.6[0.4,1.1]	0.099	0.7[0.4,1.2]	0.212
45-64	0.3[0.1,0.5]	<0.001	0.3[0.2,0.6]	0.001
65+	0.1[0.1,0.3]	<0.001	0.1[0.1,0.3]	<0.001

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Table 3.4, (cont'd)

	Unadjusted		Adjusted I	
	OR[95% CI]	*p*-value	OR[95% CI]	*p*-value
Education				
Less than high school	1.0(ref)	---	1.0(ref)	---
High school/GED	0.8[0.5,1.4]	0.436	0.8[0.5,1.5]	0.506
Some college	0.9[0.5,1.5]	0.647	0.8[0.4,1.5]	0.528
College or more	0.3[0.2,0.7]	0.005	0.4[0.2,0.8]	0.017

Table 3.5 Unadjusted and adjusted models for the associations between covariates of interest and newly incident suicide attempts. Data from the US National Epidemiologic Survey on Alcohol and Alcohol Related Conditions (NESARC), Wave I 2001-2002 (n=43,093), Wave II 2004-2005 (n=34,653).

	Adjusted II Cigarette		Adjusted II SLT	
	OR[95% CI]	*p*-value	OR[95% CI]	*p*-value
Baseline cigarette smoking				
Current	2.0[1.3,3.1]	0.003		
Former	1.6[0.8,3.2]	0.177		
Never	1.0(ref)	---	1.0(ref)	---
Baseline smokeless tobacco use[†]				
Current			3.2[1.0,10.0]	0.043
Former			1.1[0.2,4.5]	0.945
Never	1.0(ref)	---	1.0(ref)	---
Major depression prior to cigarette onset				
Yes	2.1[0.6,7.4]	0.235		
No	1.0(ref)	---	1.0(ref)	---
Major depression prior to SLT onset				
Yes			N/A	N/A
No	1.0(ref)	---	1.0(ref)	---
Alcohol use disorder prior to cigarette onset				
Yes	1.7[0.4,7.1]	0.463	0.1[0.1,1.0]	0.055
No	1.0(ref)	---	1.0(ref)	---
Alcohol use disorder prior to SLT onset				
Yes				
No	1.0(ref)	---	1.0(ref)	---
Sex				
Male	0.5[0.3,0.8]	0.002		
Female	1.0(ref)	---	1.0(ref)	---
Race/ethnicity				
Non-Hispanic White	1.0(ref)	---	1.0(ref)	---
Non-Hispanic Black	0.6[0.3,1.2]	0.176	0.6[0.3,1.2]	0.128
Non-Hispanic American Indian/Alaska Native	2.8[1.1,7.2]	0.036	2.8[1.1,6.8]	0.027
Non-Hispanic Asian/Native Hawaiian/Pacific Islander	1.7[0.5,5.3]	0.358	1.5[0.5,4.8]	0.460
Hispanic	1.8[1.0,3.2]	0.046	1.6[0.9,3.0]	0.129

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Table 3.5, (cont'd)

	Adjusted II Cigarette		Adjusted II SLT	
	OR[95% CI]	*p*-value	OR[95% CI]	*p*-value
Age (in years)				
18-24	1.0(ref)	---	1.0(ref)	---
25-34	0.8[0.4,1.5]	0.543	0.6[0.3,1.2]	0.128
35-44	0.7[0.4,1.2]	0.224	0.7[0.4,1.3]	0.289
45-64	0.3[0.2,0.6]	0.001	0.3[0.2,0.7]	0.002
65+	0.1[0.1,0.3]	<0.001	0.1[0.1,0.3]	<0.001
Education				
Less than high school	1.0(ref)	---	1.0(ref)	---
High school/GED	0.8[0.5,1.5]	0.517	0.8[0.4,1.4]	0.442
Some college	0.8[0.4,1.5]	0.516	0.8[0.4,1.4]0 .391	0.391
College or more	0.4[0.2,0.8]	0.013	0.3[0.2,0.7]	0.005

Table 3.6 Unadjusted and adjusted models for the associations between covariates of interest and newly incident suicidal ideation. Data from the US National Epidemiologic Survey on Alcohol and Alcohol Related Conditions (NESARC), Wave I 2001-2002 (n=43,093), Wave II 2004-2005 (n=34,653).

	Unadjusted		Adjusted I	
	OR[95% CI]	*p*-value	OR[95% CI]	*p*-value
Baseline cigarette smoking				
Current	2.3[1.9,2.8]	<0.001	2.1[1.7,2.6]	<0.001
Former	1.2[0.9,1.6]	0.154	1.6[1.2,2.1]	0.002
Never	1.0(ref)	---	1.0(ref)	---
Baseline smokeless tobacco use[†]				
Current	1.4[0.8,2.1]	0.150	1.3[0.8,2.1]	0.374
Former	1.3[0.8,2.1]	0.306	1.2[0.7,2.0]	0.513
Never	1.0(ref)	---	1.0(ref)	---
Major depression prior to cigarette onset				
Yes	1.5[0.6,3.8]	0.397		
No	1.0(ref)	---	1.0(ref)	---
Major depression prior to SLT onset				
Yes	5.5[1.0,29.3]	0.045		
No	1.0(ref)	---	1.0(ref)	---
Alcohol use disorder prior to cigarette onset				
Yes	1.8[0.8,4.3]	0.183		
No	1.0(ref)	---	1.0(ref)	---
Alcohol use disorder prior to SLT onset				
Yes	3.2[1.3,8.2]	0.011		
No	1.0(ref)	---	1.0(ref)	---
Sex				
Male	0.8[0.7,1.0]	0.026	0.7[0.6,0.9]	0.001
Female	1.0(ref)	---	1.0(ref)	---
Race/ethnicity				
Non-Hispanic White	1.0(ref)	---	1.0(ref)	---
Non-Hispanic Black	1.0[0.7,1.3]	0.901	0.9[0.7,1.2]	0.559
Non-Hispanic American Indian/Alaska Native	1.9[1.1,3.2]	0.021	1.6[0.9,2.7]	0.087
Non-Hispanic Asian/Native Hawaiian/Pacific Islander	1.1[0.6,1.9]	0.850	1.2[0.6,2.2]	0.581
Hispanic	1.1[0.8,1.4]	0.611	0.9[0.7,1.3]	0.695

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Table 3.6, (cont'd)

	Unadjusted		Adjusted I	
	OR[95% CI]	*p*-value	OR[95% CI]	*p*-value
Age (in years)				
18-24	1.0(ref)	---	1.0(ref)	---
25-34	0.7[0.5,1.0]	0.047	0.8[0.6,1.1]	0.142
35-44	0.8[0.6,1.0]	0.102	0.8[0.6,1.1]	0.164
45-64	0.6[0.4,0.8]	<0.001	0.6[0.4,0.8]	0.001
65+	0.3[0.2,0.4[	<0.001	0.3[0.2,0.4]	<0.001
Education				
Less than high school	1.0(ref)	---	1.0(ref)	---
High school/GED	0.9[0.7,1.2]	0.387	0.8[0.6,1.1]	0.164
Some college	0.9[0.7,1.2]	0.622	0.8[0.6,1.1]	0.220
College or more	0.5[0.4,0.7]	<0.001	0.6[0.4,0.8]	0.002

Table 3.7 Unadjusted and adjusted models for the associations between covariates of interest and newly incident suicidal ideation. Data from the US National Epidemiologic Survey on Alcohol and Alcohol Related Conditions (NESARC), Wave I 2001-2002 (n=43,093), Wave II 2004-2005 (n=34,653).

	Adjusted II Cigarette		Adjusted II SLT	
	OR[95% CI]	*p*-value	OR[95% CI]	*p*-value
Baseline cigarette smoking				
Current	2.1[1.7,2.6]	<0.001		
Former	1.5[1.2,2.1]	0.003		
Never	1.0(ref)	---	1.0(ref)	---
Baseline smokeless tobacco use[†]				
Current			1.1[0.7,1.9]	0.623
Former			1.1[0.7,1.9]	0.647
Never	1.0(ref)	---	1.0(ref)	---
Major depression prior to cigarette onset				
Yes	0.9[0.3,2.3]	0.792		
No	1.0(ref)	---	1.0(ref)	---
Major depression prior to SLT onset				
Yes			2.5[0.3,22.8]	0.423
No	1.0(ref)	---	1.0(ref)	---
Alcohol use disorder prior to cigarette onset				
Yes	1.4[0.6,3.3]	0.491	3.5[1.3,9.7]	0.013
No	1.0(ref)	---	1.0(ref)	---
Alcohol use disorder prior to SLT onset				
Yes				
No	1.0(ref)	---	1.0(ref)	---
Sex				
Male	0.7[0.6,0.9]	0.001	0.8[0.6,0.9]	0.006
Female	1.0(ref)	---	1.0(ref)	---
Race/ethnicity				
Non-Hispanic White	1.0(ref)	---	1.0(ref)	---
Non-Hispanic Black	0.9[0.7,1.2]	0.4910	0.8[0.6,1.1]	0.217
Non-Hispanic American Indian/Alaska Native	1.6[0.9,2.7]	0.085	1.6[1.0,2.8]	0.058
Non-Hispanic Asian/Native Hawaiian/Pacific Islander	1.2[0.6,2.2]	0.613	1.0[0.6,1.9]	0.909
Hispanic	0.9[0.7,1.3]	0.668	0.8[0.6,1.1]	0.169

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Table 3.7, (cont'd)

	Adjusted II Cigarette		Adjusted II SLT	
	OR[95% CI]	*p*-value	OR[95% CI]	*p*-value
Age (in years)				
18-24	1.0(ref)	---	1.0(ref)	---
25-34	0.8[0.6,1.1]	0.126	0.8[0.6,1.1]	0.217
35-44	0.8[0.6,1.1]	0.145	0.8[0.6,1.1]	0.216
45-64	0.6[0.4,0.8]	0.001	0.6[0.4,0.8]	0.001
65+	0.3[0.2,0.4]	<0.001	0.3[0.2,0.4]	<0.001
Education				
Less than high school	1.0(ref)	---	1.0(ref)	---
High school/GED	0.8[0.6,1.1]	0.178	0.8[0.6,1.0]	0.095
Some college	0.8[0.6,1.1]	0.220	0.8[0.6,1.0]	0.083
College or more	0.6[0.4,0.8]	0.001	0.5[0.3,0.7]	<0.001

Table 3.8 Unadjusted and adjusted models for the associations between covariates of interest and newly incident suicidal behavior. Data from the US National Epidemiologic Survey on Alcohol and Alcohol Related Conditions (NESARC), Wave I 2001-2002 (n=43,093), Wave II 2004-2005 (n=34,653).

	Unadjusted		Adjusted I	
	OR[95% CI]	*p*-value	OR[95% CI]	*p*-value
Baseline cigarette smoking				
Current	2.2[1.9,2.7]	<0.001	2.0[1.7,2.5]	<0.001
Former	1.2[0.9,1.6]	0.160	1.6[1.2,2.1]	0.002
Never	1.0(ref)	---	1.0(ref)	---
Baseline smokeless tobacco use[†]				
Current	1.6[1.0,2.5]	0.074	1.4[0.7,2.3]	0.194
Former	1.2[0.7,2.0]	0.452	1.1[0.7,1.9]	0.625
Never	1.0(ref)	---	1.0(ref)	---
Major depression prior to cigarette onset				
Yes	1.5[0.6,3.9]	0.373		
No	1.0(ref)	---	1.0(ref)	---
Major depression prior to SLT onset				
Yes	5.4[1.0,28.7]	0.048		
No	1.0(ref)	---	1.0(ref)	---
Alcohol use disorder prior to cigarette onset				
Yes	1.8[0.8,4.3]	0.177		
No	1.0(ref)	---	1.0(ref)	---
Alcohol use disorder prior to SLT onset				
Yes	3.3[1.3,8.0]	0.010		
No	1.0(ref)	---	1.0(ref)	---
Sex				
Male	0.8[0.7,0.9]	0.011	0.7[0.6,0.9]	0.001
Female	1.0(ref)	---	1.0(ref)	---
Race/ethnicity				
Non-Hispanic White	1.0(ref)	---	1.0(ref)	---
Non-Hispanic Black	1.0[0.7,1.3]	0.868	0.9[0.7,1.2]	0.535
Non-Hispanic American Indian/Alaska Native	2.1[1.2,3.5]	0.007	1.8[1.0,3.0]	0.035
Non-Hispanic Asian/Native Hawaiian/Pacific Islander	1.1[0.6,1.9]	0.847	1.2[0.6,2.2]	0.585
Hispanic	1.1[0.9,1.4]	0.421	1.0[0.7,1.3]	0.895

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Table 3.8, (cont'd)

	Unadjusted		Adjusted I	
	OR[95% CI]	*p*-value	OR[95% CI]	*p*-value
Age (in years)				
18-24	1.0(ref)	---	1.0(ref)	---
25-34	0.7[0.5,1.0]	0.077	0.8[0.6,1.1]	0.214
35-44	0.8[0.6,1.1]	0.115	0.8[0.6,1.1]	0.190
45-64	0.6[0.4,0.8]	<0.001	0.6[0.4,0.8]	0.002
65+	0.3[0.2,0.4]	<0.001	0.3[0.2,0.4]	<0.001
Education				
Less than high school	1.0(ref)	---	1.0(ref)	---
High school/GED	0.9[0.7,1.1]	0.286	0.8[0.6,1.1]	0.119
Some college	0.9[0.7,1.2]	0.634	0.8[0.6,1.1]	0.226
College or more	0.5[0.4,0.7]	<0.001	0.6[0.4,0.8]	0.001

Table 3.9 Unadjusted and adjusted models for the associations between covariates of interest and newly incident suicidal behavior. Data from the US National Epidemiologic Survey on Alcohol and Alcohol Related Conditions (NESARC), Wave I 2001-2002 (n=43,093), Wave II 2004-2005 (n=34,653).

