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Date

Assessing the Overlap Between Marijuana and Tobacco Use in Adults:  
A Mixed Methods Approach

By

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Doctor of Philosophy

Behavioral Sciences and Health Education

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**Assessing the Overlap Between Marijuana and Tobacco Use in Adults:  
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M.P.H., School of Public Health, University of Washington, 2010

B.S. Northwestern University, 2003

Advisor:

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An abstract of

A dissertation submitted to the Faculty of the James T. Laney School of Graduate Studies  
of Emory University in partial fulfillment of the requirements for the degree of

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## **Abstract**

Tobacco use is more prevalent among people using other substances, including illicit drugs. Data suggest an overlap between tobacco and marijuana, the most widely used federally illicit substance in the U.S. Given the well-documented harms from tobacco, co-occurring tobacco use is an important and concerning comorbidity of marijuana use. Existing research on this topic focuses largely on adolescents and young adults. Nationally representative data on the prevalence of and trends in co-use among adults are not available, and are needed to characterize the extent of the epidemic in light of changing marijuana policies. Additionally, although a number of theoretical reasons have been proposed to explain overlapping use of marijuana and tobacco, no qualitative studies have been conducted with adults to understand reasons for and patterns of co-use. Accordingly, this mixed methods research sought to quantify and characterize co-use of marijuana and tobacco in adults.

Data for the quantitative component of this research came from the 378,459 adults age 18 years and older who responded to the 2003-2012 National Survey on Drug Use and Health, a nationally representative, household interview survey conducted annually. Data for the qualitative component were collected from Washington State residents aged 18-34 years who reported past month use of both tobacco and marijuana (n=48).

Taken together, findings suggest that co-use increased among the U.S. adult population between 2003-2012, with increases occurring among those ages 26-34 and 50+ years. Among adult marijuana users, blunt use (cigar wrappers filled with marijuana) increased significantly between 2005-2012, while cigarettes use decreased. Qualitative findings suggest that adults aged 18-34 years report using marijuana in specific ways

(e.g., sequentially, co-administered, as substitutes) and for different reasons (e.g., to enhance the high, ease cravings or addiction to nicotine, help cut back on use of one or both substances, or when use of one substances is not available, appropriate or allowed), with qualitative themes differing based on frequency of use. These data provide an epidemiologic foundation to justify ongoing studies to prevent and reduce co-occurring marijuana and tobacco use in adults. Qualitative findings on reasons for co-use provide possible avenues for future, theory-based interventions.

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## CHAPTER 1:

### Introductory Literature Review

Epidemiologic studies suggest high rates of substance use comorbidity, with use of particular substances, like tobacco and marijuana, co-occurring more often across the lifespan (Kendler, Jacobson, Prescott, & Neale, 2003; Kendler, Prescott, Myers, & Neale, 2003; Kessler et al., 2005). Comorbid substance use may have added health risks and can negatively impact dependence and quitting (Agrawal, Budney, & Lynskey, 2012; Ramo, Liu, & Prochaska, 2012). This literature review explores marijuana and tobacco use and their comorbid or co-use, and outlines a mixed-methods study that aims to address foundational gaps in knowledge about the prevalence and reasons for co-use of marijuana and tobacco.

#### **Marijuana Use**

##### *Marijuana use among U.S. adults*

Marijuana (also referred to as cannabis or hashish) is the most commonly used illicit substance in the U.S. and the third most commonly used drug behind tobacco and alcohol (Stinson et al., 2005; Substance Abuse and Mental Health Services Administration, 2013). In 2012, 43% of individuals age 12 and older reported lifetime marijuana use, 12% reported past year use, and 7% reported past month (current) use (Substance Abuse and Mental Health Services Administration, 2013).

Marijuana use is most prevalent in young adults, with between 17 and 21% of those aged 18-25 years and 11% of adults aged 26 to 34 years reporting past month use compared with 4% of adults age 35 and older and 7.2% of those ages 12 to 17 years (Substance Abuse and Mental Health Services Administration, 2013). While the rate of

current marijuana use among youth and adolescents has declined over the past decade, rates of past month and daily or near daily use of marijuana among young adults and adults have increased (Substance Abuse and Mental Health Services Administration, 2013). The prevalence of marijuana use disorders has also increased among adults over the past decade (Compton, Grant, Colliver, Glantz, & Stinson, 2004), suggesting that use may increasingly be leading to abuse or dependence.

Among adults, groups with relatively higher rates of marijuana use are males versus females (10% versus 5%), those who are Black, American Indian/Alaska Native, or multi-racial versus Whites (9 to 13% versus 7%), those with less than a high school education versus those with more education (9% versus 5 to 8%), and those who have part time employment or are unemployed versus those who are employed (10% and 15%, respectively, versus 7%) (Substance Abuse and Mental Health Services Administration, 2013).

The frequency of marijuana use appears to be increasing as well. In 2012, nearly 8% of those age 12 and older reported using marijuana on 20 or more days of the past month, compared with just 5% in 2006, and the number of daily or near daily users represented 40% of all past month marijuana users (Substance Abuse and Mental Health Services Administration, 2013). The increasing prevalence and frequency of use are major public health concerns, given that most of the comorbid and negative health effects from marijuana are associated with chronic, regular use (Hall, 2009).

### ***Changing risk perception about marijuana***

Increases in both the prevalence and frequency of use may be due to a changing perception about the risks and social acceptability of marijuana. Perceptions of risk or

harmfulness have been theoretically linked to substance use behavior (Ajzen, 1985; Bandura, 1986; Hochbaum, 1958; Rosenstock, 1974). Studies of marijuana use support this link, finding that the greater the perceived risk of use, the lower the likelihood of use (Johnston, O'Malley P, Bachman, & Schulberg, 2005; O'Callaghan, Reid, & Copeland, 2006). In longitudinal studies, negative societal norms and perceptions of harm about marijuana have been negatively associated with marijuana use (Keyes et al., 2011). Over the past five years, the percent of youth and young adults who perceive monthly or more than monthly use of marijuana to be risky has been steadily declining (Substance Abuse and Mental Health Services Administration, 2013). In 2012, only 23% of those aged 18-25 and 43% of those aged 26 and older perceived great risk from smoking marijuana once or twice a week (Substance Abuse and Mental Health Services Administration, 2013). Based on both theory and empirical evidence, these declines in the perceived risk of using marijuana could be contributing to increases in use (Kuehn, 2013).

### ***Changing marijuana use policies***

A changing policy landscape may be further contributing to changes in perceptions of harm. At the federal level, marijuana is classified by the Drug Enforcement Agency as an illegal, Schedule 1 drug with no accepted uses. However, as of 2015, 24 states and the District of Columbia have legalized medical marijuana, and four states (Alaska, Colorado, Oregon, and Washington) and the District of Columbia have legalized recreational marijuana (Association of State and Territorial Health Officials, 2015). A number of additional states have decriminalized marijuana use or have legalized specific cannabinoids in marijuana for medicinal use (Association of State and Territorial Health Officials, 2015).

National data indicate that individuals living in states with medical marijuana laws have higher odds of marijuana use and marijuana abuse or dependence than residents in states without such laws (Cerda, Wall, Keyes, Galea, & Hasin, 2012), suggesting that marijuana-related policies may normalize use and potentially lead to use disorders. However, studies have found that medical marijuana policies are not linked to increased use in youth and adolescents (Harper, Strumpf, & Kaufman, 2012; Lynne-Landsman, Livingston, & Wagenaar, 2013). Data from the first year following the 2012 legalization of recreational marijuana in Colorado and Washington suggest that use increased among adults (but not among youth) in both states, even though retail marketplaces selling recreational marijuana were not yet open (Substance Abuse and Mental Health Services Administration, 2014a). With both medical and recreational marijuana legalization policies increasing throughout the U.S. (Caulkins, Hawken, Kilmer, & Kleinman, 2012), more research is needed to understand the potential risks and comorbidities of increasing marijuana use among adults, including the impact of changing marijuana policies on use of other substances like alcohol and tobacco.

### ***Marijuana products and modes of use***

A number of marijuana products exist, and can be consumed in a variety of ways. Marijuana products include the dried and crushed marijuana flowers (cannabis herb), the resin (hashish), and oils or concentrates (hash oil, butane honey or hash oil, or wax) (Caulkins et al., 2012). The oils or concentrates are often extracted using solvents, like butane, which could compound potential health impacts. These marijuana products can be smoked (e.g., in joints, pipes, bongs, hookah), vaporized (e.g., in e-cigarette-like vaporizers), eaten (e.g., in cakes, cookies, brownies, candies), consumed in beverages, or

dabbed, which involves inhaling the marijuana concentrates. Combusted marijuana use predominates among the various modes of use (Schauer, King, Bunnell, Promoff, & McAfee, In Press), though increases in other modes may occur as a result of changing marijuana use policies.

### ***Increasing potency of marijuana***

Marijuana contains at least 85 different compounds, with delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD) being the two primary compounds (Caulkins et al., 2012). THC is the primary psychotropic component in marijuana and has been linked to increased dependence, anxiety, panic, and psychosis (Russo, 2011; Smith, 2005). CBD, on the other hand, is non-psychotropic, and may work with THC to modulate the high (Caulkins et al., 2012). In addition, CBD has been shown to have certain analgesic, anti-anxiety, anti-psychotic, antihyperalgesic, anticonvulsant, and neuroprotective properties (Crippa et al., 2011; Morgan & Curran, 2008; Russo, 2011; Sewell, Ranganathan, & D'Souza, 2009). Over the past few decades, the ratio of CBD to THC has declined such that recreational marijuana available in the U.S. today contains high levels of the psychoactive compound, THC, and no or little CBD (Burgdorf, Kilmer, & Pacula, 2011; Caulkins et al., 2012; Mehmedic et al., 2010). In particular, hash oil or concentrate can contain more than 60% THC (versus 5 to 10% in cannabis herb or resin). The increased ratio of THC to CBD, and the increased potency of and use of high THC products, may facilitate increased abuse and dependence (Caulkins et al., 2012) and may be associated with more adverse psychological health consequences among users (Morgan & Curran, 2008; Potter, Clark, & Brown, 2008; Sewell et al., 2009; Smith, 2005).

### ***Marijuana abuse and dependence***

In substance use, abuse has traditionally been thought of as milder than dependence (American Psychiatric Association, 2000; Hasin et al., 2013), referring to a maladaptive pattern of use leading to clinically significant impairment or distress (American Psychiatric Association, 2000). Dependence, on the other hand, has been synonymous with addiction, representing a pattern of use that results in a number of symptoms over a 12-month period (American Psychiatric Association, 2000). The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), published in May 2013, recognizes substance use disorders across a continuum, with different symptoms present in different individuals and based on different substances (Hasin et al., 2013). Accordingly, new diagnosis codes combine abuse and dependence into a single “substance use disorder” category, where diagnoses are divided into “mild,” “moderate,” and “severe” subtypes (American Psychiatric Association, 2013). Diagnosis of these subtypes across each substance is based on the presence of a certain number of symptoms, including tolerance (needing more of the substance to feel the same effects), withdrawal (physical symptoms when the substance is not used), taking larger amounts of the substance and over a longer time than intended, unsuccessful efforts to cut down or quit using the substance, and decreasing or giving up social, occupational, or recreational activities due to use (American Psychiatric Association, 2000, 2013). For the purposes of this literature review, we refer to dependence, addiction, and use disorder interchangeably.

Marijuana use disorders are less common than use disorders for other illicit substances, with around 9% of those who try marijuana developing dependence versus



between 15% and 24% percent of people who try other illicit drugs (Budney, Roffman, Stephens, & Walker, 2007). However, because the marijuana use is more prevalent than other illicit drugs, marijuana use disorders are more prevalent (Budney et al., 2007). Marijuana dependence has been increasing across all age groups over the past decade (Budney et al., 2007), perhaps due to the increased potency (higher THC levels) in the drug (Compton et al., 2004). In 2012, data from the National Survey on Drug Use and Health (NSDUH) suggest that among adults aged 12 and older, the prevalence of marijuana dependence was 1.7%, with those aged 18-25 having the highest prevalence of dependence of any age group at 5.5%.