	Adjusted II Cigarette		Adjusted II SLT	
	OR[95% CI]	*p*-value	OR[95% CI]	*p*-value
Baseline cigarette smoking				
Current	2.0[1.7,2.5]	<0.001		
Former	1.6[1.2,2.1]	0.003		
Never	1.0(ref)	---		
Baseline smokeless tobacco use[†]				
Current			1.3[0.7,2.1]	0.380
Former			1.1[0.7,1.8]	0.767
Never	1.0(ref)	---	1.0(ref)	---
Major depression prior to cigarette onset				
Yes	0.9[0.3,2.3]	0.813		
No	1.0(ref)	---	1.0(ref)	---
Major depression prior to SLT onset				
Yes	1.4[0.6,3.3]	0.467	2.4[0.2,23.5]	0.455
No	1.0(ref)	---	1.0(ref)	---
Alcohol use disorder prior to cigarette onset				
Yes				
No	1.0(ref)	---	1.0(ref)	---
Alcohol use disorder prior to SLT onset				
Yes			3.6[1.3,9.6]	0.013
No	1.0(ref)	---	1.0(ref)	---
Sex				
Male	0.7[0.6,0.9]	0.001	0.7[0.6,0.9]	0.003
Female	1.0(ref)	---	1.0(ref)	---
Race/ethnicity				
Non-Hispanic White	1.0(ref)	---	1.0(ref)	---
Non-Hispanic Black	0.9[0.7,1.2]	0.459	0.8[0.6,1.1]	0.212
Non-Hispanic American Indian/Alaska Native	1.8[1.0,3.0]	0.034	1.8[1.1,3.0]	0.022
Non-Hispanic Asian/Native Hawaiian/Pacific Islander	1.2[0.6,2.2]	0.623	0.6[0.5,0.8]	0.908
Hispanic	1.0[0.7,1.3]	0.847	0.8[0.6,1.1]	0.268

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Table 3.9, (cont'd)

	Adjusted II Cigarette		Adjusted II SLT	
	OR[95% CI]	*p*-value	OR[95% CI]	*p*-value
Age (in years)				
18-24	1.0(ref)	---	1.0(ref)	---
25-34	0.8[0.6,1.1]	0.188	0.8[0.6,1.1]	0.233
35-44	0.8[0.6,1.1]	0.160	0.9[0.6,1.1]	0.249
45-64	0.6[0.4,0.8]	0.001	0.6[0.5,0.8]	0.002
65+	0.3[0.2,0.4]	<0.001	0.3[0.2,0.4]	<0.001
Education				
Less than high school	1.0(ref)	---	1.0(ref)	---
High school/GED	0.8[0.6,1.1]	0.130	0.8[0.6,1.0]	0.068
Some college	0.8[0.6,1.1]	0.226	0.8[0.6,1.0]	0.087
College or more	0.6[0.1,0.8]	0.001	0.5[0.3,0.7]	<0.001

Table 3.10 Models for the associations between covariates of interest and occurrence of suicidal behavior. Data from the US National Epidemiologic Survey on Alcohol and Alcohol Related Conditions (NESARC), Wave I 2001-2002 (n=43,093), Wave II 2004-2005 (n=34,653).

	Suicide attempt		Suicidal ideation		Either suicidal behavior	
First occurrence	OR[95% CI]	*p*-value	OR[95% CI]	*p*-value	OR[95% CI]	*p*-value
Baseline cigarette smoking						
Current	2.3[2.0,2.7]	<0.001	1.8[1.1,2.9]	0.023	2.2[1.8,2.7]	<0.001
Former	1.2[1.0,1.5]	0.106	0.8[0.4,1.8]	0.620	1.2[0.9,1.6]	0.178
Never	1.0(ref)	---	1.0(ref)	---	1.0(ref)	---
Baseline smokeless tobacco use[†]						
Current	1.1[0.7,1.7]	0.550	2.9[1.1,7.5]	0.034	1.4[0.8,2.2]	0.209
Former	1.1[0.7,1.3]	0.449	0.8[0.2,2.8]	0.700	1.0[0.8,2.2]	0.990
Never	1.0(ref)	---	1.0(ref)	---	1.0(ref)	---
First occurrence or reoccurrence						
Baseline cigarette smoking						
Current	2.9[2.1,4.2]	<0.001	2.5[2.2,2.9]	<0.001	2.5[2.2,2.9]	<0.001
Former	0.8[0.5,1.4]	0.456	1.1[0.9,1.3]	0.283	1.1[0.9,1.3]	0.313
Never	1.0(ref)	---	1.0(ref)	---	1.0(ref)	---
Baseline smokeless tobacco use[†]						
Current	1.4[0.6,3.2]	0.487	1.1[0.7,1.6]	0.796	1.1[0.7,1.7]	0.608
Former	0.7[0.3,1.8]	0.430	0.8[0.5,1.2]	0.309	0.8[0.6,1.2]	0.391
Never	1.0(ref)	---	1.0(ref)	---	1.0(ref)	---

*Estimates for cigarette smoking and smokeless tobacco are evaluated from the same model

Table 4.1 Suicidal behaviors among current, former and never tobacco users. Data from the US National Survey on Drug Use and Health (NSDUH), 2008-2010 (n=114,048).

	All persons	Ideation		Plan		Attempt	
	n	n	%[†]	n	%[†]	n	%[†]
All persons	114,048	6,197	3.8	1,858	1.1	1,005	0.5
Cigarette Smokers							
Never	37,186	1,445	2.5	392	0.1	193	0.3
Current	43,070	3,360	6.3	1,094	1.9	665	1.0
Former (quit 1-3 years)	6,553	335	4.5	92	1.2	46	0.4
Former (quit >3 years)	27,239	1,057	2.8	280	0.7	101	0.3
Smokeless Tobacco Users[§]							
Never	89,789	4,713	0.4	1,416	1.0	762	0.4
Current	8,444	560	0.5	173	1.6	109	0.8
Former (quit 1-3 years)	3,227	194	0.5	59	1.3	38	1.0
Former (quit >3 years)	12,588	730	0.5	210	1.2	96	0.5
Chewing Tobacco Users							
Never	97,888	5,213	3.6	1,563	1.0	839	0.5
Current	3,934	295	7.0	92	2.1	64	1.2
Former (quit 1-3 years)	2,390	152	4.8	50	1.2	28	0.6
Former (quit >3 years)	9,836	537	4.2	153	1.0	74	0.5
Snuff Users							
Never	94,358	4,956	3.7	1,494	1.0	799	0.4
Current	7,268	481	5.3	145	1.7	89	0.9
Former (quit 1-3 years)	2,674	173	5.5	49	1.4	31	1.1
Former (quit >3 years)	9,748	587	4.9	170	1.3	86	0.6

*75,964 persons at least of 18 years of age were surveyed. 250 were missing for recency of cigarette use; 210 were missing for recency of smokeless tobacco use; 107 were missing for recency of chewing tobacco use; 156 were missing for recency of snuff use; 274 were missing for suicidal ideation; 2 were missing for suicidal plan; 4 were missing for suicide attempt.

[†]Row percentages

[§]Chewing tobacco use and/or snuff use

Table 4.2 Characteristics of the sample by lifetime tobacco use.

	Total sample	Cigarette		Smokeless		Chewing		Snuff	
	n	n	%*	n	%*	n	%*	n	%*
All persons	114,048	76,862	69.3	24,259	19.1	16,160	13.9	19,690	14.2
Sex									
Male	53,097	38,073	74.8	19,634	33.4	13,924	26.0	16,102	25.3
Female	60,951	38,789	64.2	4,625	5.3	2,236	2.6	3,588	3.9
Race									
Non-Hispanic white	72,819	53,372	75.5	19,791	23.5	13,259	17.3	16,245	17.7
Non-Hispanic black	13,974	7,500	58.3	976	9.2	611	6.3	687	6.0
Non-Hispanic American Indian/Alaskan native	1,677	1,332	73.3	681	37.1	494	28.4	567	27.8
Non-Hispanic Pacific Islander	532	333	53.1	94	15.4	53	7.7	74	11.7
Non-Hispanic Asian	4,322	1,884	38.8	281	5.6	173	3.8	203	3.4
Non-Hispanic multiracial	3,061	2,292	77.2	747	24.4	519	18.5	599	17.9
Hispanic	17,663	10,149	57.4	1,689	9.1	1,051	6.2	1,315	6.6
Age									
18-25	56,546	35,976	63.2	12,032	79.3	7,259	12.3	10,251	17.8
26-34	17,009	12,114	71.2	4,048	76.8	2,635	15.1	3,371	19.3
≥35	40,493	28,772	70.2	8,179	82.2	6,266	14.0	6,068	12.3
Family income									
<$20k	28,593	18,525	65.3	5,179	15.5	3,263	10.7	4,231	11.5
$20k-$49k	39,365	26,734	68.5	8,059	17.7	5,405	12.9	6,473	12.9
$50k-$74k	18,725	12,846	71.1	4,309	20.5	2,945	15.1	3,494	15.3
≥$75k	27,365	18,757	71.4	6,712	21.9	4,547	16.2	5,492	16.5
Pop. Density									
MSA>1million	47,732	30,830	67.6	7,386	15.2	4,609	10.7	5,953	11.1
MSA<1million	57,211	39,394	70.9	13,935	22.5	9,414	16.6	11,314	16.9
Non-MSA	9,105	6,638	73.3	2,938	29.0	2,137	22.4	2,423	22.0
Depression: interview									
Yes	16,292	12,551	79.6	3,531	20.6	2,309	14.5	2,898	15.9
No	97,276	64,029	67.8	20,652	18.9	13,800	13.9	16,735	14.0

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Table 4.2, (cont'd)									
	Total sample	Cigarette		Smokeless		Chewing		Snuff	
	n	n	%*	n	%*	n	%*	n	%*
Depression: self-report									
Yes	14,182	2,848	80.1	3,086	19.0	1,959	13.3	2,473	14.0
No	40,934	12,672	70.6	8,688	19.3	6,007	14.7	6,882	13.6
Alcohol use disorder									
Yes	13,332	11,790	88.4	5,403	37.4	3,651	27.2	4,631	30.8
No	100,716	65,072	67.8	18,856	17.6	12,509	12.8	15,059	12.9
*Row percentages									

Table 4.3 Tobacco use characteristics of the sample

Cigarette Smokers	Total sample (n)	Never used smokeless (n)	Never used chew (n)	Never used snuff (n)
Never	37,186	35,134	35,965	35,635
Current	43,070	29,243	22,567	31,564
Former (quit 1-3 years)	6,553	4,681	5,308	4,975
Former (quit >3 years)	27,239	20,731	34,048	22,184
Smokeless Tobacco Users	Total sample (n)	Never smoked cigarette (n)	Never used chew (n)	Never used snuff (n)
Never	89,789	35,134	89,789	89,789
Current	8,444	831	2,542	810
Former (quit 1-3 years)	3,227	248	1,282	535
Former (quit >3 years)	12,588	973	4,275	3,224

*Among the 50,898 cigarette smokers, there were 36,311 who have never used smokeless tobacco (cigarette only users).

† Among the 15,958 smokeless tobacco users, there were 1,371 who had never smoked a cigarette (smokeless only users).

Table 4.4 Crude and covariate adjustment logistic regressions predicting past year suicidal related outcomes by recency of tobacco use. Data from the US National Survey on Drug Use and Health (NSDUH), 2008-2010 (n=114,048).