Nationally representative data suggest that being male, being Native American, having low income (<\$20,000 per year), being separated or divorced, and residing in the western U.S. are associated with an increased odds of marijuana use disorder, while being Black, Asian, or Hispanic (versus White) are associated with decreased odds (Stinson, Ruan, Pickering, & Grant, 2006). However, marijuana use disorders appear to be increasing among Black, non-Hispanic and Hispanic men, and among Black women (Compton et al., 2004). Reasons for increases in minority populations remain unclear (Budney et al., 2007).

Data from the National Epidemiologic Survey on Alcohol and Related Conditions found that nearly all adults with a diagnosis of lifetime marijuana use disorder had a psychiatric comorbidity (96% of men and 94% of women) and that gender moderated the clinical characteristics of use, with men meeting more criteria for abuse and dependence and having longer periods of marijuana use disorders than women (Khan et al., 2013). Early onset of dependence after initiating use has been associated with earlier use of

marijuana, low family income (<\$20,000 per year), and use of other substances (e.g., tobacco, alcohol, other drugs) before trying marijuana (Chen, O'Brien, & Anthony, 2005).

Marijuana dependence is clinically similar to other substance use dependence disorders, though it has been thought of as less severe largely because of a lack of evidence for withdrawal symptoms when trying to quit (Budney et al., 2007). Evidence suggesting that some individuals experience significant withdrawal in quitting has grown in recent years (Hasin et al., 2013). While marijuana withdrawal was not included as a symptom of dependence in the DSM-IV due to a lack of evidence, it was added to the criteria for marijuana use disorder in the DSM-V. In studies, about one-third of regular users (Agrawal, Pergadia, & Lynskey, 2008; Hasin et al., 2008) and between 50 and 95% of heavy users (Copersino et al., 2006; Levin et al., 2010) report withdrawal symptoms.

### ***Health effects and comorbidity due to marijuana use***

In addition to use disorders, marijuana use has a number of other health and psychosocial effects. Both the benefits and the risks of marijuana use are still widely debated (Caulkins et al., 2012; Twombly, 2006; Wodak, 2012).

***Benefits:*** Research suggests a number of potential medical benefits from marijuana use (Clark, Capuzzi, & Fick, 2011; Leung, 2011), hence the recent increase in state initiatives to legalize marijuana for medical use. These benefits may include reduced nausea during chemotherapy (Bowles, O'Bryant, Camidge, & Jimeno, 2012; Clark et al., 2011), management of chronic pain (Greenwell, 2012), treatment of wasting syndrome associated with AIDS (Lutge, Gray, & Siegfried, 2013), and improved participant reports of muscle spasms related to multiple sclerosis (Grant, Atkinson, Gouaux, & Wilsey,

2012; Thaera, Wellik, Carter, Demaerschalk, & Wingerchuk, 2009). Interestingly, many of the identified medicinal benefits of marijuana derive not from THC, but largely from CBD and terpenoids in the cannabis plant (Ashton, Moore, Gallagher, & Young, 2005). Samples collected from marijuana in the U.S. find high levels of THC and low or no CBD (Burgdorf et al., 2011; Caulkins et al., 2012; Mehmedic et al., 2010). Thus, while components of marijuana have been shown to have health benefits, these components are not likely to be present at therapeutic levels in most recreational marijuana.

**Risks:** Studying the independent health risks from marijuana use has been difficult in part due to the heterogeneity of marijuana products, each with differing levels of compounds (McLaren, Swift, Dillon, & Allsop, 2008), and due to the schedule 1 status of marijuana, which makes it challenging for researchers to access and study marijuana. Some evidence suggests that higher potency of THC may cause more harm (Smith, 2005), yet the ratio of THC to CBD is rarely taken into account in epidemiologic studies. In addition, combusted marijuana use is often not delineated in studies and may have specific risks over other forms of administration (e.g., vaporized, edible, etc.). Finally, epidemiologic findings have been difficult to interpret because marijuana use often co-occurs with use of other substances (e.g., alcohol, tobacco, or other illicit drug use) that carry health risks that are similar to or overlap with those related to marijuana (Hall, 2009; Hall & Degenhardt, 2009). In spite of these limitations, current research suggests that the primary risks from marijuana use are psychosocial, acute, and chronic (Hall, 2009).

**Psychosocial Risks:** Negative psychosocial effects can include poor or reduced educational attainment (Lynskey & Hall, 2000) and increased use of other substances

(Kandel, 2002). In addition, brief and short-lived psychotic episodes can follow acute use in both the general population and among those at risk for schizophrenia (Hall, 2009; Hall, Degenhardt, & Teesson, 2009; Roffman & Stephens, 2012). In addition, poorer psychosocial functioning and increased hospitalizations are likely among patients with psychosis who regularly use marijuana (Grech, Van Os, Jones, Lewis, & Murray, 2005; Roffman & Stephens, 2012). Some evidence suggests that heavy use of marijuana can lead to the development of psychosis, schizophrenia, and mood disorder in those not otherwise predisposed (de Irala, Ruiz-Canela, & Martinez-Gonzalez, 2005; Hall et al., 2009; Moore et al., 2007; Zammit, Allebeck, Andreasson, Lundberg, & Lewis, 2002).

*Acute effects:* Marijuana does not produce the same respiratory depression effects as opiates or other illicit substances, making acute overdose rare (Gable, 2004). However, acute effects from its use include increased anxiety and panic (Hall & Pacula, 2003) and impaired cognitive functioning that can result in increased injury (Asbridge, Poulin, & Donato, 2005; Ramaekers, Berghaus, van Laar, & Drummer, 2004). In particular, marijuana can produce impaired reaction time, information processing, perceptual-motor coordination, motor-performance, attention, and tracking behavior (Solowij, Stephens, Roffman, & Babor, 2002). While studies assessing driving ability demonstrate more modest impairment for those under the influence of marijuana versus alcohol (Smiley, 1999), drivers who report using marijuana are twice as likely to report being in accidents than those who do not report marijuana use (Asbridge et al., 2005).

*Chronic effects:* Regular marijuana use has been shown to increase risk for respiratory diseases (Tashkin, Baldwin, Sarafian, Dubinett, & Roth, 2002), including chronic bronchitis (Aldington et al., 2007; Tashkin et al., 2002), and for cardiovascular

effects, including short-term risk for increased incidence of myocardial infarction (Mittleman, Lewis, Maclure, Sherwood, & Muller, 2001). It is unclear whether these risks derive from combusted use of the product or from specific compounds within the drug (Tormey, 2010). While some data suggest that chronic marijuana use also increases the risk of upper respiratory tract and lung cancers, findings are inconsistent (Hall, 2009; Mehra, Moore, Crothers, Tetrault, & Fiellin, 2006). For example, a recent longitudinal cohort study concluded that chronic marijuana use (>50 uses over a lifetime) was associated with a twofold risk of lung cancer, even after adjusting for tobacco use, alcohol use, other respiratory conditions, and socioeconomic status (Callaghan, Allebeck, & Sidorchuk, 2013). However, a case-control study in the U.S. found that associations between marijuana use and head, neck, and lung cancer were no longer significant after controlling for cigarette smoking (Hashibe et al., 2006). Another study of combusted marijuana use found a link between marijuana smoke and cellular damage, but not between smoke and lung cancer (Tashkin, 2005). Though the chronic health effects from marijuana use likely have a small to moderate adverse health impact compared to other substances (Hall, 2009), they are greatly exacerbated by frequent co-use of cigarettes and other tobacco products (Peters, Budney, & Carroll, 2012; Wodak, 2012).

## **Tobacco Use**

### ***Tobacco use among U.S. adults***

In 2013, 18% of adults were current cigarette smokers, with the highest prevalence occurring among those aged 25 to 44, those identifying as American Indian/Alaska Native or multi-racial, those with a General Education Diploma (GED) or less than high school education, and those living below the federal poverty line (Centers for Disease

Control and Prevention, 2014a). In contrast to the increasing prevalence of marijuana use among adults, cigarette smoking prevalence has decreased over the past two decades, with declines slowing in recent years (Centers for Disease Control and Prevention, 2011, 2012). Between 2005 and 2010, a slight overall decline in current cigarette smoking occurred, with the largest decline occurring among those aged 18-24; however, a significant increase was observed in the prevalence of light (1-9 cigarettes per day) and nondaily smoking (Centers for Disease Control and Prevention, 2011).

While cigarette smoking appears to be slowly declining among U.S. adults, the use of other tobacco products, either alone or in combination with cigarettes may be increasing (Centers for Disease Control and Prevention, 2006; King, Dube, & Tynan, 2012). In particular, new products, including snus, dissolvable or smokeless/spitless tobacco products, and electronic nicotine delivery systems (ENDS or e-cigarettes) have been gaining in popularity (Etter, 2010; McMillen, Maduka, & Winickoff, 2012; Zhu et al., 2013). The use of new or emerging nicotine-based products among those who have never smoked cigarettes may normalize tolerance towards tobacco use (McMillen et al., 2012), potentially threatening decades of work in reducing tobacco use. Furthermore, it is unknown how use of non-cigarette tobacco products impact co-use of other substances like marijuana.

### ***Tobacco products and modes of use***

Tobacco in the U.S. is still primarily consumed in combusted form, with cigarettes being the predominant product (Centers for Disease Control and Prevention, 2014b). Tobacco can also be consumed in cigars, little cigars and cigarillos; pipes, hookah or waterpipes; smokeless chewing tobacco, snuff, and snus (spitless moist snuff

packed in porous bags); or dissolvable products (spitless dissolvable oral tobacco products that look like breath mints, strips, or toothpicks) (Centers for Disease Control and Prevention, 2014b; Choi, Fabian, Mottey, Corbett, & Forster, 2012). In addition, electronic nicotine delivery systems like e-cigarettes, e-hookah, and other vaporizing devices can be used to consume nicotine liquid, and have increased dramatically in prevalence since their introduction to the marketplace around 2007 (King, Patel, Nguyen, & Dube, 2015).

### ***Nicotine abuse and dependence***

Nicotine is the main psychoactive component in tobacco products and is a main cause of dependence (Fiore et al., 2008; U.S. Department of Health and Human Services, 2010). Most tobacco users are addicted to nicotine, with dependence being characterized as a chronic, relapsing condition (Fiore et al., 2008). The pharmacologic and behavioral processes that drive nicotine addiction are similar to those that drive heroin or cocaine addiction, including strong drug-seeking behaviors, self-administration, and extreme difficulty quitting (U.S. Department of Health and Human Services, 1988).

While nicotine and marijuana share some dependence characteristics, nicotine dependence has some unique symptomology. For example, in a study comparing adults using tobacco to those using alcohol, marijuana, cocaine, or opioids, tobacco users were significantly more likely to report tolerance, withdrawal, greater consumption or duration of use, inability to stop/cut down/control use, and compulsive use (Hughes, 1994).

Population and community-based surveys suggest that the prevalence of nicotine dependence in adult smokers ranges from 28 to 75% (Breslau & Johnson, 2000; Breslau, Johnson, Hiripi, & Kessler, 2001; Breslau, Novak, & Kessler, 2004; Kandel & Chen,

2000) with the wide variability being attributed to the sample, and to the screening criteria utilized (U.S. Department of Health and Human Services, 2010). While the DSM-5 criteria for tobacco use disorder were aligned with the criteria for other substance use disorders, a number of diagnostic issues have been identified in using DSM-criteria to assess nicotine dependence (e.g., criteria are based on dependence factors that have been found to have low predictive validity for tobacco dependence) (DiFranza et al., 2010; U.S. Department of Health and Human Services, 2010). Tobacco researchers more commonly use the Fagerström Test for Nicotine Dependence (Fagerstrom & Schneider, 1989; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991) to assess dependence, though using DSM criteria allows for comparison with other drug dependence. The lifetime prevalence of nicotine dependence among U.S. adults (based on DSM criteria) ranges from 20-24% (U.S. Department of Health and Human Services, 2010), making nicotine dependence the most common form of addiction in the U.S. (American Society of Addiction Medicine, 2010). One out of every three first-time cigarette smokers goes on to become nicotine dependent (Substance Abuse and Mental Health Services Administration, 2013). Nicotine dependence generally follows a pattern of daily smoking (U.S. Department of Health and Human Services, 2010), though some nondaily and light smokers show signs of dependence as well (Shiffman, Ferguson, Dunbar, & Scholl, 2012).

### ***Health effects and comorbidity due tobacco use***

Whereas the health effects of marijuana are more widely debated, the health effects of tobacco are well established. Tobacco use is the primary cause of preventable death and disease in the U.S. (U.S. Department of Health and Human Services, 2014).



Substantial evidence exists from various meta analyses and U.S. Surgeon General's Reports about the negative, causal effects of tobacco use on numerous diseases including cancer, respiratory and lung diseases, heart disease, stroke, chronic obstructive pulmonary disease, diabetes, and reproductive complications (National Cancer Institute, 1998; Organization, 2007; U.S. Department of Health and Human Services, 2014). Cigarette smoking causes nearly 500,000 deaths per year in the U.S., and more than 16 million Americans are living with a smoking-related disease (Centers for Disease Control and Prevention, 2013a; U.S. Department of Health and Human Services, 2014). Evidence suggests that quitting smoking at any age has benefits, but helping people quit before the age of 35 has been shown at a population level to lead to similar life expectancy to never smokers (Doll, Peto, Boreham, & Sutherland, 2004; Jha et al., 2013), making young adulthood a critical period to prevent future tobacco-related death and disease.

### **Co-Use of Marijuana and Tobacco**

Numerous epidemiologic studies have identified overlapping marijuana and tobacco use across the life course. A recent review of co-use in adolescents and young adults found 87 studies that assessed the association between the two substances; 90% found a positive association between current use of marijuana and tobacco (Ramo et al., 2012). Studies have generally looked at co-use using either current marijuana users or current tobacco users as the denominator. We are not aware of any studies that have assessed the prevalence or changing trends in co-use patterns among the general U.S. adult population.

### ***Tobacco use among marijuana users***

Marijuana users have been shown to have a higher prevalence of cigarette smoking than non-marijuana users (Agrawal et al., 2012). Nationally representative cross-sectional data from adults (age 18 and older) in 1997 found that 74% of past month marijuana users were also current smokers, though these data are now 18 years old (Richter et al., 2004). More recent cross sectional data from 2009 suggest that among respondents age 12 and older, 90% of those who had ever used marijuana reported being cigarette smokers at some point in their lifetime (vs. 47% of non-users) (Agrawal et al., 2012). Recent nationally representative data on the prevalence of current tobacco use among adult marijuana users are not available. Unadjusted odds ratios from a meta-analysis of studies using largely convenience samples or data from clinical trials suggest that among young adults who use marijuana, the odds of concurrent cigarette smoking are two to five times higher than among those who do not use marijuana (Ramo et al., 2012). Interestingly, two studies of nationally representative data have found a similar mean number of cigarettes smoked per day between marijuana and cigarette smokers, and cigarette only smokers, suggesting that the frequency of tobacco use among marijuana users is similar to the general smoking population (Moore, Augustson, Moser, & Budney, 2005; Richter et al., 2004).

### ***Marijuana use among tobacco users***

Tobacco users have been shown to have higher prevalence of marijuana use than non-tobacco users. Nationally representative, cross-sectional data from 2009 suggest that 58% of cigarette smokers age 12 and older reported having used marijuana at some point in their life (vs. 12% of non-smokers) (Agrawal et al., 2012). Unadjusted odds ratios from a meta analysis suggest that among young adult tobacco users, the odds of concurrent

marijuana use are three to six times higher than among those who do not use tobacco (Ramo et al., 2012).

### ***Relationship with alcohol***

Marijuana and tobacco use have also been shown to overlap with alcohol use. In 2012 nationally representative data, 42% of adults age 18-25 years and 18% of adults age 26 and older who used cigarettes and alcohol also used marijuana (vs. 4% and 1%, respectively, of those not using cigarettes and alcohol) (Substance Abuse and Mental Health Services Administration, 2013).

### ***Overlapping products and modes of use***

In addition to use of separate marijuana and tobacco products, a growing number of products exist that combine marijuana and tobacco. Concurrent consumption of marijuana and tobacco at the same time or within minutes of each other is common among adolescents and young adults. For example, one study of college students in Florida found that 65% had smoked both marijuana and cigarettes within the same hour, with 31% reporting they used the tobacco to prolong the effects from marijuana (Tullis, Dupont, Frost-Pineda, & Gold, 2003). Another study in the United Kingdom found that 95% of marijuana users reported that they had used tobacco with their marijuana (Hammersley & Leon, 2006).

*Spliffs/Mulling:* A growing body of research suggests that among adolescents, tobacco is commonly added to marijuana joints (referred to as spliffs or “mulling”) (Akre, Michaud, Berchtold, & Suris, 2010; Amos, Wiltshire, Bostock, Haw, & McNeill, 2004; Belanger et al., 2013), either because pure marijuana joints are too strong, too expensive, or do not burn correctly (Akre et al., 2010). Presently, spliff use is thought to

be more common internationally (compared with the U.S.) and among youth and adolescents (Belanger, Akre, Kuntsche, Gmel, & Suris, 2011; Belanger et al., 2013), but few studies have been conducted in the U.S. to confirm this. For example, a study in Switzerland found that four out of five adolescents reported frequent spliff use, with the highest occurrence being among daily cigarette smokers (Belanger et al., 2011). Few studies have explored the prevalence of spliff use among an adult population.

*Blunts:* A more common approach to co-administration in the U.S. is through use of “blunts” (Ream, Benoit, Johnson, & Dunlap, 2008). Blunts are formed when users remove part or all of the tobacco from a cigar (like a Phillies Blunts cigar, hence the name), replacing it with marijuana (Ream et al., 2008; Sifaneck, Johnson, & Dunlap, 2005). Even if all of the tobacco is removed, blunts typically still contain some residual tobacco (Ream et al., 2008). Blunts are usually shared among three or more smokers (Dunlap, Johnson, Benoit, & Sifaneck, 2005; Sifaneck et al., 2005) and have been found to be more commonly used among African American and Latino populations (versus Whites) (Mariani, Brooks, Haney, & Levin, 2011). Some data suggest that increases in marijuana use among U.S. youth during the 1990’s may have been partly due to the growing popularity of blunts (Golub, Johnson, & Dunlap, 2005). The prevalence of blunt usage has only recently become available; in 2000, surveillance systems began asking youth and adolescents questions specifically about blunts, after discovering that users did not consider blunts to be either marijuana or cigars (Golub et al., 2005). In 2005, 3.5% of U.S. adolescents were estimated to have used blunts in the past month (Substance Abuse and Mental Health Services Administration, 2007). Data on the prevalence of adult use of blunts have not been published.

*Chasing:* Another practice is “chasing” marijuana with a cigarette or cigarillo, or following a hit from a joint or bong with a cigarette (Ream et al., 2008). “Blunt chasing,” or smoking a cigarette, cigar, or cigarillo following a blunt has also been found to be an emerging practice that exposes marijuana smokers (particularly adolescents) to tobacco products (Sifaneck et al., 2005). No data exist among a nationally representative sample of young adults or adults to suggest how common “chasing” is as a co-administration technique.

### ***Health effects of marijuana and tobacco co-use***

Limited data are available on the health effects of comorbid substance use, including marijuana and tobacco co-use. As outlined, use of tobacco alone causes a myriad of diseases and death, making tobacco use a major potential comorbidity of marijuana use (Leatherdale, Hammond, Kaiserman, & Ahmed, 2007; Richter et al., 2004). Use of both cigarettes and smoked marijuana may have an additive effect, leading to potentially more severe health consequences (Barsky, Roth, Kleerup, Simmons, & Tashkin, 1998; Fligel et al., 1997; Hall & Solowij, 1998). A recent review of correlates of co-use found that compared to marijuana only users, those who also used tobacco had significantly more psychosocial problems, a greater likelihood of marijuana use disorders, and poorer marijuana cessation outcomes (Peters et al., 2012). Health risk behaviors, particularly among young adults, have been shown to be negatively impacted by co-use (Ramo et al., 2012). These include increased drugged driving (Bingham & Shope, 2004), decreased condom use (Parkes, Wight, Henderson, & Hart, 2007), and decreased educational attainment (McCaffrey, Pacula, Han, & Ellickson, 2008).

Tobacco smoke contains over 4000 identified chemicals, include 50 that are known carcinogens (U.S. Department of Health and Human Services, 2004, 2010). Studies assessing the chemistry of marijuana smoke are lacking. However, a recent study comparing both mainstream and side-stream smoke from marijuana versus cigarettes found that marijuana smoke contained a number of the same carcinogenic chemicals, and contained some (e.g., ammonia, aromatic amines, and polycyclic aromatic hydrocarbons) at significantly higher levels (Moir et al., 2008). The long-term health effects from these exposures are still unclear, but those who use both products have been shown to have significantly elevated risk of respiratory distress compared to those who use either product alone (Taylor et al., 2002). On the other hand, longitudinal studies of the development of lung cancer among adult dual users suggest that marijuana use does not add additional risk over tobacco use alone (Hashibe et al., 2005; Mehra et al., 2006). More research about the health effects of smoking both marijuana and cigarettes is needed.

Questions also remain about the impact that co-marijuana and tobacco use have on mental illness, since use of both substances is more prevalent among those with mental illness and has been shown to increase mental health symptoms (de Irala et al., 2005). A recent review of co-use of tobacco and marijuana among young adults found that exacerbation of mental health symptoms was a consistent consequence of using both drugs (Ramo et al., 2012). Studies have also shown a greater likelihood of depression diagnosis (Boys et al., 2003), depression symptoms (Lee Ridner, Staten, & Danner, 2005), and psychiatric disorder from dual use (Boys et al., 2003).

Another risk of co-marijuana and tobacco use is increased dependence on one or both products. This relationship appears to be bidirectional, though more research suggests that nicotine dependence leads to increases in marijuana use disorder than the converse. Data suggest that those with nicotine dependence are more than five times as likely as those without to have a past 12-month marijuana use disorder (Stinson et al., 2006). The relationship between marijuana use and nicotine dependence is less clear, with some studies finding that drug use disorders (including marijuana) are unique predictors of nicotine dependence, even after adjusting for confounding factors (U.S. Department of Health and Human Services, 2010), and others finding no relationship (Peters et al., 2012). However, a study using nationally representative data found the prevalence of nicotine dependence among adults with any past-12 month marijuana use disorder (abuse or dependence) was 53% (68% among those with marijuana dependence) (Stinson et al., 2006). Furthermore, co-use of marijuana does not appear to lead to lower levels of tobacco use (Flatz, Belanger, Berchtold, Marclay, & Suris, 2013) or higher rates of tobacco cessation compared to those who use only tobacco products (Ford, Vu, & Anthony, 2002).

### ***Sociodemographic correlates of co-use***

Correlates of co-marijuana and tobacco use have not been well studied among adults. To our knowledge, only one study has assessed correlates of tobacco use among adult marijuana users. Findings from that study, which was based on cross sectional data from the 1997 NSDUH, suggest that few demographic variables are correlated with dual use (Richter et al., 2004). However, the odds of being a current smoker were greater for individuals using one or more other illicit drug (e.g., not marijuana) in the past month

(Richter et al., 2004). Interestingly, alcohol intake and frequency of marijuana use were not significant correlates of cigarette smoking (though alcohol abuse and dependence are associated with marijuana abuse and dependence) (Pacek, Malcolm, & Martins, 2012).

Demographic correlates of co-use have been more widely studied among adolescents and young adults, but remain unclear. While some studies have found co-use to be associated with older age (Suris, Akre, Berchtold, Jeannin, & Michaud, 2007; Victoir, Eertmans, Van den Bergh, & Van den Broucke, 2007), a recent study found that co-users are younger than those who use only tobacco (Ramo, Delucchi, Hall, Liu, & Prochaska, 2013). Sex is also an unclear correlate. While some studies of adolescents and young adults have suggested a positive association between male sex and co-use (Guxens, Nebot, & Ariza, 2007; Penetar et al., 2005; Victoir et al., 2007), others have suggested a negative association (Ohene, Ireland, & Blum, 2005; Suris et al., 2007), and one found no correlation (Aung, Pickworth, & Moolchan, 2004). A number of studies have found African-American ethnicity (Aung et al., 2004; Vaughn, Wallace, Perron, Copeland, & Howard, 2008; White, Jarrett, Valencia, Loeber, & Wei, 2007) or multi-ethnicity to be associated with co-use (Ramo et al., 2013). Gaining a clearer understanding of sociodemographic correlates of co-use among adults could improve our understanding of potential disparities in use of these two substances, and aid in the development of future interventions targeting specific populations.