Cigarette smoking estimates

	Past year suicidal ideation[¶]				Past year suicide plan**				Past year suicide attempt[††]			
	uOR*	*p*	aOR[†]	*p*	uOR*	*p*	aOR[†]	*p*	uOR*	*p*	aOR[†]	*p*
Current	2.6[2.4,3.0]	<0.001	2.3[2.1,2.6]	<0.001	2.8[2.2,3.6]	<0.001	2.5[1.9,3.2]	<0.001	3.2[2.3,4.4]	<0.001	2.8[2.0,4.0]	0.001
Former (quit 1-3 years)	1.7[1.3,2.2]	<0.001	1.5[1.2,1.9]	0.002	1.8[1.3,2.6]	0.001	1.7[1.2,2.4]	0.005	1.5[0.9,2.3]	0.105	1.3[0.8,2.1]	0.248
Former (quit >3 years)	1.1[1.0,1.3]	0.069	1.2[1.1,1.4]	0.002	1.1[0.8,1.5]	0.537	1.3[0.9,1.7]	0.147	0.8[0.6,1.2]	0.308	1.1[0.7,1.7]	0.567
Never	1.0	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

Smokeless tobacco[§] estimates

	Past year suicidal ideation[¶]				Past year suicide plan**				Past year suicide attempt[††]			
	uOR*	*p*	aOR[†]	*p*	uOR*	*p*	aOR[†]	*p*	uOR*	*p*	aOR[†]	*p*
Current	1.6[1.4,1.8]	<0.001	1.2[1.0,1.4]	0.071	1.6[1.2,2.1]	0.001	1.2[0.8,1.6]	0.357	1.9[1.4,2.6]	<0.001	1.3[0.9,1.9]	0.153
Former (quit 1-3 years)	1.5[1.2,1.9]	<0.001	0.9[0.7,1.2]	0.470	1.4[0.9,2.2]	0.151	0.8[0.5,1.3]	0.367	2.3[1.4,3.7]	0.001	1.2[0.7,2.0]	0.423
Former (quit >3 years)	1.3[1.2,1.5]	<0.001	1.2[1.1,1.5]	<0.001	1.2[1.0,1.5]	0.109	1.2[0.9,1.6]	0.162	1.2[0.8,1.6]	0.365	1.4[0.9,1.9]	0.101
Never	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

Chewing tobacco estimates

	Past year suicidal ideation[¶]				Past year suicide plan**				Past year suicide attempt[††]			
	uOR*	*p*	aOR[†]	*p*	uOR*	*p*	aOR[†]	*p*	uOR*	*p*	aOR[†]	*p*
Current	2.0[1.6,2.5]	<0.001	1.6[1.2,2.1]	0.003	2.1[1.4,3.1]	0.001	1.4[0.8,2.2]	0.200	2.6[1.8,4.0]	<0.001	1.6[0.9,2.8]	0.089
Former (quit 1-3 years)	1.3[1.0,1.7]	0.041	1.0[0.7,1.4]	0.908	1.1[0.7,1.8]	0.578	0.8[0.5,1.2]	0.260	1.3[0.8,2.2]	0.313	0.7[0.4,1.5]	0.354
Former (quit >3 years)	1.2[1.0,1.3]	0.039	1.2[1.0,1.4]	0.137	1.0[0.8,1.3]	0.831	0.9[0.6,1.3]	0.574	1.2[0.8,1.7]	0.447	1.3[0.7,2.4]	0.475
Never	1.0	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

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Table 4.4, (cont'd)

Snuff estimates

	Past year suicidal ideation[¶]				Past year suicide plan**				Past year suicide attempt[††]			
	uOR*	*p*	aOR[†]	*p*	uOR*	*p*	aOR[†]	*p*	uOR*	*p*	aOR[†]	*p*
Current	1.5[1.3,1.8]	<0.001	1.1[0.9,1.4]	0.399	1.7[1.2,2.2]	0.001	1.3[0.9,1.9]	0.150	2.0[1.5,2.9]	<0.001	1.5[1.0,2.3]	0.065
Former (quit 1-3 years)	1.6[1.2,2.1]	0.003	1.1[0.8,1.6]	0.547	1.4[0.8,2.4]	0.198	1.1[0.6,2.1]	0.779	2.5[1.4,4.4]	0.003	1.8[0.9,3.4]	0.092
Former (quit >3 years)	1.4[1.2,1.6]	<0.001	1.4[1.2,1.7]	<0.001	1.3[1.0, 1.7]	0.030	1.5[1.1,2.2]	0.018	1.4[0.9,2.2]	0.091	1.6[0.9,3.0]	0.106
Never	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

* Unadjusted odds ratio with 95% confidence interval; [†] Adjusted odds ratio with 95% confidence interval. Adjustments for sex, race (non-Hispanic White vs. other), age(18-25, 26-35 and 35+), income(<$20k, $20k-$49k, $50k-$74k and ≥$75k) and population density(MSA>1 million, MSA<1 million, non-MSA). Cigarette and smokeless tobacco estimates are from the same model; [§] Smokeless tobacco users had either used chewing tobacco, snuff or both; [¶] Asked to all adults, "During the past 12 months, did you seriously think about trying to kill yourself?"; ** Asked to all adults with ideation, "During the past 12 months, did you make any plans to kill yourself?"; [††] Asked to all adults with planning, "During the past 12 months, did you try to kill yourself?";

Table 4.5. Logistic regressions predicting past year suicidal related outcomes by recency of tobacco use stratified by history of major depression[†]. Data from the US National Survey on Drug Use and Health (NSDUH), 2008-2010 (n=114,048).

Cigarette smoking estimates

	Past year suicidal ideation[¶]				Past year suicide plan**				Past year suicide attempt[††]			
	With depression		Without depression		With depression		Without depression		With depression		Without depression	
	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*
Current	1.7[1.4,2.1]	<0.001	2.1[1.8,2.5]	<0.001	1.5[1.1,2.2]	0.016	2.4[1.8,3.3]	<0.001	1.7[1.1,2.6]	0.022	3.0[1.9,4.8]	0.001
Former (quit 1-3 years)	1.0[0.7,1.5]	0.852	1.9[1.3,2.6]	0.001	1.2[0.7,2.1]	0.563	1.9[1.2,3.2]	0.010	0.8[0.4,1.7]	0.490	1.9[1.1,3.3]	0.022
Former (quit >3 years)	0.7[0.6,0.9]	0.008	1.1[1.0,1.3]	0.159	0.6[0.4,1.0]	0.029	1.4[1.0,2.0]	0.079	0.4[0.2,0.7]	0.004	1.2[0.7,2.1]	0.480
Never	1.0	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

Smokeless tobacco[§] estimates

	Past year suicidal ideation[¶]				Past year suicide plan**				Past year suicide attempt[††]			
	With depression		Without depression		With depression		Without depression		With depression		Without depression	
	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*
Current	1.6[1.2,2.1]	<0.001	1.7[1.4,2.1]	<0.001	1.6[1.1,2.4]	0.013	1.9[1.2,3.0]	0.005	1.7[1.1,2.8]	0.018	2.5[1.5,4.2]	0.001
Former (quit 1-3 years)	1.6[1.1,2.3]	0.020	1.4[1.1,2.0]	0.028	1.2[0.7,2.1]	0.479	1.5[0.8,2.7]	0.162	1.8[0.9,3.8]	0.105	3.1[1.5,6.5]	0.004
Former (quit >3 years)	1.1[0.9,1.3]	0.487	1.4[1.2,1.7]	<0.001	1.1[0.8,1.4]	0.723	1.3[0.8,2.2]	0.250	1.0[0.7,1.4]	0.829	1.4[0.8,2.7]	0.249
Never	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

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Table 4.5, (cont'd)

Chewing tobacco estimates

	Past year suicidal ideation[¶]				Past year suicide plan**				Past year suicide attempt[††]			
	With depression		Without depression		With depression		Without depression		With depression		Without depression	
	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*
Current	2.1[1.5,2.9]	<0.001	2.6[2.0,3.5]	<0.001	2.0[1.1,3.6]	0.030	3.1[1.8,5.3]	<0.001	1.8[1.1,3.0]	0.019	4.4[2.4,8.1]	0.001
Former (quit 1-3 years)	1.2[0.8,1.7]	0.462	1.5[1.0,2.3]	0.049	1.0[0.6,1.6]	0.935	1.2[0.6,2.4]	0.614	0.9[0.4,1.9]	0.804	2.0[1.0,4.1]	0.058
Former (quit >3 years)	1.0[0.8,1.2]	0.804	1.3[1.1,1.7]	0.008	0.8[0.6,1.2]	0.296	1.2[0.7,1.9]	0.544	1.1[0.7,1.8]	0.534	1.2[0.6,2.4]	0.681
Never	1.0	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

Snuff estimates

	Past year suicidal ideation[¶]				Past year suicide plan**				Past year suicide attempt[††]			
	With depression		Without depression		With depression		Without depression		With depression		Without depression	
	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*
Current	1.6[1.2,2.1]	0.001	1.6[1.3,2.0]	<0.001	1.7[1.1,2.5]	0.021	1.9[1.2,2.9]	0.005	1.8[1.1,3.0]	0.018	2.7[1.6,4.5]	0.001
Former (quit 1-3 years)	1.6[1.1,2.5]	0.026	1.4[0.9,2.1]	0.123	1.1[0.6,2.2]	0.669	1.6[0.8,2.9]	0.162	2.0[0.9,4.5]	0.110	3.2[1.4,7.5]	0.007
Former (quit >3 years)	1.1[0.9,1.4]	0.256	1.5[1.2,1.9]	0.001	1.1[0.8,1.4]	0.556	1.5[0.8,2.7]	0.170	1.1[0.8,1.6]	0.464	1.7[0.7,4.3]	0.216
Never	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

* Unadjusted odds ratio with 95% confidence interval [†] Depression was assessed by the NSDUH's structured interview module;[§] Smokeless tobacco users had either used chewing tobacco, snuff or both; [¶] Asked to all adults "During the past 12 months, did you seriously think about trying to kill yourself?"; **Asked to all adults with ideation, "During the past 12 months, did you make any plans to kill yourself?"; [††] Asked to all adults with planning, "During the past 12 months, did you try to kill yourself?";

Table 4.6. Logistic regressions predicting past year suicidal related outcomes by recency of tobacco use stratified by history of major depression[†]. Data from the US National Survey on Drug Use and Health (NSDUH), 2008-2010 (n=114,048).

Cigarette smoking estimates

	Past year suicidal ideation[¶]				Past year suicide plan**				Past year suicide attempt[††]			
	With depression		Without depression		With depression		Without depression		With depression		Without depression	
	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*
Current	1.7[1.4,2.1]	<0.001	2.4[1.9,2.9]	<0.001	1.4[1.0,2.1]	0.076	3.7[2.4,5.8]	<0.001	1.8[1.1,3.0]	0.017	2.6[1.6,4.3]	0.001
Former (quit 1-3 years)	1.3[0.9,1.8]	0.200	1.7[1.2,2.5]	0.008	1.0[0.5,1.8]	0.958	3.1[1.6,6.0]	0.001	0.8[0.4,1.9]	0.652	1.3[0.4,4.0]	0.701
Former (quit >3 years)	0.9[0.7,1.1]	0.295	0.9[0.8,1.2]	0.580	0.7[0.4,1.0]	0.067	1.4[0.9,2.3]	0.105	0.5[0.3,1.0]	0.044	0.8[0.4,1.6]	0.541
Never	1.0	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

Smokeless tobacco[§] estimates

	Past year suicidal ideation[¶]				Past year suicide plan**				Past year suicide attempt[††]			
	With depression		Without depression		With depression		Without depression		With depression		Without depression	
	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*
Current	1.7[1.3,2.3]	0.001	1.7[1.3,2.3]	<0.001	1.4[0.9,2.4]	0.150	2.5[1.6,4.1]	<0.001	2.2[1.3,3.8]	0.005	2.1[1.0,4.4]	0.057
Former (quit 1-3 years)	1.4[0.9,2.2]	0.104	2.0[1.4,2.8]	0.001	1.1[0.7,1.9]	0.694	2.3[0.8,6.7]	0.141	1.8[0.7,4.4]	0.213	4.0[1.7,9.5]	0.002
Former (quit >3 years)	1.2[1.0,1.4]	0.044	1.2[1.0,1.5]	0.094	1.1[0.8,1.5]	0.436	1.4[0.153]	0.153	1.1[0.7,1.7]	0.793	1.5[0.7,3.0]	0.306
Never	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

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Table 4.6, (cont'd)

Chewing tobacco estimates

	Past year suicidal ideation[¶]				Past year suicide plan**				Past year suicide attempt[††]			
	With depression		Without depression		With depression		Without depression		With depression		Without depression	
	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*
Current	2.3[1.4,3.8]	0.002	2.8[1.9,4.1]	<0.001	1.5[0.7,3.0]	0.257	4.6[2.4,8.5]	<0.001	2.8[1.2,6.5]	0.518	4.2[1.8,9.8]	0.001
Former (quit 1-3 years)	1.1[0.7,1.9]	0.644	1.6[0.9,2.8]	0.083	0.9[0.5,1.6]	0.629	1.0[0.4,2.2]	0.993	1.3[0.6,2.6]	0.506	2.6[1.1,6.4]	0.032
Former (quit >3 years)	1.2[1.0,1.5]	0.067	1.1[0.8,1.4]	0.552	1.0[0.7,1.4]	0.945	0.9[0.5,1.7]	0.763	1.2[0.7,2.0]	0.020	1.0[0.4,2.5]	0.954
Never	1.0	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

Snuff estimates

	Past year suicidal ideation[¶]				Past year suicide plan**				Past year suicide attempt[††]			
	With depression		Without depression		With depression		Without depression		With depression		Without depression	
	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*
Current	1.7[1.3,2.3]	0.001	1.7[1.3,2.3]	0.001	1.6[1.0,2.8]	0.061	2.3[1.4,3.7]	0.001	2.3[1.3,4.1]	0.006	2.3[1.1,5.1]	0.034
Former (quit 1-3 years)	1.5[1.0,2.4]	0.071	2.0[1.1,3.6]	0.026	1.3[0.7,2.4]	0.407	2.5[0.7,8.6]	0.134	2.0[0.7,5.9]	0.205	4.0[1.4,10]	0.010
Former (quit >3 years)	1.3[1.0,1.5]	0.024	1.5[1.1,1.9]	0.005	1.1[0.8,1.5]	0.398	1.8[1.0,3.3]	0.054	1.2[0.8,2.0]	0.331	1.8[0.6,5.4]	0.278
Never	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

* Unadjusted odds ratio with 95% confidence interval; [†] Depression was assessed by asking participants "has a doctor, nurse or other health professional ever told you that you have major depression?"; [§] Smokeless tobacco users had either used chewing tobacco, snuff or both; [¶] Asked to all adults, "During the past 12 months, did you seriously think about trying to kill yourself?";**Asked to all adults with ideation, "During the past 12 months, did you make any plans to kill yourself?";[††]Asked to all adults with planning, "During the past 12 months, did you try to kill yourself?";

Table 4.7. Logistic regressions predicting past year suicidal related outcomes by recency of tobacco use stratified by past year alcohol use disorders[†]. Data from the US National Survey on Drug Use and Health (NSDUH), 2008-2010 (n=114,048).