### **Reasons for Marijuana and Tobacco Co-Use**

Surprisingly little research has been conducted with adults to identify reasons for co-marijuana tobacco and use. In particular, few qualitative studies have been conducted with co-users to elicit and understand reasons for co-use, or identify theory-based



constructs that might explain the co-occurring behaviors. However, researchers have hypothesized a number of possible explanations for the overlapping use of marijuana and tobacco. These include:

***Shared mode of use:*** While other modes of administration exist for both marijuana and tobacco, a majority of use for both tobacco and marijuana occurs through smoking or inhalation (Agrawal et al., 2012). Analysis of data from U.S. adults who participated in the National Epidemiological study on Alcohol Related Conditions found that smoking tobacco (e.g., cigarettes, cigars, pipes) was associated with 3.3 to 4.5 times the risk of marijuana use, as well as marijuana abuse and dependence, while use of smokeless forms of tobacco was not associated with elevated rates of marijuana use, abuse, or dependence (Agrawal & Lynskey, 2009). The authors hypothesize that the respiratory adaptations from smoking one product may facilitate use of the other because the sensation of inhaled smoke may be less unpleasant (Agrawal & Lynskey, 2009). Smoking may also serve as a behavioral or conditioned cue, such that use of one product cues use of the other (Agrawal et al., 2012; Niaura et al., 1998; Shadel et al., 1998).

***Physiologic effects:*** Certain functional interactions between the physiological effects of nicotine and THC may promote and perpetuate co-use. Data from animal models indicate that co-administration of lower doses of both THC and nicotine induced rewarding effects (Valjent, Mitchell, Besson, Caboche, & Maldonado, 2002), suggesting that use of both drugs (versus just one) may enhance the psychoactive high (Valjent et al., 2002). Nicotine and marijuana may also modulate the unpleasant effects of each product; animal models suggesting that compounds in marijuana work to reduce nicotine withdrawal symptoms by blocking the cannabinoid receptors that play a key role in

nicotine withdrawal (Balerio, Aso, Berrendero, Murtra, & Maldonado, 2004; Cohen, Perrault, Griebel, & Soubrie, 2005). Findings related to reduced withdrawal symptoms, however, have not translated in practice. In fact, studies suggest that among dual users, withdrawal symptoms when trying to quit or reduce either marijuana or tobacco are similar (Budney, Vandrey, Hughes, Thostenson, & Bursac, 2008; Vandrey, Budney, Hughes, & Liguori, 2008), while symptoms when trying to quit both drugs appear more severe (Vandrey et al., 2008). Still, these findings suggest that co-use may occur as a way to enhance the rewarding effects from marijuana, or to reduce unpleasant physiologic effects related to nicotine withdrawal.

***Shared environmental factors:*** Environmental factors, including peer influences, availability of the products, and familial and other social environmental exposures may contribute to co-use of marijuana and tobacco (Agrawal et al., 2012). Peer influence is strongly associated with early onset of drug use (Lynskey, Fergusson, & Horwood, 1998). Recent data suggest these influences may continue to play a role into young adulthood, perpetuating regular and continued substance use (Agrawal et al., 2010). An 11-year prospective study of social influences on substance use (tobacco, alcohol, marijuana) from early adolescence to adulthood found that deviant peer influences remained important in throughout the life course and that deviant peers were the only significant social predictor of use in adulthood (Van Ryzin, Fosco, & Dishion, 2012).

Familial and social influences also appear to play a role in dual use. In a longitudinal study following male twins in the U.S. from adolescence to adulthood, familial influences (e.g., lack of parental monitoring) were a strong predictor of early use of both tobacco and marijuana, but decreased into adulthood, while the effects of other

shared environmental influences (e.g., at school, etc.) persisted into adulthood (Kendler, Schmitt, Aggen, & Prescott, 2008). Descriptive norms (e.g., perceptions about what people do) and injunctive norms (e.g., perceptions about how others want you to behave) appear to be correlated with both increased marijuana and tobacco use among young adults (Buckner, 2013; van den Putte, Yzer, & Brunsting, 2005).

***Shared genetic factors:*** Genetic predispositions may facilitate co-use (Agrawal et al., 2012; Ramo et al., 2012). Data from a community-based sample of dizygotic twins, biological sibling pairs, and adoptive sibling pairs in the U.S. suggests that problem use of tobacco, alcohol, and marijuana are mediated by common genetic influences (Young, Rhee, Stallings, Corley, & Hewitt, 2006). However, the degree to which genetic factors influence tobacco and marijuana misuse may depend on the state of use under study. For example, genetic factors related to sensation seeking, impulsivity, and problem behavior may contribute to initiation (Meyers & Dick, 2010), while genetic factors related to positive reinforcement, addiction, or withdrawal may contribute to abuse or dependence (Agrawal et al., 2012).

A recent review of correlates of dual marijuana and tobacco use among adolescents and young adults indicates that genetics account for only a small percentage of the variance in co-use (Ramo et al., 2012). Some data suggest that the genetic influence on initiation of tobacco and marijuana may explain significantly more variation for initiation than for progression to continued use or abuse (Neale, Harvey, Maes, Sullivan, & Kendler, 2006). However, a longitudinal study following male twins in the U.S. from adolescence to middle adulthood suggests the opposite – while environmental influences are stronger in adolescence, genetic factors increasingly influence substance

use into adulthood (Kendler et al., 2008). Thus, while common genetic factors have been identified, the extent to which they impact dual use of both tobacco and marijuana is unclear (Agrawal et al., 2012).

In summary, while explanations for the co-use of marijuana and tobacco have been proposed, for the most part, they are not based on findings from qualitative discussions with co-users, and remain largely disjointed from theory-based constructs that can explain behavior and inform interventions to change behavior.

### **Limitations of Previous Research**

A number of gaps and methodological limitations exist when assessing current data about co-marijuana and tobacco use.

*Data are largely from adolescents and young adults:* Most studies focus on the prevalence of dual use among adolescents and young adults (up to age 25). We are aware of only one epidemiologic study that uses nationally representative data to assess the prevalence of current cigarette smoking among current adult marijuana users, and data from this study are 18 years old (Richter et al., 2004). With marijuana use increasing among adults, current prevalence data among a broader age range is warranted.

*Studies focus on cigarette smoking, not other tobacco use:* To our knowledge, no nationally representative data have been published on the prevalence of use of other tobacco products among adult marijuana users. Studies typically define tobacco use as current cigarette smoking. While cigarette smoking is still the predominant method of consumption (Centers for Disease Control and Prevention, 2006, 2010), a number of other tobacco products are gaining in popularity (Etter, 2010; McMillen et al., 2012).

Understanding how these products are associated with other substances like marijuana is critical to future interventions to decrease tobacco and substance use.

***Studies often assess marijuana use among cigarette smokers, but rarely the reverse:*** Prevalence of marijuana use is often assessed among cigarette smokers, rather than assessing cigarette smoking or tobacco use among marijuana users. For example, in 2012, data from the detailed tables published from NSDUH suggest that the prevalence of marijuana use among current cigarette smokers aged 12 and older is 19.4%. Similar data using current marijuana users as the denominator are not reported (Substance Abuse and Mental Health Services Administration, 2013). Sample size from a single year of national data may preclude these additional analyses. However, since tobacco use carries greater harm than current patterns of marijuana use (Hall, 2009; Hall & Pacula, 2003), co-use of tobacco among marijuana users is a critical public health issue. Furthermore, as marijuana legalization expands in the U.S., marijuana users may become a more prominent and easier to identify population with important health disparities – one of which is likely to be a significantly higher use of tobacco products compared to the general population. Characterizing the prevalence of cigarette smoking and other tobacco use among marijuana users is critically important to understanding the extent to which tobacco is a comorbidity.

***Most data come from single, cross-sectional studies that use convenience samples:*** A paucity of longitudinal data exist to suggest how trends in dual tobacco and marijuana use may be changing. A majority of studies have assessed cross-sectional prevalence among convenience samples (Ramo & Prochaska, 2012). It is unclear to what extent increasing marijuana use may threaten further reductions in tobacco use,

particularly among the adult population (Leatherdale et al., 2007). Trend analyses could provide important data about whether co-marijuana and tobacco use is increasing or decreasing and to what extent tobacco use among marijuana users is an evolving problem. Longitudinal data from France suggest that co-use of tobacco and marijuana increased throughout the 1990's (Choquet, Morin, Hassler, & Ledoux, 2004). Data also seem to suggest that co-use of marijuana and tobacco occurs across the lifespan, not just during adolescence. However, these longitudinal and trend data are not from the U.S. and have not been updated to reflect changes that have occurred in the tobacco product landscape over the past decade.

*Frequency of marijuana use is not taken into account:* In existing epidemiologic studies, marijuana use is often assessed as a dichotomous yes/no variable, with any past month use qualifying as current use (Ramo et al., 2013; Roffman & Stephens, 2012). This is often due to a small sample size of current marijuana users in national surveillance systems. A recent cross sectional study with a convenience sample of young adult co-users assessed marijuana as a continuous variable and, not surprisingly, found differences in the relationship between tobacco and marijuana based on different levels of use (heavier marijuana use was associated with heavier tobacco use) (Ramo et al., 2013). Qualitative data are needed to begin to assess what, if any, differences exist in use and the relationship between marijuana and tobacco across a frequency gradient.

### **Mixed Methods Research**

The current mixed methods research sought to assess the overlapping relationship between marijuana and tobacco among U.S. adults. This research employed a two-phase explanatory mixed methods design (Creswell & Plano Clark, 2007), with quantitative

epidemiologic data being utilized first to identify and describe patterns in use, and qualitative data being collected second to provide context for epidemiologic findings. In particular, epidemiologic findings were used to inform the specific age range we focused on for the qualitative study, allowing us to focus on reasons for use among the age ranges with either the highest or increasing trends in use. A strength of explanatory mixed methods design is that in-depth qualitative data can be used to enrich findings from quantitative data. Specific methods for each phase of the study are described below.

### *Quantitative studies*

To address the aforementioned gaps in epidemiologic knowledge about co-use, the quantitative studies use nationally representative data from the 2003-2012 National Survey on Drug Use and Health to: (1) describe the prevalence, correlates, and temporal trends in co-marijuana and tobacco use, marijuana-only use and tobacco-only use among U.S. adults, and (2) describe the prevalence and temporal trends in specific tobacco product use (e.g., cigarettes, cigars, blunts, smokeless tobacco) among adult marijuana users.

As described above, little nationally representative data exist to describe tobacco use among adult marijuana users, and no trend data exist to characterize co-use over time. Furthermore, no published data (cross-sectional or otherwise) exist to characterize tobacco product use and trends among adult marijuana users. Data from these quantitative studies characterize the current co-marijuana and tobacco use epidemic, identify disparities in use, and provide context for the types of products people may be using.

For the first aim, we hypothesized that the prevalence of co-use would increase among the general adult population between 2003 and 2012. Although cigarette smoking and tobacco use as a whole show a stable trend among the general U.S. adult population (Centers for Disease Control and Prevention, 2012), some evidence suggests that tobacco use remains high and may be increasing among individuals with substance use disorder (Secades-Villa et al., 2013). Furthermore, marijuana use has increased, and individuals using substances have been shown to have higher tobacco use rates. Finally, the overlapping new tobacco and marijuana products that have become available in the past decade may perpetuate increasing co-marijuana and tobacco use.

For the second aim, we hypothesized that among adult marijuana users, the prevalence of use of other combusted products (e.g., cigars, little cigars, cigarillos, pipes, and blunts) would show an increasing trend relative to other tobacco products including cigarettes and smokeless tobacco. New and emerging tobacco products have been hypothesized to appeal to young adults (McMillen et al., 2012), who also have the highest prevalence of marijuana use (Substance Abuse and Mental Health Services Administration, 2013). Because other combusted products share a similar route of administration to the typical marijuana use administration (e.g., smoked or inhaled) (Agrawal et al., 2012), we would expect them to appeal to marijuana users more than non-combusted products like smokeless tobacco or snus. However, because cigarette use has been declining among the general population (U.S. Department of Health and Human Services, 2014), we hypothesized that it would have declined among adult marijuana users.

### ***Qualitative study***



A qualitative study was undertaken to address the aforementioned gaps in knowledge about the relationship between marijuana and tobacco, and to provide context to the epidemiological findings. Through in-depth interviews with adults aged 18-34 years who reported past month use of both marijuana and tobacco, the qualitative study aimed to assess described patterns of co-use, the relationship between marijuana and tobacco, and reasons for co-use versus use of either tobacco or marijuana alone. In addition, to determine whether the relationship between marijuana and tobacco differed by frequency of use of each substance, participants were recruited and themes were analyzed across four frequency-of-use strata (high tobacco use-high marijuana use, high tobacco use-low/moderate marijuana use, low/moderate tobacco use-high marijuana use, low/moderate tobacco use-low/moderate marijuana use). The relationship with alcohol and other illicit drugs was also explored.

The qualitative study was conducted in Washington State, where marijuana was legalized recreationally in 2012 for adults aged 21 year and older. Adults aged 18-34 years were selected as the study population because marijuana use has been shown to be substantially higher among younger age ranges, compared with older ages (Substance Abuse and Mental Health Services Administration, 2014b). Data from the qualitative portion of this research can be used to provide context to quantitative findings, and to begin to generate and test hypotheses about how marijuana and tobacco use are related, and potential differences in the relationship by frequency of use.

### **Summary**

In summary, epidemiologic data about the prevalence and correlates of, and trends in co-marijuana and tobacco use among adults are lacking and are needed to

inform future research on the overlapping use of both substances. Furthermore, few qualitative studies have been conducted to understand how adults characterize their co-occurring marijuana and tobacco use. Given the rapidly changing marijuana policy landscape, understanding the relationship marijuana has to tobacco is critical to help prevent associated tobacco use increases. Accordingly, this study used mixed methods to explore co-marijuana and tobacco use among adults. This study is unique in that it focused on co-use among a broader adult population (versus adolescents or young adults aged 18-24 years), it focused on tobacco use (versus only cigarette smoking), and it employed a mixed-methods approach to assess both epidemiologic trends, and qualitative descriptions of perceptions and practices from the affected individuals. These data can be used to inform future research among adult co-marijuana and tobacco users, including additional cross-sectional, longitudinal, and intervention research.

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## CHAPTER 2:

### **Trends in Patterns of Co-Use of Tobacco and Marijuana in Adults from 2003-2012**

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#### **Abstract**

**Background:** As marijuana legalization and acceptability increase in the U.S., it is important to understand the potential impact on tobacco use. Accordingly, we assessed prevalence, correlates, and ten-year trends in co-use of marijuana and tobacco among U.S. adults.

**Methods:** Data came from 378,459 adults participating in the 2003-2012 National Survey on Drug Use and Health, an annual, cross-sectional, household survey. Data from 2011-2012 were used to compute the most recent prevalence of past 30-day marijuana and tobacco use (co-use). Data from 2003-2012 were used to compute demographic correlates of co-use, overall trends in co-use, and trends by age, race, and sex. We also assessed trends in tobacco use among marijuana users and marijuana use among tobacco users.

**Results:** From 2011 to 2012, 5.2% of the sample were past month co-marijuana and tobacco users, 24.0% were tobacco-only users, and 2.3% were marijuana-only users. From 2003 to 2012, prevalence of co-use increased overall ( $p<.0001$ ), and among males and females ( $p<.001$ ,  $p<.05$ ), those ages 26-34 ( $p<.001$ ) and 50+ years ( $p<.0001$ ), and

Whites ( $p < .01$ ), Blacks ( $p < .05$ ), and Hispanics ( $p < .01$ ); there were no changes among adults 18-25 years. Tobacco use among marijuana users decreased between 2003 and 2012 (from 74.3% to 69.6%,  $p < .0001$ ), while marijuana use increased among tobacco users (from 14.2% to 17.8,  $p < .0001$ ).

**Conclusions:** Co-use of tobacco and marijuana increased from 2003-2012, with marijuana use increasing among past-month tobacco users and tobacco use declining among past-month marijuana users. Improved surveillance of co-use is needed as marijuana legalization policies expand and become more integrated in communities.



## **Introduction**

Marijuana is the most widely used illicit drug in the United States (U.S.) (Stinson et al., 2005; Substance Abuse and Mental Health Services Administration, 2013). Studies suggest a strong relationship between marijuana and tobacco use. Nationally representative cross-sectional data from adults (age 18 and older) in 1997 found that 74% of past month marijuana users were also current smokers (Richter et al., 2004). More recent cross sectional data from 2009 suggest that among respondents age 12 years and older, 90% of those who had ever used marijuana reported being cigarette smokers at some point in their lifetime, and about 60% of cigarette smokers reported a lifetime history of marijuana use (Agrawal, Budney, & Lynskey, 2012). Recent studies using convenience samples of both adolescents and young adults have found a slightly lower prevalence of co-use (Ramo & Prochaska, 2012; Tullis, Dupont, Frost-Pineda, & Gold, 2003). Among young adults, the odds of cigarette smoking are up to five times higher among marijuana users compared to non-users (Ramo, Liu, & Prochaska, 2012) and about 3.5 times higher among adult marijuana users compared to non-users (Richter et al., 2004).

Although the health effects of marijuana are still widely debated (Hall, 2009), the deleterious effects of tobacco are not (U.S. Department of Health and Human Services, 2014). Tobacco use causes cancer, cardiovascular disease, respiratory disease, and a myriad of other adverse health effects (U.S. Department of Health and Human Services, 2010, 2014), making it a significant comorbidity of marijuana use. Use of both cigarettes and smoked marijuana may have an additive effect, leading to potentially more severe health consequences (Barsky, Roth, Kleerup, Simmons, & Tashkin, 1998; Fligel et al.,

1997; Hall & Solowij, 1998). A recent review of the clinical correlates of co-use found that, compared to marijuana-only users, those who also used tobacco had significantly more psychosocial problems, a greater likelihood of marijuana use disorders, and poorer marijuana cessation outcomes (Peters, Budney, & Carroll, 2012). Compared to tobacco-only users, co-use of marijuana does not appear to lead to lower levels of tobacco use (Flatz, Belanger, Berchtold, Marclay, & Suris, 2013) or higher rates of tobacco cessation (Ford, Vu, & Anthony, 2002). Health risk behaviors, particularly among young adults, have also been shown to be negatively associated with co-use (Ramo et al., 2012), including increased drugged driving (Bingham & Shope, 2004), decreased condom use (Parkes, Wight, Henderson, & Hart, 2007), and decreased educational attainment (McCaffrey, Pacula, Han, & Ellickson, 2008).

Co-use can refer to concurrent use of both substances, individually, but within the past 30-days, and to co-administration, or use of the substances at the same time or through blunts (hollowed out cigars filled with marijuana) and spliffs (joints filled with tobacco). Research on why co-use of tobacco and marijuana occurs is limited. Researchers have hypothesized that the shared route of administration for use (e.g., both are primarily smoked), the ability to co-administer both substances (e.g., through blunts and spliffs), shared environmental factors (e.g., peer influences, availability of the products, and familial and other social environmental exposures), and shared genetic predispositions may promote co-use (Agrawal et al., 2012). Data from animal models suggests that use of both substances may also enhance the psychoactive high (Valjent, Mitchell, Besson, Caboche, & Maldonado, 2002). Another study found that individuals

reported that marijuana use increased tobacco urges and vice versa (Ramo, Liu, & Prochaska, 2013).

Limited research has documented the demographic correlates of co-use. While a few studies among adolescents have found co-use to be associated with older age (Suris, Akre, Berchtold, Jeannin, & Michaud, 2007; Victoir, Eertmans, Van den Bergh, & Van den Broucke, 2007), a recent study of young adults found that co-users were younger than tobacco-only users (Ramo, Delucchi, Hall, Liu, & Prochaska, 2013). Some studies of adolescents and young adults have suggested a positive association between male sex and co-use (Guxens, Nebot, & Ariza, 2007; Penetar et al., 2005; Victoir et al., 2007), others have suggested a negative association (Ohene, Ireland, & Blum, 2005; Suris et al., 2007), and one found no correlation (Aung, Pickworth, & Moolchan, 2004). A number of studies have found African-American ethnicity (Aung et al., 2004; Vaughn, Wallace, Perron, Copeland, & Howard, 2008; White, Jarrett, Valencia, Loeber, & Wei, 2007) or multi-ethnicity to be associated with co-use (Ramo, Delucchi, et al., 2013). Another study assessing the correlates of cigarette smoking among adult marijuana users found that the odds of being a current smoker were greater for individuals using one or more other illicit drug (e.g., not marijuana) in the past month, but alcohol use was not a significant correlate (Richter et al., 2004).

A limitation of recent studies on the prevalence and correlates of co-tobacco and marijuana use is that most focus only on adolescents and young adults (aged 18-24 years), and use convenience samples rather than nationally representative data. To our knowledge, no data have been published on national trends in co-use of tobacco and marijuana among U.S. adults. Because of the relationship between both substances, it is

conceivable that increasing legalization and public acceptability of marijuana could impact tobacco use in the U.S. In particular, increased prevalence of marijuana use could lead to increased tobacco use. Assessing changes in patterns of co-use over the past decade can help provide context for future surveillance as more states look to legalize marijuana for recreational or medical use. Accordingly, this study used nationally representative data from the U.S. adult population to assess the recent prevalence of co-use of tobacco and marijuana, and trends over time in co-use, overall, and by demographic characteristics.

## **Methods**

### ***Sample:***

Data for this study come from 378,459 non-institutionalized adults aged 18 and older who responded to the U.S. National Survey on Drug Use and Health (NSDUH) between 2003 and 2012. NSDUH is a cross-sectional, nationally representative household interview survey conducted annually by the Substance Abuse and Mental Health Services Administration (SAMHSA). NSDUH employs a state-based design with stratified independent, multistage area probability sampling within each state and the District of Columbia. Because of changes to the sampling and survey methodology, only data after 2003 are used in these analyses. Data from the most recent two years (2011-2012) were used to characterize co-use of marijuana and tobacco vs. marijuana-only and tobacco-only use (n=77,002). Data from all years were used to assess demographic correlates and compute trends in co-use. Response rates for NSDUH between 2003 and 2012 ranged from 73% to 76%. Because these were secondary analyses of public-use data, this study was exempted from IRB approval.

***Measures:***

Past month marijuana use was defined as any past 30-day use of marijuana, hashish, or blunts. NSDUH did not ask questions about medicinal versus recreational marijuana use, thus we are unable to differentiate between the two for the purpose of these analyses. Past month tobacco use was defined as any past 30-day use of any of the following tobacco products: all or part of a cigarette, cigars, pipes, snuff, or chewing tobacco.

For the purpose of these analyses, co-use refers to concurrent use of both tobacco and marijuana on one or more of the past 30 days. Due to the questions on NSDUH, we were unable to assess whether or not use of tobacco and marijuana occurred on the same day, only that both substances were used at some point during the past 30 days. A crosstab of past month marijuana users and past month tobacco users was used to identify past month co-users of marijuana and tobacco, marijuana-only, tobacco-only, or neither marijuana nor tobacco. Individuals with past month blunt use but no other past month tobacco use were considered to be past month marijuana users only (not co-users), since blunt use was not collected as a separate substance in NSDUH until after 2004, and we cannot be certain that blunt-only users would have considered themselves to be tobacco users as well. During the years when blunt use was collected, only 3% of tobacco and marijuana users were blunt-only users; 97% reported using other tobacco products. Data on use of spliffs was not collected by NSDUH.

Past month alcohol use was defined as having had any drink of an alcoholic beverage in the past 30 days. Participants were also asked on how many days they had five or more drinks on the same occasion (at the same time or within a couple hours of

each other). Binge drinkers were individuals reporting 1 to 4 days of having five or more drinks in the past month; heavy alcohol users were defined as those reporting five or more days of having five or more drinks in the past month.

Other past month illicit substance use was defined as one or more days of any nonmedical use of any of the following products in the past 30 days: cocaine, crack, heroin, hallucinogens, inhalants, opiates, tranquilizers, stimulants, and sedatives.

Sex (male, female), age (18-25, 26-34, 35-49, 50+ years), race/ethnicity (White, Black, Hispanic, other), education (< high school, high school or general equivalency degree, some college, college or more), income (<\$20,000, \$20,000-49,999, \$50,000+), employment status (full-time, part-time, unemployed, other/not in the labor force), marital status (married, widowed, divorced or separated, never married), and health status (excellent, very good, good, fair, poor) were also collected and included in these analyses. Education was only computed among those >25 years old.