Cigarette smoking estimates

	Past year suicidal ideation[¶]				Past year suicide plan**				Past year suicide attempt[††]			
	With AUD		Without AUD		With AUD		Without AUD		With AUD		Without AUD	
	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*
Current	1.7[1.3,2.3]	0.001	2.3[2.0,2.6]	<0.001	1.4[0.8,2.5]	0.279	2.5[1.9,3.2]	<0.001	2.8[1.2,6.2]	0.015	2.5[1.7,3.5]	0.001
Former (quit 1-3 years)	1.1[0.7,1.8]	0.619	1.6[1.2,2.0]	0.001	1.2[0.5,3.0]	0.654	1.6[1.0,2.4]	0.041	1.4[0.5,4.2]	0.561	1.2[0.8,2.0]	0.402
Former (quit >3 years)	0.9[0.6,1.3]	0.503	1.1[1.0,1,3]	0.135	0.6[0.3,1.4]	0.270	1.1[0.8,1.5]	0.476	1.0[0.4,2.9]	0.926	0.8[0.5,1.2]	0.207
Never	1.0	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

Smokeless tobacco[§] estimates

	Past year suicidal ideation[¶]				Past year suicide plan**				Past year suicide attempt[††]			
	With AUD		Without AUD		With AUD		Without AUD		With AUD		Without AUD	
	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*
Current	1.1[0.9,1.4]	0.181	1.2[0.9,1.4]	0.147	1.2[0.8,1.8]	0.273	1.1[0.8,1.6]	0.578	1.3[0.8,2.1]	0.235	1.2[0.8,1.9]	0.358
Former (quit 1-3 years)	1.0[0.6,1.5]	0.876	1.2[0.9,1.6]	0.251	1.0[0.5,2.1]	0.954	0.9[0.6,1.5]	0.774	1.0[0.5,2.2]	0.954	2.1[1.0,4.1]	0.037
Former (quit >3 years)	0.9[0.7,1.1]	0.299	1.3[1.1,1.5]	<0.001	0.9[0.5,1.4]	0.570	1.2[0.8,1.6]	0.328	0.9[0.5,1.3]	0.492	1.1[0.7,1.7]	0.705
Never	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

(Cont'd on next page)

Table 4.7, (cont'd)

Chewing tobacco estimates

	Past year suicidal ideation¶				Past year suicide plan**				Past year suicide attempt††			
	With AUD		Without AUD		With AUD		Without AUD		With AUD		Without AUD	
	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*
Current	1.4[1.1,1.9]	0.020	1.5[1.1,2.0]	0.016	1.8[1.0,3.3]	0.059	1.2[0.7,1.9]	0.555	1.6[0.8,3.2]	0.160	1.9[1.0,3.7]	0.043
Former (quit 1-3 years)	0.7[0.5,1.1]	0.137	1.2[0.8,1.7]	0.406	0.8[0.4,1.4]	0.406	0.8[0.4,1.4]	0.419	0.7[0.4,1.5]	0.358	1.0[0.5,2.3]	0.937
Former (quit >3 years)	0.7[0.6,1.0]	0.034	1.2[1.0,1.4]	0.065	0.9[0.5,1.5]	0.666	0.9[0.6,1.2]	0.326	1.2[0.7,1.9]	0.468	0.9[0.5,1.6]	0.687
Never	1.0	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

Snuff estimates

	Past year suicidal ideation¶				Past year suicide plan**				Past year suicide attempt††			
	With AUD		Without AUD		With AUD		Without AUD		With AUD		Without AUD	
	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*	OR*	*p*
Current	1.1[0.9,1.4]	0.231	1.1[0.9,1.4]	0.423	1.2[0.8,1.9]	0.363	1.2[0.8,1.8]	0.443	1.5[0.9,2.5]	0.162	1.3[0.8,2.1]	0.363
Former (quit 1-3 years)	1.1[0.7,1.6]	0.799	1.2[0.8,1.8]	0.376	1.0[0.4,2.4]	0.935	0.9[0.5,1.7]	0.763	1.3[0.6,2.9]	0.536	2.0[0.9,4.8]	0.099
Former (quit >3 years)	1.0[0.8,1.3]	0.898	1.3[1.1,1.5]	0.001	1.0[0.6,1.6]	0.967	1.2[0.9,1.8]	0.244	1.0[0.6,1.7]	0.883	1.3[0.7,2.4]	0.372
Never	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-	1.0 (Ref)	-

* Unadjusted odds ratio with 95% confidence interval; † Alcohol use disorders were either DSM-IV alcohol abuse or alcohol dependence. Both were assessed using a structured interview asked to all individuals who had drank alcohol in the year prior to assessment; § Smokeless tobacco users had either used chewing tobacco, snuff or both; ¶ Asked to all adults, "During the past 12 months, did you seriously think about trying to kill yourself?"; ** Asked to all adults with ideation, "During the past 12 months, did you make any plans to kill yourself?"; †† Asked to all adults with planning, "During the past 12 months, did you try to kill yourself?";

Table 4.8 Mean number of days used tobacco in the past 30 days by past year suicide related outcome status. Data from the US National Survey on Drug Use and Health (NSDUH), 2008-2010 (n=114,048).

	Past year suicidal ideation[¶]		Past year suicide plan**		Past year suicide attempt[††]	
	Yes	No	Yes	No	Yes	No
	Weighted mean(SE)	Weighted mean(SE)	Weighted mean(SE)	Weighted mean(SE)	Weighted mean(SE)	Weighted mean(SE)
Cigarettes	23.6(0.3)	22.9(0.1)	23.7(0.6)	22.9(0.1)	23.1(0.8)	22.9(0.1)
Chewing tobacco	12.8(1.9)	14.7(0.6)	15.8(2.6)	14.6(0.6)	13.0(2.5)	14.6(0.6)
Snuff	16.1(1.1)	20.8(0.3)	19.7(1.4)	20.6(0.3)	19.8(1.9)	20.6(0.3)

*Standard errors provided in parenthesis [§] Smokeless tobacco users had either used chewing tobacco, snuff or both; [¶] Asked to all adults, "During the past 12 months, did you seriously think about trying to kill yourself?"; ** Asked to all adults with ideation, "During the past 12 months, did you make any plans to kill yourself?"; [††]Asked to all adults with planning, "During the past 12 months, did you try to kill yourself?";

Table 4.9 Significance tests for a possible dose response between past year suicidal related outcomes and number of days used tobacco in the past 30 days. Data from the US National Survey on Drug Use and Health (NSDUH), 2008-2010*

	Past year suicidal ideation†			Past year suicide plan§			Past year suicide attempt¶		
	Cigarettes	Chew	Snuff	Cigarettes	Chew	Snuff	Cigarettes	Chew	Snuff
Crude	0.090	0.352	<0.001 (-)	0.204	0.603	0.541	0.752	0.575	0.686
Interview depression**									
Yes	0.303	0.669	0.113	0.075	0.096	0.760	0.549	0.073	0.426
No	0.755	0.490	0.001 (-)	0.009 (-)	0.346	0.256	0.050 (-)	0.923	0.946
Self-report depression††									
Yes	0.317	0.605	0.018 (-)	0.261	0.941	0.322	0.386	0.041 (-)	0.697
No	0.130	0.189	0.020 (-)	0.313	0.817	0.908	0.144	0.132	0.365
AUD§§									
Yes	0.015 (+)	0.537	0.199	0.270	0.044 (+)	0.719	0.216	0.718	0.640
No	0.065	0.533	0.003 (-)	0.123	0.379	0.937	0.791	0.794	0.155

* *p*-values generated from a series of weighted logistic regressions; † Asked to all adults, "During the past 12 months, did you seriously think about trying to kill yourself?"; § Asked to all adults with ideation, "During the past 12 months, did you make any plans to kill yourself?"; ¶ Asked to all adults with planning, "During the past 12 months, did you try to kill yourself?";** Depression was assessed by the NSDUH's structured interview module; †† Depression was assessed by asking participants "has a doctor, nurse or other health professional ever told you that you have major depression?"; §§Alcohol use disorders were either DSM-IV alcohol abuse or alcohol dependence;. Both were assessed using a structured interview asked to all individuals who had smoked cannabis in the year prior to assessment;

Table 4.10 Frequency of suicide related outcomes among tobacco users who are either exclusive cigarette smokers or exclusive smokeless tobacco users. Data from the US National Survey on Drug Use and Health (NSDUH), 2008-2010

	All persons	Ideation		Plan		Attempt	
	n	n	%[†]	n	%[†]	n	%[†]
Cigarette smokers/never SLT users							
Never	35,134	1,374	2.5	372	0.7	183	0.03
Current	29,243	2,245	5.9	754	1.8	459	0.09
Former (quit 1-3 years)	4,681	254	4.1	68	1.2	35	0.05
Former (quit >3 years)	20,731	840	2.8	222	0.7	85	0.02
SLT users/never smokers*							
Never	35,134	1,374	2.5	372	0.7	183	0.003
Current	831	29	4.0	9	0.7	4	0.004
Former (quit 1-3 years)	248	8	1.2	4	0.9	2	0.007
Former (quit >3 years)	973	34	2.2	7	0.7	4	0.003

*Smokeless tobacco users had either used chewing tobacco, snuff or both; [†]Row percentages

p-values for unadjusted logistic regressions:
Cigarette Ideation:
Current=<0.001; Former (quit 1-3 years)=<0.001; Former (quit >3 years)=0.661

Cigarette Plan:
Current=<0.001; Former (quit 1-3 years)=0.001; Former (quit >3 years)=0.937

Cigarette Attempt:
Current=<0.001; Former (quit 1-3 years)=0.020; Former (quit >3 years)=0.087

Smokeless Ideation:
Current=0.807; Former (quit 1-3 years)=0.045; Former (quit >3 years)=0.374

Smokeless Plan:
Current=0.547; Former (quit 1-3 years)=0.561; Former (quit >3 years)=0.459

Smokeless Attempt:
Current=0.911; Former (quit 1-3 years)=N/A ; Former (quit >3 years)=0.823

Table 4.11 Frequency of suicide related outcomes among tobacco users who currently use only one type of tobacco. Data from the US National Survey on Drug Use and Health (NSDUH), 2008-2010

	All persons	Ideation		Plan		Attempt	
	n	n	%	n	%	n	%
Cigarette smokers/non current SLT users							
Never	36,355	1,416	2.5	383	0.7	189	0.3
Current	37,310	2,885	6.2	946	1.8	570	0.9
Former (quit 1-3 years)	5,923	309	4.3	82	1.3	39	0.4
Former (quit >3 years)	26,016	1,027	2.8	274	0.7	98	0.2
SLT users/non current smokers							
Never	60,546	2,468	2.7	662	0.7	303	0.3
Current	2,684	85	2.6	25	0.6	14	0.4
Former (quit 1-3 years)	949	30	2.3	10	0.7	4	0.2
Former (quit >3 years)	6,799	254	3.1	67	0.8	19	0.3

*Smokeless tobacco users had either used chewing tobacco, snuff or both; [†]Row percentages

p-values for unadjusted logistic regressions:
Cigarette Ideation:
Current=<0.001; Former (quit 1-3 years)=<0.001; Former (quit >3 years)=0.039

Cigarette Plan:
Current=<0.001; Former (quit 1-3 years)=0.001; Former (quit >3 years)=0.493

Cigarette Attempt:
Current=<0.001; Former (quit 1-3 years)=0.217; Former (quit >3 years)=0.313

Smokeless Ideation:
Current=0.796; Former (quit 1-3 years)=0.334; Former (quit >3 years)=0.195

Smokeless Plan:
Current=0.420; Former (quit 1-3 years)=0.978; Former (quit >3 years)=0.487

Smokeless Attempt:
Current=0.124; Former (quit 1-3 years)=0.494; Former (quit >3 years)=0.709

Table 5.1 Descriptive characteristics of current, formers and never smokers. Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=10,341).