***Analysis:***

Variables used in these analyses were imputation-revised variables made available publicly as part of the NSDUH data. Imputation was conducted using predictive mean neighborhood, which is a combination of model-assisted and nearest neighbor hot-deck imputation methods. More information about the imputation process can be found elsewhere (RTI International, 2010; Substance Abuse and Mental Health Services Administration, 2013). Estimates were weighted to the national census-based population data (RTI International, 2010). To account for the complex survey design, all analyses were conducted in SAS-callable SUDAAN v9.2 (RTI International, Research Triangle,

NC). Alpha levels were set at  $p < 0.05$  for all analyses. Data were pooled into two-year time increments to stabilize estimates.

To characterize current marijuana and tobacco users, data from the most recent two-year period (2011-2012) were used to compute weighted frequencies across demographic and substance use characteristics, by past 30-day tobacco and marijuana use status (co-user, marijuana-only user, tobacco-only user, neither).

Data from the most recent ten years (2003-2012) were used to assess correlates of and trends in co-use. Multinomial logistic regression was used to compare correlates of co-use, marijuana-only use, and tobacco-only use (vs. use of neither substance), controlling for year. For trends, prevalence estimates of co-use were computed for each time increment, adjusting for sex, age, and race/ethnicity. Stratified estimates were also computed among co-users by age, sex, and race/ethnicity to assess differences within groups. To evaluate variation in change among all tobacco users versus all marijuana users, adjusted trends in the prevalence of tobacco use among marijuana users, and marijuana use among tobacco users were also computed. Logistic regression models were used to test for linear and non-linear time trends, using orthogonal polynomials to model time simultaneously in models as linear and quadratic.

## **Results**

### ***Current prevalence of co-use, by demographics:***

From 2011-2012, 5.2% of participants were co-users of marijuana and tobacco, 2.3% were marijuana-only users, and 24.0% were tobacco-only users. Compared to both marijuana-only and tobacco-only users, a significantly higher percentage of co-users were male, ages 18-25 or 26-34 years, of lower income, unemployed, never married, and

with past month heavy drinking or other illicit substance use (Table 2.1). Compared to tobacco-only users, a higher percentage of co-users were Black, and a lower percentage were White; no racial ethnic demographic differences were found between co-users and marijuana-only users (Table 2.1).

***Correlates of co-use:***

In a multinomial regression model adjusting for year (2003-2012), co-users of marijuana and tobacco had higher odds than marijuana-only and tobacco-only users (reference group=non-users) of being male, younger in age, self-reporting poorer health status, being heavy drinkers or binge drinkers, and reporting past month other substance use (Table 2.2). Both co-users and marijuana-only users were more likely to be Black compared to tobacco-only users and to be employed part-time (vs. full-time). Both co-users and tobacco-only users were more likely to have lower educational attainment than marijuana-only users.

***Trend analyses:***

*Overall*

From 2003 to 2012, past month co-use of marijuana followed a significant nonlinear increasing trend (from 4.4% of the sample in 2003-2004 to 5.2% of the sample in 2011-2012,  $p$  for trend<.0001), adjusting for sex, age, and race/ethnicity. Adjusted past month marijuana-only use followed a significant linear increasing trend ( $p$ <.0001), while adjusted past month tobacco-only use followed a significant nonlinear decreasing trend ( $p$ <.0001) (Table 2.3, Figure 2.1).

In order to determine the magnitude of co-occurring use among the population of marijuana users versus the population of tobacco users, we assessed changes in use of



tobacco use among current marijuana users, and marijuana use among current tobacco users over time, adjusting for sex, age, and race/ethnicity. Tobacco use among marijuana users was extremely prevalent, but declined significantly between 2003 and 2012 (from 74.3% in 2003-2004 to 69.6% in 2011-2012,  $p$  for trend  $<.0001$ ). Marijuana use among current tobacco users (a larger population) was less prevalent, but increased significantly over time, from 14.2% in 2003-2004 to 17.8% in 2011-2012 ( $p$  for trend  $<.0001$ ) (Table 2.3, Figure 2.2).

#### *By demographic characteristics*

Assessing stratified trends, co-use increased linearly among both males and females ( $p<.001$  and  $p<.05$ , respectively), with a faster rate of increase among males (% change=12.9%) (Table 2.3). Co-use increased nonlinearly among those ages 26-34 years ( $p<.001$ , % change=21.2%), and linearly among those ages 50+ years ( $p<.0001$ , % change 114.3%), but did not change among adults ages 18-25 years or 35-49 years (Table 2.3, Figure 2.3). Co-use also increased linearly among Whites, Blacks, and Hispanics ( $p<.01$ ,  $p<.05$ ,  $p<.01$ , respectively), with a faster rate of increase among Blacks and Hispanics, compared to Whites (% change=23.6% for Blacks, 21.9% for Hispanics, and 8.5% for Whites) (Table 2.3, Figure 2.3).

#### **Discussion**

The most important findings from this study are that co-use of marijuana and tobacco among adults increased between 2003-2012, with increases occurring among both males and females, those ages 26-34 and 50+ years, and across most racial/ethnic groups. Compared to those who do not use both substances, the odds of co-use of marijuana and tobacco are higher among males, those in younger age groups, those with

poorer health, binge drinkers or heavy drinkers, and those who have other past month substance use.

These data suggest that an overwhelming majority of marijuana users also use tobacco, but use is declining. On the other hand, a smaller percent of tobacco users also use marijuana, but use is increasing. Policies making marijuana use legal for medicinal or recreational reasons may increase access and thus utilization of marijuana among tobacco users. These policies coincide with greater public acceptance of marijuana (Gallup, 2013), which may also increase use. In addition, the advent and commercialization of new products for consuming tobacco, like electronic nicotine delivery systems (ENDS) (King, Alam, Promoff, Arrazola, & Dube, 2013; Pepper & Brewer, 2014), overlaps with similar products being used for marijuana consumption (Malouff, Rooke, & Copeland, 2014). These delivery systems may be sold by the same vendors and marketed in tandem, thus promoting co-use. More research is needed to assess how changing policies and new and emerging tobacco and marijuana products impact co-use of marijuana and tobacco. Future research should also seek to assess what is driving increases in co-use - increasing marijuana use in existing tobacco users, or the converse?

Use among individuals of different ages also warrants attention. While people ages 18-25 years continue to have the highest prevalence of use among all age groups, prevalence has remained stable over the past decade and is not increasing. Much of the prior research on co-use of substances has focused on this young adult age group (Akre, Michaud, Berchtold, & Suris, 2010; Leatherdale, Hammond, Kaiserman, & Ahmed, 2007; Ramo, Delucchi, et al., 2013; Ramo et al., 2012; Ramo & Prochaska, 2012). However, our data suggest that significant increases in the prevalence of co-use of

marijuana and tobacco have occurred among those ages 26-34 years. More research is needed to understand why co-use is increasing in this age group. Genetic influences on substance use, including nicotine, may increase during adulthood relative to adolescence (Kendler, Schmitt, Aggen, & Prescott, 2008), and could contribute to more stable patterns of co-use later in young adulthood. A second possible influence is the role of stressful transitional events (e.g., obtaining employment) and role-related changes (e.g., marital and parenting roles) that foster stress-relief co- or poly-substance use (Bachman et al., 2002). Whatever the reason, these findings suggest that future research on co-use of tobacco and marijuana may need to embrace an expanded definition of young adults that includes those up to age 34 years.

Co-use also increased among individuals aged 50+ years, though the prevalence of use among this age group remains low (<2%). More research is needed to determine why use is increasing in this group. Are these individuals existing tobacco users who are initiating or re-initiating marijuana use? If so, is their marijuana use for medical reasons? How has their initiation or re-initiation coincided with increases in medical marijuana legalization policies? Future surveillance systems should consider including questions about whether marijuana use is for medicinal or recreational reasons (or both), as these reasons may help to explain changes in use patterns among certain populations or age groups.

The finding that prevalence of co-use is highest among Blacks and continues to increase is concerning and suggests disparities in co-use. Due to a lack of consistent data collection, this study did not include blunt-only users (e.g., individuals reporting use of blunts but no other tobacco products). It is likely that including this sub-population of

blunt users would further increase the prevalence of co-use among Blacks, since their use of blunts has traditionally been higher (Golub, Johnson, & Dunlap, 2005; Mariani, Brooks, Haney, & Levin, 2011). Studies suggest that many Blacks initiated blunt use as adolescents or young adults in the 1990's and have continued use over time (Golub et al., 2005; Timberlake, 2013). While blunts were not included as a tobacco product in this study, some research suggests that blunts contain residual nicotine that can lead to dependence (Henningfield, Fant, Radzius, & Frost, 1999). This continued exposure to nicotine might lead some individuals to initiate use of other tobacco products, leading to higher prevalence of co-use. More research is needed to understand why co-use is more prevalent among Blacks and what role, if any, blunts play in promoting use of other tobacco products.

Data suggest a clear relationship between past month heavy or binge alcohol use or use of other illicit substances and co-use, even after adjusting for age. While prior studies have not assessed correlates of co-use among a nationally representative sample of adults, research has found alcohol, illicit drug use (including marijuana use) and tobacco to be related in both adults and adolescents (Fraser, Gartner, & Hall, 2014; Nelson, Van Ryzin, & Dishion, 2014; Tzilos, Reddy, Caviness, Anderson, & Stein, 2014). The relationship may be in part because of genetic factors that pre-dispose people to substance use or addiction (Agrawal et al., 2012; Ramo et al., 2012; Young, Rhee, Stallings, Corley, & Hewitt, 2006), or it may be due to the social environments in which these substances are typically used. More research is needed to assess the impact that alcohol use and other illicit drug use have on tobacco and marijuana dependence, use patterns of each over time, and cessation.

Data also suggest that decreasing levels of self-reported health are associated with higher adjusted odds of co-use. In looking at the prevalence of demographics across co-use and marijuana-only and tobacco-only groups, marijuana-only users have a significantly higher prevalence of self-reported good to excellent health compared to either tobacco-only or co-use groups. We were not able to ask participants qualitative questions about how they perceive their use of marijuana and tobacco to contribute to their overall health, but it may be that tobacco use is the primary contributing factor among co-users in self-reporting poorer health. More research is needed to determine how decisions to initiate or discontinue use of either tobacco or marijuana may relate to perceived health status in co-users (e.g., do tobacco users begin using marijuana because they perceive it to be a healthier alternative?).

To our knowledge, this is the first study to use nationally representative data to assess trends in co-use of tobacco and marijuana among adults in the U.S. These data can be used as a baseline upon which to compare changes that may occur in the prevalence of co-use as marijuana policies change and tobacco and marijuana products evolve. Knowledge of specific populations that may have high levels of co-use can also help inform tobacco prevention and cessation programs. Strengths of this study include the large, nationally representative sample, the use of two-year increments to stabilize current estimates, and the use of multiple cross sections to assess changes over time.

A number of limitations should also be considered when interpreting these data. First, while data from NSDUH have been shown to be reliable, data are self-reported. As such, they are subject to recall bias, and given the sensitive nature of inquiring about illicit activities, are also subject to social desirability bias. Second, while multiple cross-

sections were utilized for this study, data are not longitudinal. No inferences about individual trends or within-person patterns of use are possible. Third, these analyses sought to characterize population-based trends. Based on our objectives and on the small span of years of surveillance, we did not explore age-based cohort effects. We were unable to include data prior to 2003 due to methodological changes in NSDUH. Future studies could use other surveillance systems to focus on the possibility that patterns of co-use change by age-based cohorts. Fourth, due to lower marijuana use prevalence rates in older age groups, we were unable to use more granular age categories. Fifth, we did not include blunt-only users in these analyses, since questions asking specifically about blunt use were not included consistently for the adult population surveyed by NSDUH over our time period of interest. Therefore, these data may underestimate the prevalence of co-use, particularly among specific populations who have been shown to use blunts in greater proportion. Finally, our analyses were limited to the questions asked as part of NSDUH and thus we are unable to assess the impact that policy changes, psychosocial factors, or the normative environment may have had on trends.

In conclusion, co-use of tobacco and marijuana increased among adults between 2003-2012, with increases occurring disproportionately among specific demographic groups, including those ages 26-34, and 50+ years, and Whites, Blacks, and Hispanics. Because tobacco use is the primary cause of preventable death and disease in the U.S., improved and increased surveillance of co-use is needed as marijuana legalization policies expand.

**Table 2.1: Demographic characteristics and other substance use among adults, by marijuana and tobacco use groups, 2011-2012 NSDUH**

		Past Month Marijuana Use and Tobacco Use N=7,111 Wt % (95% CI)	Past Month Marijuana Use, No Tobacco Use N=2,616 Wt % (95% CI)	Past Month Tobacco Use, No Marijuana Use N=20,323 Wt % (95% CI)	No Past Month Marijuana Use, No Past Month Tobacco Use N=46,952 Wt % (95% CI)
<b>Sex</b>	Male	67.4 (65.6, 69.2)	59.6 (56.0, 63.2)	57.8 (56.9, 58.8)	43.0 (42.2, 43.9)
<b>Age</b>	18-25	40.6 (38.8, 42.3)	34.4 (31.5, 37.5)	15.7 (15.1, 16.3)	11.9 (11.6, 12.2)
	26-34	25.1 (23.4, 26.9)	21.5 (18.9, 24.4)	19.6 (18.8, 20.5)	13.5 (13.0, 13.9)
	35-49	21.2 (19.3, 23.3)	18.4 (16.3, 20.7)	30.3 (29.3, 31.2)	25.3 (24.8, 25.9)
	≥50	13.1 (11.3, 15.2)	25.7 (21.9, 29.9)	34.5 (33.2, 35.7)	49.3 (48.5, 50.1)
<b>Race/Ethnicity</b>	White, NH <sup>a</sup>	67.4 (65.7, 69.1)	67.0 (63.3, 70.6)	72.2 (71.0, 73.3)	64.5 (63.6, 65.4)
	Black, NH	15.6 (14.3, 17.1)	13.4 (11.3, 15.8)	11.1 (10.4, 11.9)	11.3 (10.7, 11.9)
	Hispanic	11.6 (10.3, 13.0)	15.1 (12.9, 17.7)	11.1 (10.3, 11.9)	16.2 (15.4, 16.9)
	Other, NH	5.4 (4.7, 6.1)	4.4 (3.4, 5.6)	5.6 (5.0, 6.2)	8.0 (7.5, 8.6)
<b>Education</b> <sup>b</sup>	<High School	21.5 (18.8, 24.6)	10.5 (7.5, 14.5)	18.2 (16.9, 19.5)	12.4 (11.9, 12.9)
	High School or GED <sup>c</sup>	34.4 (31.7, 37.1)	23.9 (19.3, 29.2)	35.4 (34.2, 36.6)	27.0 (26.2, 27.7)
	Some College	26.5 (23.7, 29.4)	23.4 (19.9, 27.2)	26.9 (25.7, 28.1)	23.9 (23.1, 24.7)
	College or more	17.6 (14.9, 20.7)	42.2 (36.7, 47.8)	19.5 (18.6, 20.5)	36.7 (36.0, 37.5)
<b>Household Income</b>	<\$20,000	44.0 (42.2, 45.9)	34.3 (30.7, 38.1)	36.9 (35.5, 38.4)	26.8 (26.0, 27.5)
	\$20,000-49,999	22.9 (21.1, 24.9)	20.8 (18.5, 23.3)	23.5 (22.3, 24.8)	20.9 (20.2, 21.7)
	\$50,000+	33.0 (31.1, 35.0)	44.9 (41.1, 48.7)	39.5 (38.1, 40.9)	52.3 (51.3, 53.3)
<b>Employment Status</b>	Full time	46.5 (44.6, 48.5)	48.1 (44.6, 51.6)	53.0 (52.0, 54.1)	49.1 (48.3, 50.0)
	Part time	18.8 (17.5, 20.2)	21.3 (18.9, 23.9)	12.2 (11.5, 12.9)	14.0 (13.5, 14.5)
	Unemployed	13.4 (12.2, 14.6)	9.6 (7.6, 12.1)	8.2 (7.7, 8.7)	4.3 (4.0, 4.6)
	Other/Not in labor force	21.3 (19.6, 23.0)	21.0 (18.2, 24.1)	26.6 (25.5, 27.7)	32.6 (31.8, 33.4)
<b>Marital Status</b>	Married	20.5 (18.7, 22.4)	31.9 (28.7, 35.3)	44.2 (43.1, 45.3)	58.7 (57.9, 59.5)
	Widowed	1.0 (0.6, 1.8)	1.6 (0.8, 3.0)	4.2 (3.8, 4.8)	7.1 (6.7, 7.5)
	Divorced or Separated	14.3 (12.9, 15.7)	14.7 (12.0, 17.8)	20.4 (19.5, 21.3)	12.3 (11.8, 12.8)
	Never Married	64.3 (62.1, 66.4)	51.9 (48.4, 55.4)	31.2 (30.1, 32.3)	21.9 (21.4, 22.5)
<b>Health Status</b>	Good to Excellent	84.5 (82.8, 86.2)	90.2 (87.4, 92.4)	82.4 (81.4, 83.5)	87.7 (87.1, 88.3)
	Fair	12.0 (10.7, 13.4)	7.4 (5.5, 9.8)	13.4 (12.6, 14.4)	10.0 (9.5, 10.5)
	Poor	3.5 (2.7, 4.5)	2.4 (1.3, 4.5)	4.1 (3.6, 4.7)	2.3 (2.0, 2.6)
<b>Past Month Tobacco Use Frequency</b> <sup>d</sup>	Daily use of at least one product	54.4 (52.6, 56.1)	--	59.2 (58.1, 60.2)	--
	Nondaily use	45.6 (43.9, 47.4)		40.8 (39.8, 41.9)	
<b>Past Month Marijuana Use Frequency</b>	20+ days	44.7 (42.6, 46.7)	33.6 (30.1, 37.3)	--	--
	<20 days	55.3 (53.3, 57.4)	66.4 (62.7, 69.9)		
<b>Past Month Alcohol Use</b> <sup>e</sup>	Heavy alcohol use	28.1 (26.4, 29.9)	17.0 (13.9, 19.3)	13.1 (12.3, 13.9)	2.9 (2.7, 3.1)
	Binge, but not heavy use	36.3 (34.1, 38.4)	34.3 (30.8, 38.0)	26.3 (25.5, 27.1)	12.7 (12.3, 13.1)
	Past month use (not binge) /no use	35.6 (33.5, 37.9)	48.7 (44.7, 52.7)	60.6 (59.6, 61.7)	84.4 (83.9, 84.9)
<b>Other past month illicit substance use</b> <sup>f</sup>		23.8 (22.0, 25.6)	12.5 (10.0, 15.5)	3.6 (3.2, 4.1)	1.3 (1.2, 1.5)

<sup>a</sup> NH=Non-Hispanic, <sup>b</sup> Education was only computed among participants >25 years of age (by group, n=1,831, n=750, n=10,334, n=26,289, respectively). <sup>c</sup> GED=general equivalency degree, <sup>d</sup> Daily use is defined as use on 30 of the past 30 days for any of the following products: cigarettes, cigars, chewing tobacco, or snuff, <sup>e</sup> Past month alcohol use was created by examination of past month binge alcohol use (5+ drinks on the same occasion, at least one day in the past 30 days), past month heavy alcohol use (binge drinking on five or more days of the past 30 days), and past month alcohol use (any). To be considered a past month "binge" or heavy alcohol user, a respondent must have used alcohol in the past month. Further, to be a past month heavy alcohol user, a respondent must also be a past month "binge" alcohol user, <sup>f</sup> Illicit substance use includes use of any of the following substances at least one day in the past month: cocaine, heroin, pain relievers not prescribed to you, sedatives, stimulants, hallucinogens, inhalants, tranquilizers.

**Table 2.2: Multinomial logistic regression model assessing correlates of past month co-use of marijuana and tobacco, tobacco-only use, and marijuana-only use, versus use of neither substance, NSDUH, 2003-2012**

	<b>Co-use of marijuana and tobacco (vs. use of neither) N=378,390 AOR (95% CI)</b>	<b>Marijuana-only use (vs. use of neither) N=378,390 AOR (95% CI)</b>	<b>Tobacco-only use (vs. use of neither) N=378,390 AOR (95% CI)</b>
<b>Sex</b>			
Male	2.1 (2.0, 2.2)***	1.7 (1.6, 1.9)***	1.5 (1.4, 1.6)***
Female	Ref	Ref	Ref
<b>Age</b>			
18-25 years	12.2 (11.0, 13.5)***	4.2 (3.6, 4.7)***	1.9 (1.8, 2.0)***
26-34 years	7.8 (7.0, 8.7)***	2.4 (2.1, 2.8)***	2.2 (2.1, 2.3)***
35-49 years	3.7 (3.3, 4.2)***	1.7 (1.5, 2.0)***	1.8 (1.7, 1.9)***
≥50 years	Ref	Ref	Ref
<b>Race/Ethnicity</b>			
White, Non-Hispanic (NH)	Ref	Ref	Ref
Black, NH	1.2 (1.1, 1.3)***	1.3 (1.2, 1.5)***	0.7 (0.6, 0.8)***
Hispanic	0.3 (0.2, 0.4)***	0.6 (0.5, 0.7)***	0.4 (0.3, 0.5)***
Other, NH	0.6 (0.5, 0.7)***	0.5 (0.4, 0.6)***	0.6 (0.5, 0.7)***
<b>Education</b>			
<High School	3.3 (2.9, 3.7)***	1.0 (0.9, 1.1)	3.2 (3.0, 3.3)***
High School or GED	2.4 (2.2, 2.7)***	1.1 (1.0, 1.2)***	2.5 (2.4, 2.6)***
Some College	2.0 (1.8, 2.2)***	1.2 (1.1, 1.3)**	2.0 (1.9, 2.1)***
College or more	Ref	Ref	Ref
<b>Employment Status</b>			
Full time	Ref	Ref	Ref
Part time	1.2 (1.1, 1.2)***	1.3 (1.2, 1.4)***	0.8 (0.7, 0.9)***
Unemployed	1.9 (1.7, 2.0)***	1.6 (1.4, 1.8)***	1.4 (1.3, 1.5)***
Other/Not in labor force	0.9 (0.8, 1.0)*	0.8 (0.7, 0.9)**	0.8 (0.7, 0.9)***
<b>Health Status</b>			
Excellent	Ref	Ref	Ref
Very Good	1.7 (1.6, 1.8)***	1.2 (1.1, 1.3)***	1.4 (1.3, 1.5)***
Good	2.4 (2.2, 2.5)***	1.0 (0.9, 1.1)	1.8 (1.7, 1.9)***
Fair	3.1 (2.8, 3.4)***	1.1 (0.9, 1.3)	2.2 (2.1, 2.4)***
Poor	5.1 (4.2, 6.1)***	2.0 (1.4, 2.8)**	3.2 (2.9, 3.6)***
<b>Past Month Alcohol Use</b>			
Heavy alcohol use	13.5 (12.7, 14.3)***	6.8 (6.2, 7.6)***	4.8 (4.6, 5.0)***
Binge, but not heavy use	4.7 (4.5, 5.0)***	3.6 (3.3, 4.0)***	2.6 (2.5, 2.7)***
Past month use (not binge) or no use	Ref	Ref	Ref
<b>Other past month illicit substance use</b>			
Yes	12.7 (11.7, 13.8)***	7.6 (6.7, 8.5)***	2.1 (1.9, 2.2)***
No	Ref	Ref	Ref
<b>Year</b>			
	1.1 (1.0, 1.2)***	1.1 (1.0, 1.2)***	0.9 (0.8, 1.0)***

AOR=Adjusted Odds Ratio, Ref=reference group \*p<.05, \*\*p<.01, \*\*\*p<.0001



**Table 2.3: Time trends for the prevalence of tobacco-only, marijuana-only, and co-use of marijuana and tobacco among adults – overall, and stratified among co-users by sex, age, and race, NSDUH, 2003-2012**