	All persons		Current smokers		Former smokers		Never smokers	
	n	%	n	%	n	%	n	%
All persons	10,341	100	2,425	24.5	2,589	27.3	5,327	48.2
Sex								
Male	4,507	47.3	1,276	27.6	1,354	30.6	1,877	41.7
Female	5,834	52.7	1,149	21.6	1,235	24.4	3,450	54.0
Age								
18-25	1,696	16.5	451	29.1	307	17.3	938	53.6
26-35	2,335	17.6	595	28.2	420	18.0	1,320	53.8
36-45	2,336	20.6	626	28.7	525	21.2	1,185	50.1
46-64	2,870	28.8	632	23.0	888	33.7	1,350	43.3
65+	1,104	16.6	121	8.9	449	26.5	534	43.0
Race								
White	4,180	70.7	1,200	25.4	1,219	29.5	1,761	45.2
Asian	2,178	4.3	292	13.5	411	17.8	1,475	68.7
Hispanic	3,119	12.0	632	20.6	767	25.0	1,720	54.4
Black	679	10.9	207	23.6	151	19.8	321	56.6
Other	185	2.1	94	43.8	41	27.2	50	29.0
Study*								
NCS-R	5,692	86.8	1,638	25.5	1,569	28.0	2,485	46.5
NLAAS	4,649	13.2	787	17.9	1,020	23.0	2,842	59.1
Income								
$0-$19,999	2,563	23.0	711	31.1	571	25.3	1,281	43.6
$20,000-$49,999	3,090	30.0	797	26.1	784	28.3	1,509	45.6
$50,000-$74,999	1,735	18.7	398	23.7	453	27.6	884	48.7
$75,000 +	2,953	28.4	519	17.9	781	27.7	1,653	54.4
Highest level of education								
<High school	2,159	18.0	619	33.6	522	28.6	1,018	37.7
Less than high school	2,717	31.2	835	30.7	662	26.3	1,220	43.0
High school/GED	2,805	27.6	644	22.3	757	29.1	1,404	48.6
Some college	2,660	23.3	327	11.6	648	25.6	1,684	62.8

* NCS-R=National comorbidity survey replication, NLAAS=National Latino and Asian American Study.

Table 5.2 Lifetime diagnosis of mental illness by smoking status. Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=10,341).

	All persons	Current smokers		Former smokers		Never smokers	
	n	n	%	n	%	n	%
Suicidal ideation							
Yes	1,475	529	38.8	387	24.8	559	36.4
No	8,866	1,896	22.4	2,202	27.7	4,768	49.9
Suicidal planning							
Yes	542	235	45.2	124	20.2	183	34.6
No	9,799	2,190	23.5	2,465	27.7	5,144	48.8
Suicidal attempt							
Yes	523	242	50.1	126	22.3	155	27.7
No	9,818	2,183	23.4	2,463	27.5	5,172	49.1
Bipolar I							
Yes	104	48	46.1	20	17.7	36	36.3
No	10,237	2,377	24.3	2,569	27.4	5,291	48.3
Bipolar II							
Yes	101	58	61.4	20	19.6	23	19.0
No	10,240	2,367	24.2	2,569	27.4	5,291	48.5
Major Depression							
Yes	2,137	630	30.5	558	27.2	949	42.3
No	8,204	1,795	23.3	2,031	27.4	4,378	49.4
Dysthymia							
Yes	542	203	38.5	148	29.1	191	32.4
No	9,799	2,222	23.8	2,441	27.3	5,136	48.9
Alcohol use disorder							
Yes	1,326	677	52.1	438	31.9	211	16.0
No	9,015	1,748	21.5	2,151	26.7	5,116	52.9
Substance use disorder							
Yes	828	446	56.0	276	31.3	106	12.7
No	9,513	1,979	21.9	2,313	27.0	5,221	51.1

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Table 5.2, (cont'd)							
	All persons	Current smokers		Former smokers		Never smokers	
	n	n	%	n	%	n	%
Conduct disorder							
Yes	1,612	673	45.4	411	24.6	528	30.0
No	8,729	1,752	21.1	2,178	27.8	4,799	51.1
Post-traumatic stress disorder							
Yes	775	297	40.0	197	26.5	281	33.5
No	9,566	2,128	23.4	2,392	27.4	5,046	49.2
Generalized anxiety disorder							
Yes	939	311	35.0	261	28.1	367	36.9
No	9,402	2,114	23.6	2,328	27.3	4,960	49.1
Panic							
Yes	2,987	963	32.2	789	26.1	1,235	41.4
No	7,354	1,462	19.9	1,800	24.5	4,092	55.6

*Diagnosis was made using the WMH-CIDI

Table 5.3 Social support assessment items and response proportions. Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=10,341).

	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
1: How often do you talk on the phone or get together with relatives who do not live with you?	14.6	10.4	24.3	30.2	20.6
2: How much can you open up to relatives who do not live with you if you need to talk about your worries?	8.5	10.0	18.6	62.9	---
3: How much can you open up to relatives who do not live with you if you need to talk about your serious problems?	11.1	14.7	26.6	47.6	---
4: How often do your relatives make too many demands on you?	7.7	17.3	34.1	40.9	---
5: How often do your relatives argue with you	4.1	13.1	37.0	45.8	---
6: How often do you talk on the phone or get together with friends?	14.1	8.7	23.2	32.2	21.8
7: How much can you rely on your friends for help if you have a serious problem?	10.1	15.3	28.2	46.5	---
8: How much can you open up to your friends if you need to talk about your worries?	10.4	14.6	30.5	44.5	---
9: How often do your friends make too many demands on you?	2.0	11.0	36.8	50.2	---
10: How often do your friends argue with you?	1.1	8.6	35.5	54.8	
11: When you have a problem or worry, how often do you let your partner worry about it?	2.9	7.3	20.1	37.9	31.8
12: When you have a problem or worry, how often do you let someone (else) know about it?	9.8	25.9	35.9	19.6	8.8

Responses were coded as follows:
Items 1, and 6: 1=Less than once a month 2=Once a month 3=A few times a month 4=A few times a week 5=Most every day; Items 2, 3, 7 and 8: 1=Not at all 2=Little 3=Some 4=A lot; Items 4, 5, 9 and 10 : 1=Often 2=Sometimes 3=Rarely 4=Never; Items 11 and 12: 1=Never 2=Rarely 3=Sometimes 4=Most of the time 5=Always

Table 5.4 Social support assessment items and response proportions: exploratory factor analysis sample. Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=4,649).

	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
1:How often do you talk on the phone or get together with relatives who do not live with you?	14.9	10.0	24.2	30.2	20.9
2: How much can you open up to relatives who do not live with you if you need to talk about your worries?	8.0	9.2	17.9	64.9	---
3: How much can you open up to relatives who do not live with you if you need to talk about your serious problems?	10.7	14.2	26.8	48.4	---
4: How often do your relatives make too many demands on you?	7.4	16.3	35.1	41.2	---
5: How often do your relatives argue with you	4.1	12.4	37.2	46.2	---
6: How often do you talk on the phone or get together with friends?	13.1	7.8	23.0	32.9	23.2
7: How much can you rely on your friends for help if you have a serious problem?	9.0	13.7	27.8	49.6	---
8: How much can you open up to your friends if you need to talk about your worries?	9.1	13.1	31.0	46.8	---
9: How often do your friends make too many demands on you?	1.9	10.8	37.3	50.0	---
10: How often do your friends argue with you?	1.1	8.3	36.0	54.6	---
11: When you have a problem or worry, how often do you let your partner worry about it?	2.9	7.6	20.6	39.7	29.3
12: When you have a problem or worry, how often do you let someone (else) know about it?	9.0	26.1	36.1	20.3	8.5

Responses were coded as follows:
Items 1, and 6: 1=Less than once a month 2=Once a month 3=A few times a month 4=A few times a week 5=Most every day; Items 2, 3, 7 and 8: 1=Not at all 2=Little 3=Some 4=A lot; Items 4, 5, 9 and 10 : 1=Often 2=Sometimes 3=Rarely 4=Never; Items 11 and 12: 1=Never 2=Rarely 3=Sometimes 4=Most of the time 5=Always

Table 5.5 Social support assessment items and response proportions: confirmatory factor analysis sample. Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=5,692).

	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
1:How often do you talk on the phone or get together with relatives who do not live with you?	13.1	12.9	25.1	30.3	18.5
2: How much can you open up to relatives who do not live with you if you need to talk about your worries?	11.7	14.8	22.8	50.7	---
3: How much can you open up to relatives who do not live with you if you need to talk about your serious problems?	13.7	17.8	25.3	43.2	---
4: How often do your relatives make too many demands on you?	9.0	23.6	28.4	39.0	---
5: How often do your relatives argue with you	4.2	17.2	35.3	43.3	---
6: How often do you talk on the phone or get together with friends?	19.8	14.0	24.2	28.3	13.7
7: How much can you rely on your friends for help if you have a serious problem?	16.8	24.7	30.4	28.1	---
8: How much can you open up to your friends if you need to talk about your worries?	18.0	23.7	27.8	30.6	---
9: How often do your friends make too many demands on you?	2.5	12.7	33.4	51.5	---
10: How often do your friends argue with you?	1.2	10.5	32.3	56.0	---
11: When you have a problem or worry, how often do you let your partner worry about it?	3.3	5.7	17.4	45.2	28.4
12: When you have a problem or worry, how often do you let someone (else) know about it?	15.4	24.7	34.6	15.0	10.2

Responses were coded as follows:
Items 1, and 6: 1=Less than once a month 2=Once a month 3=A few times a month 4=A few times a week 5=Most every day; Items 2, 3, 7 and 8: 1=Not at all 2=Little 3=Some 4=A lot; Items 4, 5, 9 and 10 : 1=Often 2=Sometimes 3=Rarely 4=Never; Items 11 and 12: 1=Never 2=Rarely 3=Sometimes 4=Most of the time 5=Always

Table 5.6 Estimated associations between cigarette smoking and suicide related outcomes: unadjusted and adjusted for descriptive characteristics. Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=10,341).

	Ideation		Plans		Attempts	
	Unadj.	Multivar.	Unadj.	Multivar.	Unadj.	Multivar.
Smoking status						
Current	2.4[2.0,2.8]	2.2[1.8,2.6]	2.7[2.1,3.5]	2.5[1.9,3.3]	3.8[2.9,4.9]	3.2[2.4,4.2]
Former	1.2[1.0,1.5]	1.3[1.2,1.7]	1.0[0.8,1.4]	1.2[0.9,1.6]	1.4[1.1,1.9]	1.7[1.2,2.3]
Never	Ref	Ref	Ref	Ref	Ref	Ref
Sex						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	1.4[1.2,1.7]	1.5[1.3,1.8]	1.4[1.1,1.8]	1.5[1.1,1.9]	1.9[1.5,2.4]	2.1[1.6,2.7]
Age						
18-25	Ref	Ref	Ref	Ref	Ref	Ref
26-35	0.8[0.7,1.1]	0.9[0.7,1.1]	0.9[0.7,1.3]	0.9[0.6,1.3]	0.8[0.6,1.2]	0.9[0.6,1.3]
36-45	0.9[0.7,1.1]	0.9[0.7,1.2]	0.9[0.7,1.3]	1.0[0.7,1.4]	0.8[0.6,1.2]	0.9[0.6,1.3]
46-64	0.8[0.6,1.0]	0.8[0.6,1.0]	0.7[0.5,1.0]	0.8[0.5,1.1]	0.6[0.4,0.9]	0.7[0.5,1.0]
65+	0.3[0.2,0.4]	0.3[0.2,0.4]	0.2[0.1,0.4]	0.2[0.1,0.4]	0.1[0.1,0.2]	0.1[0.1,0.2]
Race						
White	Ref	Ref	Ref	Ref	Ref	Ref
Asian	0.4[0.4,0.6]	0.4[0.4,0.6]	0.5[0.3,0.7]	0.5[0.3,0.7]	0.4[0.3,0.6]	0.5[0.3,0.7]
Hispanic	0.6[0.5,0.7]	0.5[0.4,0.6]	0.6[0.4,0.7]	0.5[0.4,0.7]	0.9[0.7,1.2]	0.7[0.5,0.9]
Black	0.8[0.6,1.0]	0.7[0.5,0.9]	0.6[0.4,0.9]	0.5[0.3,0.8]	0.8[0.6,1.2]	0.6[0.4,0.9]
Other	1.4[0.9,2.2]	1.0[0.7,1.6]	2.2[1.3,3.8]	1.6[0.9,2.8]	2.4[1.4,4.2]	1.5[0.8,2.6]
Income						
$0-$19,999	Ref	Ref	Ref	Ref	Ref	Ref
$20,000-$49,999	0.8[0.7,1.0]	0.8[0.7,1.0]	1.1[0.8,1.5]	1.0[0.7,1.4]	0.9[0.7,1.1]	0.9[0.7,1.2]
$50,000-$74,999	0.7[0.6,0.9]	0.6[0.5,0.8]	0.7[0.5,1.1]	0.6[0.4,9.4]	0.6[0.4,0.8]	0.6[0.4,0.9]
$75,000 +	0.6[0.5,0.8]	0.6[0.4,0.7]	0.6[0.5,0.9]	0.5[0.4,0.8]	0.4[0.3,0.5]	0.5[0.3,0.7]
Highest level of education						
Less than high school	Ref	Ref	Ref	Ref	Ref	Ref
High school/GED	0.8[0.6,1.0]	0.7[0.5,0.9]	0.9[0.6,1.3]	0.8[0.6,1.2]	0.7[0.5,0.9]	0.6[0.4,0.9]
Some college	0.9[0.7,1.2]	0.9[0.7,1.1]	1.0[0.7,1.4]	1.0[0.7,1.5]	0.7[0.5,1.0]	0.8[0.5,1.1]
College or more	0.9[0.7,1.1]	1.1[0.8,1.4]	1.1[0.8,1.5]	1.4[0.9,2.1]	0.5[0.3,0.6]	0.6[0.4,1.0]

*Logistic regressions based on weight data.

Table 5.7 Estimated associations between cigarette smoking and suicide related outcomes: unadjusted and adjusted for mental illness (bi-variable). Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=10,341).

	Ideation	Plans	Attempts
Bipolar I Status			
Current	2.3[1.9,2.8]	2.6[2.0,3.4]	2.3[1.9,2.8]
Former	1.2[1.0,1.5]	1.0[0.8,1.4]	1.2[1.0,1.5]
Never	Ref	Ref	Ref
Bipolar II Status			
Current	2.3[1.9,2.7]	2.6[2.0,3.3]	2.3[1.9,2.7]
Former	1.2[1.0,1.5]	1.0[0.8,1.4]	1.2[1.0,1.5]
Never	Ref	Ref	Ref
Major Depression			
Current	2.2[1.9,2.6]	2.4[1.9,3.1]	2.2[1.9,2.6]
Former	1.2[1.0,1.4]	1.0[0.7,1.3]	1.2[1.0,1.4]
Never	Ref	Ref	Ref
Dysthymia			
Current	2.2[1.8,2.6]	2.4[1.9,3.2]	2.2[1.8,2.6]
Former	1.2[1.0,1.4]	1.0[0.7,1.3]	1.2[1.0,1.4]
Never	Ref	Ref	Ref
Alcohol use disorder			
Current	1.8[1.5,2.2]	1.9[1.4,2.5]	1.8[1.5,2.2]
Former	1.1[0.9,1.3]	0.9[0.6,1.1]	1.1[0.9,1.3]
Never	Ref	Ref	Ref
Substance use disorder			
Current	1.9[1.6,2.3]	1.9[1.4,2.5]	1.9[1.6,2.3]
Former	1.1[0.9,1.4]	0.9[0.6,1.2]	1.1[0.9,1.3]
Never	Ref	Ref	Ref
Conduct disorder			
Current	2.0[1.7,2.4]	2.2[1.7,2.9]	2.0[1.7,2.4]
Former	1.2[1.0,1.4]	1.0[0.7,1.3]	1.2[1.0,1.4]
Never	Ref	Ref	Ref
Post-traumatic stress disorder			
Current	2.1[1.8,2.6]	2.3[1.8,3.0]	2.1[1.8,2.6]
Former	1.2[1.0,1.4]	1.0[0.7,1.3]	1.2[1.0,1.4]
Never	Ref	Ref	Ref

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Table 5.7, (cont'd)

	Ideation	Plans	Attempts
Generalized anxiety disorder			
Former	1.2[1.0,1.4]	1.0[0.7,1.3]	1.2[1.0,1.4]
Never	Ref	Ref	Ref
Panic disorder			
Current	2.1[1.7,2.5]	2.3[1.8,2.9]	2.1[1.7,2.5]
Former	1.2[1.0,1.4]	1.0[0.7,1.3]	1.2[1.0,1.4]
Never	Ref	Ref	Ref

*The ORs in this table show the association between cigarette smoking and suicide related outcomes after adjustment for the respective mental health diagnosis.

Table 5.8 Estimated associations between cigarette smoking and suicide related outcomes: unadjusted and adjusted for mental illness (multi-variable). Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=10,341).

	Ideation		Plans		Attempts	
	Unadj.	Multivar.	Unadj.	Multivar.	Unadj.	Multivar.
Smoking status						
Current	2.4[2.0,2.8]	1.4[1.2,1.8]	2.7[2.1,3.5]	1.4[1.0,1.8]	3.8[2.9,4.9]	2.9[1.5,2.6]
Former	1.2[1.0,1.5]	1.0[0.8,1.2]	1.0[0.8,1.4]	0.8[0.6,1.1]	1.4[1.1,1.9]	1.1[0.8,1.5]
Never	Ref	Ref	Ref	Ref	Ref	Ref
Bipolar I						
Yes	7.5[4.8,11.8]	5.0[3.1,8.0]	5.8[3.4,10.0]	3.9[2.0,7.4]	7.5[4.8,11.8]	4.1[2.2,7.9]
No	Ref	Ref	Ref	Ref	Ref	Ref
Bipolar II						
Yes	6.4[4.1,10.0]	3.0[1.8,5.1]	7.4[4.5,12.3]	3.2[1.7,6.0]	6.4[4.1,10.0]	3.5[1.9,6.5]
No	Ref	Ref	Ref	Ref	Ref	Ref
Major Depression						
Yes	4.5[3.9,5.2]	3.2[2.7,3.8]	5.5[4.3,6.8]	3.8[2.9,5.0]	4.5[3.9,5.2]	2.8[2.1,3.7]
No	Ref	Ref	Ref	Ref	Ref	Ref
Dysthymia						
Yes	6.1[4.8,7.6]	1.8[1.3,2.3]	6.4[4.8,8.6]	1.7[1.2,2.4]	6.1[4.8,7.6]	2.2[1.5,3.1]
No	Ref	Ref	Ref	Ref	Ref	Ref
Alcohol use disorder						
Yes	3.2[2.7,3.8]	1.4[1.1,1.9]	3.9[3.1,5.0]	1.3[0.9,1.9]	3.2[2.7,3.8]	1.4[1.0,2.0]
No	Ref	Ref	Ref	Ref	Ref	Ref
Substance use disorder						
Yes	4.0[3.3,4.9]	1.5[1.1,2.1]	5.6[4.3,7.2]	2.2[1.5,3.2]	4.0[3.2,4.9]	1.7[1.2,2.5]
No	Ref	Ref	Ref	Ref	Ref	Ref
Conduct disorder						
Yes	2.7[2.2,3.2]	1.9[1.5,2.3]	3.1[2.3,3.9]	1.7[1.3,2.3]	2.7[2.3,3.3]	1.8[1.4,2.4]
No	Ref	Ref	Ref	Ref	Ref	Ref
Post-traumatic stress disorder						
Yes	4.7[3.9,5.8]	2.1[1.6,2.6]	6.8[5.3,8.7]	2.8[2.1,3.8]	4.7[3.9,5.8]	2.5[1.8,3.3]
No	Ref	Ref	Ref	Ref	Ref	Ref

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Table 5.8, (cont'd)

	Ideation		Plans		Attempts	
	Unadj.	Multivar.	Unadj.	Multivar.	Unadj.	Multivar.
Generalized anxiety disorder						
Yes	4.6[3.8,5.5]	1.9[1.5,2.4]	4.6[3.5,5.9]	1.5[1.1,2.1]	4.6[3.8,5.5]	2.2[1.6,3.1]
No	Ref	Ref	Ref	Ref	Ref	Ref
Panic disorder						
Yes	3.1[2.7,3.6]	1.6[1.4,2.0]	3.8[3.1,4.8]	1.7[1.4,2.2]	3.1[2.7,3.6]	1.8[1.3,2.4]
No	Ref	Ref	Ref	Ref	Ref	Ref

*The ORs in the multivariable columns of this table show the association between cigarette smoking and suicide related outcomes after adjustment for the all mental health diagnoses in this table.

Table 5.9 Model fit indices for factor structure of 12 item social support scale. Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=4,649).

# of Factors	CFI*	TLI†	RMSEA§	Eigenvalues¶
1	0.749	0.694	0.188	3.733
2	0.893	0.836	0.137	2.032
3	0.972	0.943	0.081	1.270
4	0.982	0.952	0.074	0.979

*CFI=comparative fit index (>0.9=evidence of good fit); †TLI=Tucker-Lewis fit index (>0.9=evidence of good fit); § RMSEA=root means square error of approximation (<0.08=evidence of good fit); ¶ Eigenvalues (>1.0=evidence of good fit)

Table 5.10 Results from exploratory factor analysis of 12 social support items. Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=4,649).

	1 Factor	2 Factor		3 Factor		
	Factor 1	Factor 1	Factor 2	Factor 1	Factor 2	Factor 3
	Loading(SE)	Loading(SE)	Loading(SE)	Loading(SE)	Loading(SE)	Loading(SE)
1:How often do you talk on the phone or get together with relatives who do not live with you?	0.352(0.013)	0.420(0.013)	-0.051(0.016)	0.450(0.018)	0.028(0.018)	-0.028(0.017)
2: How much can you open up to relatives who do not live with you if you need to talk about your worries?	0.724(0.009)	0.821(0.010)	0.009(0.002)	0.841(0.016)	0.007(0.012)	-0.004(0.003)
3: How much can you open up to relatives who do not live with you if you need to talk about your worries?	0.711(0.009)	0.853(0.009)	0.042(0.015)	0.896(0.014)	-0.004(0.007)	0.044(0.016)
4: How often do your relatives make too many demands on you?	-0.370(0.013)	-0.003(0.007)	0.545(0.013)	-0.224(0.025)	0.043(0.013)	0.664(0.014)
5: How often do your relatives argue with you	-0.379(0.013)	0.013(0.013)	0.580(0.013)	-0.150(0.026)	-0.033(0.016)	0.648(0.015)
6: How often do you talk on the phone or get together with friends?	0.483(0.011)	0.335(0.016)	-0.386(0.015)	0.022(0.016)	0.517(0.016)	-0.082(0.017)
7: How much can you rely on your friends for help if you have a serious problem?	0.844(0.006)	0.662(0.015)	-0.598(0.015)	0.002(0.008)	0.896(0.012)	0.031(0.013)
8: How much can you open up to your friends if you need to talk about your worries?	0.857(0.006)	0.625(0.015)	-0.621(0.015)	0.003(0.010)	0.909(0.012)	0.003(0.003)
9: How often do your friends make too many demands on you?	-0.456(0.013)	0.014(0.015)	0.679(0.012)	-0.005(0.006)	-0.237(0.025)	0.628(0.015)
10: How often do your friends argue with you?	-0.477(0.014)	0.025(0.018)	0.671(0.012)	0.029(0.019)	-0.256(0.023)	0.609(0.015)
11: When you have a problem or worry, how often do you let your partner worry about it?	0.193(0.019)	0.293(0.020)	0.040(0.021)	0.265(0.025)	0.050(0.025)	0.099(0.024)
12: When you have a problem or worry, how often do you let someone (else) know about it?	0.447(0.012)	0.397(0.014)	-0.251(0.015)	0.251(0.018)	0.299(0.017)	-0.073(0.017)

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Table 5.10,(cont'd)

	4 Factor			
	Factor 1	Factor 2	Factor 3	Factor 4
	Loading(SE)	Loading(SE)	Loading(SE)	Loading(SE)
1:How often do you talk on the phone or get together with relatives who do not live with you?	0.053(0.188)	0.478(0.017)	-0.042(0.020)	-0.052(0.047)
2: How much can you open up to relatives who do not live with you if you need to talk about your worries?	-0.006(0.012)	0.841(0.014)	-0.017(0.009)	0.020(0.014)
3: How much can you open up to relatives who do not live with you if you need to talk about your worries?	-0.007(0.017)	0.879(0.014)	0.036(0.009)	0.032(0.016)
4: How often do your relatives make too many demands on you?	0.011(0.035)	-0.142(0.022)	0.674(0.015)	0.080(0.018)
5: How often do your relatives argue with you	0.005(0.015)	-0.078(0.021)	0.662(0.014)	0.017(0.009)
6: How often do you talk on the phone or get together with friends?	3.837(12.729)	0.000(0.001)	0.000(0.001)	0.000(0.004)
7: How much can you rely on your friends for help if you have a serious problem?	0.017(0.061)	0.080(0.017)	-0.015(0.011)	0.786(0.026)
8: How much can you open up to your friends if you need to talk about your worries?	-0.009(0.031)	-0.004(0.004)	0.011(0.009)	0.991(0.020)
9: How often do your friends make too many demands on you?	-0.005(0.018)	0.046(0.010)	0.649(0.016)	-0.164(0.028)
10: How often do your friends argue with you?	-0.011(0.037)	0.072(0.015)	0.630(0.016)	-0.174(0.030)
11: When you have a problem or worry, how often do you let your partner worry about it?	-0.004(0.011)	0.273(0.024)	0.098(0.024)	0.068(0.025)
12: When you have a problem or worry, how often do you let someone (else) know about it?	0.003(0.014)	0.254(0.018)	-0.084(0.017)	0.288(0.017)

Table 5.11 Results of a confirmatory factor analysis of a 3 factor solution for 12 social support items. Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=5,692).

	Factor 1		Factor 2		Factor 3	
	Loading	*p*-value	Loading	*p*-value	Loading	*p*-value
1: How often do you talk on the phone or get together with relatives who do not live with you?	0.522	<0.001				
2: How much can you open up to relatives who do not live with you if you need to talk about your worries?	0.918	<0.001				
3: How much can you open up to relatives who do not live with you if you need to talk about your serious problems?	1.000	<0.001				
4: How often do your relatives make too many demands on you?					0.955	<0.001
5: How often do your relatives argue with you					1.000	<0.001
6: How often do you talk on the phone or get together with friends?			0.630	<0.001		
7: How much can you rely on your friends for help if you have a serious problem?			0.952	<0.001		
8: How much can you open up to your friends if you need to talk about your worries?			1.000	<0.001		
9: How often do your friends make too many demands on you?					0.917	<0.001
10: How often do your friends argue with you?					0.936	<0.001
11: When you have a problem or worry, how often do you let your partner worry about it?	0.347	<0.001				
12: When you have a problem or worry, how often do you let someone (else) know about it?	0.179	<0.001	0.377	<0.001		

* Loadings for factor 1 are scaled against item 3 (which is fixed at 1). Similarly, loadings for factor 2 are scaled against item 8, and loadings for factor 3 are scaled against item 5.

Table 5.12 Distributions of social support factor scores. Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=10,341).

	Factor 1			
	Mean	Standard dev.	Min	Max
All persons	0.039	0.686	-1.948	1.318
Smoking status				
Current	-0.038	0.705	-1.943	1.318
Former	0.059	0.683	-1.943	1.310
Never	0.068	0.678	-1.948	1.312
	Factor 2			
	Mean	Standard dev.	Min	Max
All persons	0.082	0.752	-1.944	1.686
Smoking status				
Current	0.050	0.778	-1.944	1.598
Former	0.074	0.744	-1.944	1.686
Never	0.103	0.743	-1.944	1.651
	Factor 3			
	Mean	Standard dev.	Min	Max
All persons	0.021	0.521	-1.923	0.929
Smoking status				
Current	-0.053	0.542	-1.893	0.929
Former	0.074	0.509	-1.948	1.312
Never	0.029	0.516	-1.923	0.929

Table 5.13 Estimated associations between cigarette smoking and suicide related outcomes: unadjusted and adjusted for social support (multi-variable). Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=10,341).

	Ideation		Plans		Attempts	
	Unadj.	Multivar.	Unadj.	Multivar.	Unadj.	Multivar.
Smoking status						
Current	2.4[2.0,2.8]	2.2[1.8,2.6]	2.7[2.1,3.5]	2.4[1.9,3.1]	3.8[2.9,4.9]	3.3[2.6,4.4]
Former	1.2[1.0,1.5]	1.3[1.1,1.5]	1.0[0.8,1.4]	1.1[0.8,1.4]	1.4[1.1,1.9]	1.5[1.1,2.0]
Never	Ref	Ref	Ref	Ref	Ref	Ref
Social support*						
SS factor 1 score	0.7[0.6,0.8]	0.7[0.6,0.8]	0.6[0.5,0.8]	0.7[0.5,0.8]	0.5[0.4,0.6]	0.6[0.5,0.7]
SS factor 2 score	1.0[0.9,1.1]	1.0[0.9,1.2]	1.0[0.8,1.2]	1.0[0.8,1.2]	1.0[0.8,1.2]	1.0[0.8,1.2]
SS factor 3 score	0.5[0.4,0.6]	0.5[0.5,0.6]	0.4[0.3,0.5]	0.5[0.4,0.6]	0.4[0.3,0.5]	0.5[0.4,0.6]

*Unadjusted models for social support contain all three factor scores. ORs for social support variables are the estimated OR associated with a one unit increase in the factor score.

Table 5.14 Estimated associations between cigarette smoking and suicide related outcomes: unadjusted and adjusted for social support, descriptive characteristics and mental disorders. Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=10,341).

	Ideation	Plans	Attempts
Unadjusted			
Current	2.4[2.0,2.8]	2.7[2.1,3.5]	3.8[2.9,4.9]
Former	1.2[1.0,1.5]	1.0[0.8,1.4]	1.4[1.1,1.9]
Never	Ref	Ref	Ref
Model I (descriptive characteristics)			
Current	2.2[1.8,2.6]	2.5[1.9,3.3]	3.2[2.4,4.2]
Former	1.3[1.2,1.7]	1.2[0.9,1.6]	1.7[1.2,2.3]
Never	Ref	Ref	Ref
Model II (mental disorders)			
Current	1.4[1.2,1.8]	1.4[1.0,1.8]	2.0[1.5,2.7]
Former	1.0[0.8,1.2]	0.8[0.6,1.1]	1.1[0.8,1.5]
Never	Ref	Ref	Ref
Model III (social support)			
Current	2.2[1.8,2.6]	2.4[1.9,3.1]	3.3[2.6,4.4]
Former	1.3[1.1,1.5]	1.1[0.8,1.4]	1.5[1.1,2.0]
Never	Ref	Ref	Ref
Model IV (II+III)			
Current	1.4[1.2,1.7]	1.3[1.0,1.8]	2.0[1.5,2.6]
Former	1.0[0.9,1.2]	0.8[0.6,1.0]	1.1[0.8,1.5]
Never	Ref	Ref	Ref
Model V (I+II+III)			
Current	1.4[1.1,1.7]	1.3[1.0,1.8]	1.8[1.3,2.4]
Former	1.1[0.9,1.3]	0.8[0.6,1.1]	1.2[0.9,1.7]
Never	Ref	Ref	Ref
Model VI (I+II+III)**			
Current	1.3[1.1,1.6]	1.3[1.1,1.6]	1.6[1.2,2.1]
Former	1.0[0.8,1.2]	0.8[0.6,1.1]	1.2[0.9,1.7]
Never	Ref	Ref	Ref

*Model I=age, sex, race, income and education

Model II= bipolar I, bipolar II, major depression, dysthymia, alcohol use disorder, substance use disorder, conduct disorder, post-traumatic stress disorder and generalized anxiety disorder

Model III= social support scores (f1 f2 and f3)

**Number of disorders instead of separate terms for each disorder as in model II.

Table 5.15 Exploratory analysis of subgroup variation in the effects of cigarette smoking on suicide related outcomes by mental disorder status. Data from the Collaborative Psychiatric Epidemiology Surveys (CPES), 2001-2003 (n=10,341).

	Ideation		Plans		Attempts	
	OR	*p*-value	OR	*p*-value	OR	*p*-value
Bipolar I	1.1[0.4,2.9]	0.875	0.4[0.1,1.2]	0.099	0.8[0.2,2.8]	0.756
Bipolar II	1.0[0.3,3.0]	0.974	1.2[0.3,5.2]	0.823	0.6[0.2,2.3]	0.447
Major depression	0.6[0.4,0.8]	0.004	0.5[0.3,1.1]	0.003	1.1[0.7,1.9]	0.639
Dysthymia	0.6[0.3,1.0]	0.038	0.6[0.3,1.1]	0.103	0.8[0.4,1.6]	0.580
Alcohol use disorder	0.8[0.5,1.4]	0.482	1.0[0.5,2.1]	0.936	0.6[0.3,1.2]	0.185
Substance use disorder	1.0[0.6,1.8]	0.937	1.1[0.5,2.8]	0.773	0.8[0.3,1.7]	0.532
Conduct disorder	1.1[0.7,1.8]	0.550	1.0[0.5,2.8]	0.896	1.1[06,2.1]	0.651
Post-traumatic stress disorder	0 .6[0.4,0.9]	0.026	0.4[0.2,0.8]	0.006	0.9[0.5,1.6]	0.691
Generalized anxiety disorder	0.8[0.5,1.2]	0.204	0.8[0.5,1.6]	0.577	0.8[0.4,1.4]	0.351
Panic disorder	0.9[0.6,1.2]	0.440	0.7[0.4,1.2]	0.226	1.0[0.6,1.7]	0.977

Estimates in this table are from a series of regressions containing terms for smoking, mental disorders and an interaction between smoking and mental disorders. For example, the “Major depression” estimate of 0.6 is from a model with terms for smoking, major depression and smoking*major depression. The presented OR is the OR for the interaction between current smoking and major depression. The inverse association (OR=0.6) suggests that the effects of cigarette smoking are smaller among those who have major depression.

APPENDIX B: Educational background/other research experiences

I would like to provide a brief overview of my education and research activities outside of this dissertation that I have been involved in. My interest in public health and epidemiologist started while I was an undergraduate at Grand Valley State University. In my second year, I took completed two independent studies with Drs. Justin Adams (an anthropologist) and Noor Ghiasvand (a geneticist) where I wrote a review article which I later presented as a poster on anti-malaria efforts throughout the world.

I came to the department in the Fall of 2009 as a Master's student, and quickly began working with Dr. Mat Reeves involved in a project on healthy lifestyles in the US. Specifically, the goal of this project was to determine temporal changes and regional differences in the prevalence of adults who live a 'healthy lifestyle' in the US—a healthy lifestyle was defined by not smoking, having a normal body weight, eating a sufficient amount of fruits and vegetables and getting a recommended amount of exercise. We found that very few adults in the US live a healthy lifestyle (~5%), that prevalence hasn't changed much in the past decade and that there are notable differences by geographic region where the prevalence was highest in the northeast and western states while lower in the southern and Midwest states. This trend was independent of race, income, education and age distributions. The abstract and reference for this paper can be found in appendix 3.

After my first semester, I was approached by Dr. Jim Anthony about joining his research group as a NIDA-T32 trainee. Dr. Anthony was my professor for two introductory epidemiology courses, so I had become familiar with his work. This was an excellent fit because at this point

my main interest had been on modifiable lifestyle behaviors, and under Jim I began to focus on a line of research on the epidemiology of cigarette smoking.

My first project as a NIDA fellow focused on cigarette smoking from a global perspective—specifically—how levels of smoking persistence vary cross-nationally. We found a considerable amount of cross-national variation in the proportion of 'ever smokers' who persist in smoking, ranging from ~25% in Nigeria to ~80% in China. Interestingly, these differences were independent of country income level and elapsed time since smoking onset. (Abstract in appendix 4.)

Other cigarette focused studies, currently under revision, include a case-crossover study on the propensity that cigarette smoking and smokeless tobacco use predict one another (appendix 5), a time to event study of the rapid transition from first cigarette to becoming a daily smoker (appendix 6), a factor analysis on measurement of nicotine dependence in newly-incident smokers (appendix 7) and an analysis on the age-specific incidence rates of cigarette smoking among young people in the US (appendix 8). While working with Dr. Elizabeth Meier, a post-doctoral fellow, I was able to modify the methods used in the age-specific incidence of smoking analysis for an age-specific incidence of prescription opioid use which Dr. Meier presented at the 2011 College on Problems of Drug Dependence meeting, and later published (appendix 9).

In addition to my NIDA work, I also worked as a research assistant to Dr. Naomi Breslau on a project on post-traumatic stress disorder, an area of her expertise. This study asked if predispositions to PTSD played a different role in whether someone developed PTSD depending on trauma severity. The general assumption prior to this study was that severe traumatic

events (such as rape/sexual assault) that predispositions (such as major depression) play smaller role in determining whether or not the victim will become a case of PTSD than in less severe events (accidents, disasters and unexpected death of someone close). Interestingly, we found little difference in the role of predispositions by trauma severity (appendix 10).

The intersection between my NIDA work with Dr. Anthony focused on cigarette smoking, and my experiences with Dr. Breslau on mental health played an important role in leading me to this dissertation topic.

APPENDIX C: List of non-dissertation related abstracts

Am J Public Health. 2012 Jul;102(7):1392-8.

Temporal and regional trends in the prevalence of healthy lifestyle characteristics: United States, 1994-2007.

Troost JP, Rafferty AP, Luo Z, Reeves MJ.

Source

Department of Epidemiology, Michigan State University, East Lansing, MI 48824, USA. jtroost@epi.msu.edu

Abstract

OBJECTIVES:

We examined temporal and regional trends in the prevalence of health lifestyles in the United States.

METHODS:

We used 1994 to 2007 data from the Behavioral Risk Factor Surveillance System to assess 4 healthy lifestyle characteristics: having a healthy weight, not smoking, consuming fruits and vegetables, and engaging in physical activity. The concurrent presence of all 4 characteristics was defined as a healthy overall lifestyle. We used logistic regression to assess temporal and regional trends.

RESULTS:

The percentages of individuals who did not smoke (4% increase) and had a healthy weight (10% decrease) showed the strongest temporal changes from 1994 to 2007. There was little change in fruit and vegetable consumption or physical activity. The prevalence of healthy lifestyles increased minimally over time and varied modestly across regions; in 2007, percentages were higher in the Northeast (6%) and West (6%) than in the South (4%) and Midwest (4%).

CONCLUSIONS:

Because of the large increases in overweight and the declines in smoking, there was little net change in the prevalence of healthy lifestyles. Despite regional differences, the prevalence of healthy lifestyles across the United States remains very low.

doi: 10.2105/AJPH.2011.300326. Epub 2012 May 21.

Journal of Epidemiology and Global health. 2012 Sep;2(3):135-144.

An updated global picture of cigarette smoking persistence among adults.

Troost JP, Barondess DA, Storr CL, Wells JE, Al-Hamzawi AO, Andrade LH, Bromet E, Bruffaerts R, Florescu S, de Girolamo G, de Graaf R, Gureje O, Haro JM, Hu C, Huang Y, Karam AN, Kessler RC, Lepine JP, Matschinger H, Medina-Mora ME, O'Neil S, Posada-Villa J, Sagar R, Takeshima T, Tomov T, Williams DR, Anthony JC.

Source

Department of Epidemiology, Michigan State University, East Lansing, MI 48824, USA. jtroost@epi.msu.edu

Abstract

BACKGROUND:

Cross-national variance in smoking prevalence is relatively well documented. The aim of this study is to estimate levels of smoking persistence across 21 countries with a hypothesized inverse relationship between country income level and smoking persistence.

METHODS:

Data from the World Health Organization World Mental Health Survey Initiative were used to estimate cross-national differences in smoking persistence—the proportion of adults who started to smoke and persisted in smoking by the date of the survey.

RESULTS:

There is large variation in smoking persistence from 25% (Nigeria) to 85% (China), with a random-effects meta-analytic summary estimate of 55% with considerable cross-national variation. (Cochran's heterogeneity Q statistic = 6845; $p < 0.001$). Meta-regressions indicated that observed differences are not attributable to differences in country's income level, age distribution of smokers, or how recent the onset of smoking began within each country.

CONCLUSIONS:

While smoking should remain an important public health issue in any country where smokers are present, this report identifies several countries with higher levels of smoking persistence (namely, China and India).

This work was presented at the 2011 CPDD meeting.

Smokeless tobacco use and onset of cigarette smoking: a case-crossover study

J.P. Troost & J.C. Anthony; Epidemiology, Michigan State University, College of Human Medicine, East Lansing, MI

AIMS: There is an open question as to whether the onset of smokeless tobacco use is protective of or associated with an excess risk of tobacco cigarette smoking onset with few studies providing evidence in either direction. This study seeks to examine the relationship between the smokeless tobacco onset and tobacco cigarette onset using epidemiological evidence with a case-crossover method.

METHODS: We use a nationally representative sample of persons 12+ using data from the 2004-2008 National Surveys on Drug Use and Health with computer assisted assessment of smokeless tobacco and tobacco cigarette use. We tested an immediate triggering hypothesis in which a positive (or protective) association between smokeless tobacco and cigarette onsets would manifest within the first months after smokeless tobacco onset. Using a within subject design that holds constant individual susceptibility traits, we compared the rates of smokeless tobacco onsets in the month before tobacco cigarette onset (the hazard month) to two control months: (1) the month after tobacco cigarette onset (2) the month before the hazard month. We also stratified by elapsed time since onset to control for possible recall biases. In a post estimation step we compared other control months.

RESULTS: Among newly-incident tobacco cigarette users, there was no difference in the odds smokeless tobacco onset in the hazard interval (the month prior to tobacco cigarette use) compared to either control interval (the month after tobacco cigarette use: RR=1.0, 95% CI: 0.7, 1.5; p=0.8488 or the month after the month of cigarette onset: RR=1.5, 95% CI: 0.9, 2.3; p=0.079). There were no differences after stratifying by elapsed time since onset. The use of alternative plausible control months did not alter the results.

CONCLUSION: At least with respect to an immediate triggering hypothesis, there was no evidence to suggest a positive or protective association between smokeless tobacco use and tobacco cigarette smoking. [NIDA support: T32DA021129 (JPT); K05DA15799 (JCA)].

Newly-Incident Smokers:

Daily Smoking Soon After the First Tobacco Cigarette

Jonathan P. Troost, B.S.

James C. Anthony Ph.D.

Both Authors: Department of Epidemiology, College of Human Medicine, Michigan State University, East Lansing, Michigan 48824

Background: In the United States, every day, as many as 6,000 young people start smoking tobacco cigarettes. Some transition to daily smoking soon after the onset of smoking. Our goal was to estimate occurrence and time to daily smoking once smoking starts, using recently gathered epidemiological data on newly incident smokers.

Methods: Nationally representative community sample surveys were completed each year during 2004-2008. Standardized assessments disclosed 6,427 newly-incident smokers. We measured the month to month occurrence of becoming a daily smoker, defined as smoking every day for at least 30 days, among newly-incident smokers.

Results: An estimated one in nine newly-incident tobacco cigarette smokers transition into daily smoking within one year after smoking for the first time (11%). There is no marked male-female or urban-rural variation in this estimate. Older smokers (age 18+) are more likely to transition rapidly into daily smoking, as compared to adolescent-onset smokers. Exploratory analyses disclosed that adolescent-onset Hispanic smokers were less likely to transition rapidly to daily smoking, as compared to adolescent-onset non-Hispanic Whites. Among non-Hispanics, adult-onset Blacks were more likely to transition rapidly into daily smoking, as compared to adult-onset Whites.

Conclusions: In the US, smoking a tobacco cigarette for the first time can be a transient experience, but for at least one in nine (11%), there is a major health-affecting consequence observed within one year after smoking onset – namely, progression to daily smoking. Risk of rapid transition to daily smoking is greater when smoking starts at or after age 18, especially for non-Hispanic Blacks.

Key words: Tobacco smoking; epidemiology; daily smoking

Measuring the Rapid Transition To Nicotine Dependence: Age-Associated Biases

Jonathan P. Troost, B.S.

James C. Anthony Ph.D.

Both Authors: Department of Epidemiology, College of Human Medicine, Michigan State University, East Lansing, Michigan 48824

Introduction: While evidence suggests some smokers experience a rapid transition from first cigarette to nicotine dependence symptoms, we have not yet established a proper method for measuring nicotine dependence in its early stages due to studies on nicotine dependence almost exclusively done in experienced smokers. The goal of this study was to determine the psychometric properties of the Nicotine Dependence Syndrome Scale plus one item from the Fagerström Test for Nicotine Dependence in a nationally representative sample of newly incident smokers.

Methods: Data were collected as part of the United State's National Survey on Drug Use and Health. 3,239 smokers with less than one year since their first cigarette were identified from 2004-2009. The 20-item scale was used an in exploratory factor analysis among smokers in even numbered years; odd numbered year data was used for a confirmatory factor analysis as well as a test of differential item functioning by age.

Results: Judged by model fit and factor interpretability, a 17-item, single factor solution was selected. All but one item was retained in the confirmatory analysis. Tests for differential item functioning revealed that 8 items had significant age associated biases (for example "smoking the same on weekdays as on weekends" was less often found among adolescents holding constant overall nicotine dependence).

Conclusions: While the NDSS appears to be a useful tool even in the early stages of smoking, age-associated biases in questions are problematic. Longitudinal research on nicotine dependence traversing adolescence to adulthood would benefit by either avoiding biased questions and/or developing new items.

Age-Specific Risk of Starting to Smoke Tobacco Cigarettes: United States, 2004-2008

Jonathan P. Troost, B.S.

James C. Anthony Ph.D.

Both Authors: Department of Epidemiology, College of Human Medicine, Michigan State University, East Lansing, Michigan 48824

Background: Against a background of generally successful United States tobacco cigarette smoking prevention and control during the late 20th century, we face continuing burdens of tobacco-attributable morbidity and mortality. Here, we estimate age-specific risks of starting to smoke tobacco by studying the early 21st century experiences of adolescents and young adults, and seek systematic replication of a possible 'age effect' where the risk of smoking increases with age and peaks at age 18.

Methods: Standardized field surveys of non-institutionalized community residents age 12-21 years old, completed each year from 2004 through 2008, with assessment of year at first smoking (n1=86,887 individuals at risk of smoking onset; n2=2,942 newly incident smokers). Newly-incident smoking onset was ascertained when the year of smoking initiation was the same as the year of survey assessment, given no prior smoking before that year.

Findings: For each birth cohort traversing adolescence across the years from 2004 through 2008, the risk of starting to smoke tobacco cigarettes is roughly 1% for 12 year olds, increases with age, peaks at age 18 at 8% (one in 12), and then declines.

Conclusions: The risk of starting to smoke cigarettes in the US remains clinically significant. We can and should find ways to decrease that risk.

Key words: Tobacco smoking; epidemiology; legal smoking age; smoking initiation

Arch Pediatr Adolesc Med. 2012 Sep 1;166(9):803-7.

Extramedical use of prescription pain relievers by youth aged 12 to 21 years in the United States: national estimates by age and by year.

Meier EA, Troost JP, Anthony JC.

Abstract

OBJECTIVE To identify when youth are most likely to start using prescription pain relievers to get high or for other unapproved indications outside the boundaries of what a prescribing physician might intend (ie, extramedical use). DESIGN Cross-sectional surveys of adolescent cohorts, 2004 to 2008. SETTING The United States. PARTICIPANTS Large nationally representative samples of youth in the United States who had been assessed for the 2004 through 2008 National Survey on Drug Use and Health, yielding data from 138 729 participants aged 12 to 21 years. MAIN OUTCOME MEASURES Estimated age-specific risk of starting extramedical use of prescription pain relievers, year by year, and confirmation of age at peak risk by tracing the experience of individual cohorts during this period. RESULTS The estimated peak risk of starting extramedical use of prescription pain relievers occurs in midadolescence, well before the college years. The age at peak risk is 16 years, when an estimated 2% to 3% become newly incident users. Smaller risk estimates are observed at age 12 to 14 years and at age 19 to 21 years. CONCLUSIONS For initiatives to prevent youth from using prescription pain relievers to get high or for other unapproved indications, a focus on the last year of high school and the post-secondary school years may be too little too late. Practice-based approaches are needed in addition to public health interventions based on effective alcohol and tobacco prevention programs during the earlier adolescent years.

doi: 10.1001/archpediatrics.2012.209.

Psychol Med. 2013 Feb;43(2):381-90.

Influence of predispositions on post-traumatic stress disorder: does it vary by trauma severity?

Breslau N, Troost JP, Bohnert K, Luo Z.

Source

Department of Epidemiology and Biostatistics, College of Human Medicine, Michigan State University, East Lansing, MI 48824, USA. breslau@epi.msu.edu

Abstract

BACKGROUND:

Only a minority of trauma victims (<10%) develops post-traumatic stress disorder (PTSD), suggesting that victims vary in predispositions to the PTSD response to traumas. It is assumed that the influence of predispositions is inversely related to trauma severity: when trauma is extreme predispositions are assumed to play a secondary role. This assumption has not been tested. We estimate the influence of key predispositions on PTSD induced by an extreme trauma - associated with a high percentage of PTSD - (sexual assault), relative to events of lower magnitude (accidents, disaster, and unexpected death of someone close).

METHOD:

The National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) is representative of the adult population of the USA. A total of 34 653 respondents completed the second wave in which lifetime PTSD was assessed. We conducted three series of multinomial logistic regressions, comparing the influence of six predispositions on the PTSD effect of sexual assault with each comparison event. Three pre-existing disorders and three parental history variables were examined.

RESULTS:

Predispositions predicted elevated PTSD risk among victims of sexual assault as they did among victims of comparison events. We detected no evidence that the influence of predispositions on PTSD risk was significantly lower when the event was sexual assault, relative to accidents, disasters and unexpected death of someone close.

CONCLUSIONS:

Important predispositions increase the risk of PTSD following sexual assault as much as they do following accidents, disaster, and unexpected death of someone close. Research on other predispositions and alternative classifications of event severity would be illuminating.

doi: 10.1017/S0033291712001195. Epub 2012 Jun 18.

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