	2003-2004 Wt% (95% CI)	2005-2006 Wt% (95% CI)	2007-2008 Wt% (95% CI)	2009-2010 Wt% (95% CI)	2011-2012 Wt% (95% CI)	% Change	p-value
<b>Adjusted trends, overall</b> <sup>a,b</sup>							
Tobacco Use Only	26.4 (25.9, 26.9)	26.8 (26.3, 27.3)	25.9 (25.2, 26.5)	24.6 (24.2, 25.1)	24.0 (23.5, 24.5)	-9.1%	<.0001*, <.01**
Marijuana Use Only	1.5 (1.4, 1.6)	1.5 (1.4, 1.6)	1.5 (1.4, 1.7)	1.9 (1.8, 2.1)	2.3 (2.1, 2.5)	53.3%	<.0001*
Co- Tobacco and Marijuana use	4.4 (4.3, 4.6)	4.5 (4.3, 4.7)	4.5 (4.3, 4.7)	5.0 (4.8, 5.2)	5.2 (5.0, 5.4)	18.2%	<.0001*, <.05**
<b>By Tobacco or Marijuana Users:</b> <sup>a,c</sup>							
Tobacco use among marijuana users	74.3 (72.6, 75.8)	74.9 (73.0, 76.2)	74.3 (72.2, 76.2)	72.7 (71.1, 74.2)	69.6 (67.9, 71.4)	-8.8%	<.0001*, <.05**
Marijuana use among tobacco users	14.2 (13.7, 14.8)	14.5 (13.9, 15.1)	14.8 (14.2, 15.4)	16.8 (16.2, 17.4)	17.8 (17.1, 18.6)	20.7%	<.0001*, <.01**
<b>Stratified trends, among co-users:</b> <sup>d</sup>							
<b>Co-Use, By Sex:</b>							
Males	6.2 (5.9, 6.6)	6.4 (6.1, 6.8)	6.2 (5.8, 6.5)	6.9 (6.5, 7.2)	7.0 (6.7, 7.3)	12.9%	<.001*
Females	3.0 (2.8, 3.2)	2.9 (2.7, 3.1)	2.9 (2.7, 3.1)	3.2 (3.0, 3.4)	3.1 (2.9, 3.4)	3.3%	<.05*
<b>Co-Use, By Age:</b>							
18-25 years	13.7 (13.2, 14.2)	13.8 (13.3, 14.4)	13.5 (12.9, 14.0)	14.4 (13.9, 15.0)	13.7 (13.2, 14.3)	0.0%	NS
26-34 years	6.6 (6.0, 7.3)	6.9 (6.3, 7.6)	6.9 (6.3, 7.5)	7.8 (7.1, 8.5)	8.0 (7.4, 8.6)	21.2%	<.001*
35-49 years	3.8 (3.4, 4.2)	3.7 (3.4, 4.1)	3.6 (3.2, 3.9)	3.6 (3.2, 3.9)	4.1 (3.7, 4.5)	7.9%	NS
≥50 years	0.7 (0.5, 0.9)	0.8 (0.6, 1.1)	0.9 (0.7, 1.1)	1.4 (1.3, 1.7)	1.5 (1.3, 1.8)	114.3%	<.0001*
<b>Co-Use, By Race:</b>							
White, NH	4.7 (4.5, 5.0)	4.7 (4.5, 4.9)	4.6 (4.3, 4.8)	5.1 (4.9, 5.3)	5.1 (4.8, 5.3)	8.5%	<.01*
Black, NH	5.5 (4.9, 6.2)	6.5 (5.9, 7.2)	5.8 (5.3, 6.4)	6.3 (5.6, 7.0)	6.8 (6.2, 7.4)	23.6%	<.05*
Hispanic	3.2 (2.8, 3.8)	3.1 (2.6, 3.6)	3.2 (2.8, 3.6)	3.9 (3.4, 4.5)	3.9 (3.5, 4.4)	21.9%	<.01*
Other, NH	3.2 (2.6, 3.9)	3.2 (2.6, 3.8)	3.5 (2.8, 4.4)	3.5 (3.0, 4.0)	3.7 (3.2, 4.2)	15.6%	NS

NS=non-significant trend, \*Linear trend, \*\*Quadratic trend

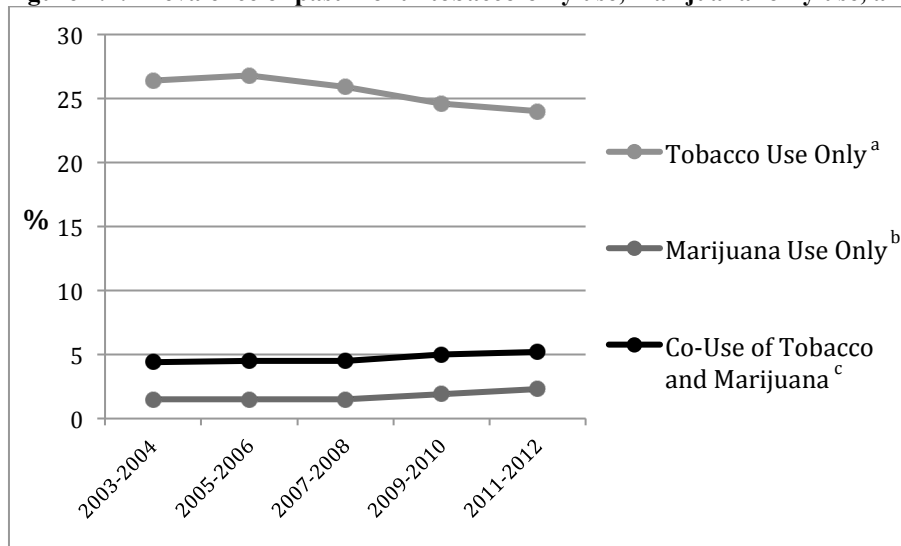
<sup>a</sup> Prevalence estimates and trend models adjusted for sex, age, and race/ethnicity.

<sup>b</sup> Denominator is entire adult sample, n=378,459

<sup>c</sup> Denominator is all marijuana users, or all tobacco users. For marijuana users, n=44,072; For tobacco users, n=142,597.

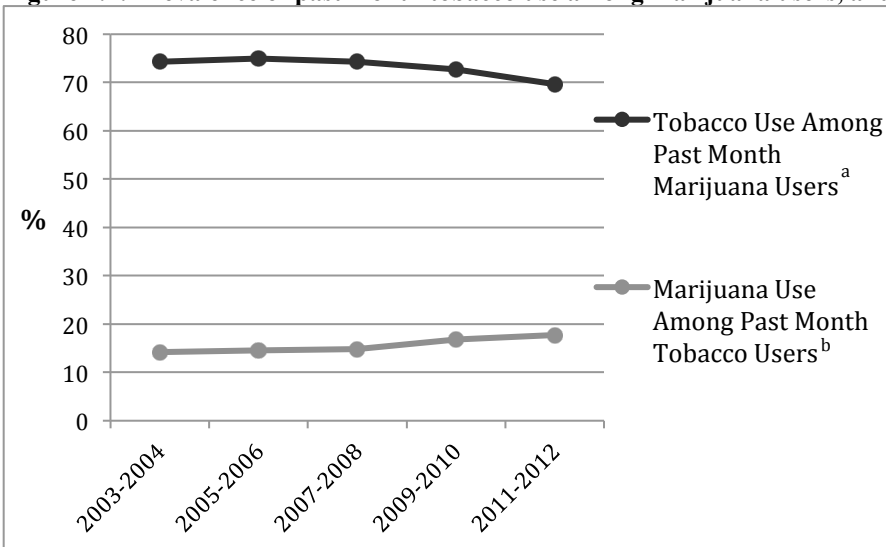
<sup>d</sup> Denominator is all co-users (n=33,753).

**Figure 2.1: Prevalence of past month tobacco-only use, marijuana- only use, and co-use of tobacco and marijuana, NSDUH, 2003-2012\***



\*Adjusted for sex, age, and race/ethnicity. a Non-linear decrease,  $p < .0001$  b Linear increase,  $p < .0001$  c Non-Linear increase,  $p < .0001$

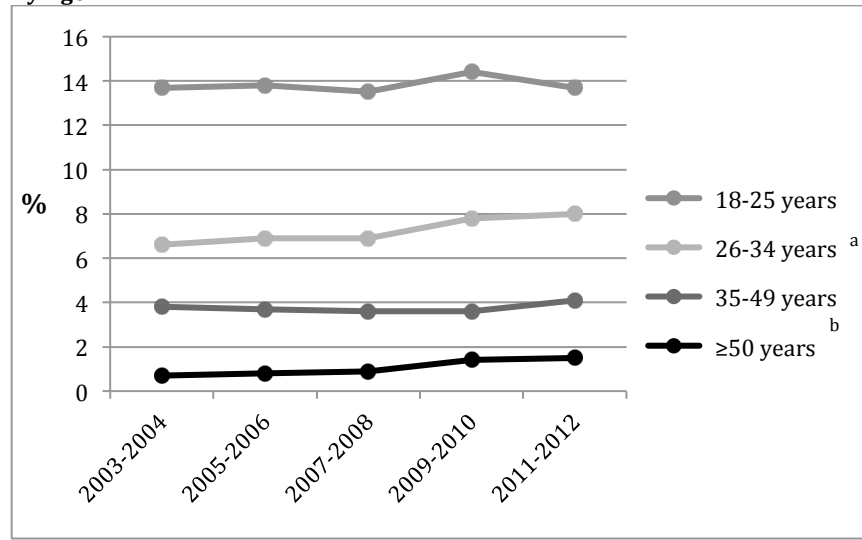
**Figure 2.2: Prevalence of past month tobacco use among marijuana users, and marijuana use among tobacco users, NSDUH, 2003-2012\***



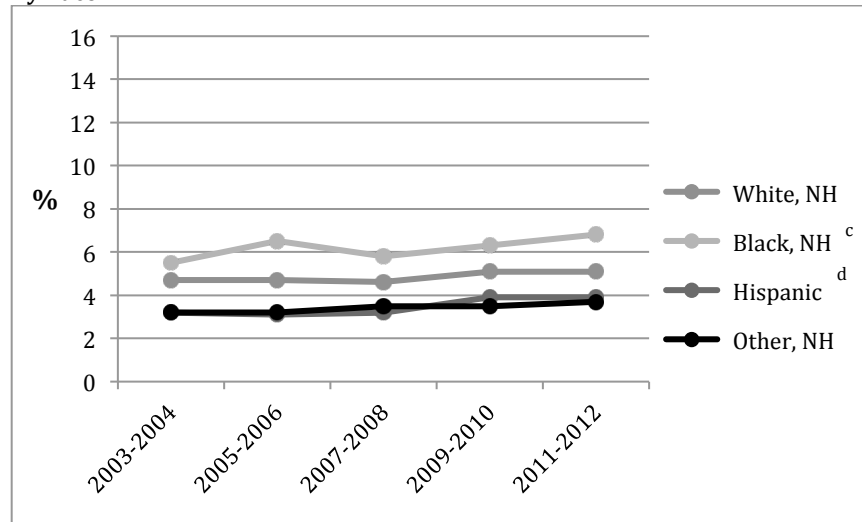
\*Adjusted for sex, age, and race/ethnicity. a Non-linear decrease,  $p < .0001$  b Non-linear increase,  $p < .0001$

**Figure 2.3: Trends in past month co-use of tobacco and marijuana, stratified by age and race, NSDUH, 2003-2012**

**By Age**



**By Race**



a Linear increase, p<.001

b Linear increase, p<.0001

c Linear increase, p<.01

d Linear increase, p<.05

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**CHAPTER 3:**  
**Differences in Tobacco Product Use Among Past Month Adult Marijuana  
Users and Non-Users**

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**Abstract**

**Introduction:** This study assessed differences in individual tobacco product use between past month marijuana users and non-users, and trends in overall tobacco use and use of specific tobacco products among marijuana users.

**Methods:** Data were obtained from 378,459 adults participating in the 2003-2012 National Survey on Drug Use and Health, a cross-sectional, household interview survey conducted annually. Data from the most recent two years (2011-2012) were used to assess differences in the prevalence of various tobacco products by past month marijuana status. Data from all years were used to assess historical trends in overall tobacco use, and use of cigarettes, cigars, and blunts among marijuana users; trend significance was assessed using orthogonal polynomials.

**Results:** From 2011-2012, the prevalence of any past month tobacco use among the 9,727 past month marijuana users was 68.6% excluding blunts, and 78.3% including blunts (vs.

25.3% for non-users,  $p < .0001$ ); 77.3% of past month marijuana users reported past month combusted tobacco use (vs. 23.4% of non-MJ users,  $p < .0001$ ). By product, 60.1% of past month marijuana users reported past month cigarette use, 42.0% reported past month blunt use, and 20.6% reported past month cigar use. Overall, adjusted trends in past month cigarette use decreased, while trends in past month blunt use increased; cigar use did not change.

***Discussion:*** Tobacco use is highly prevalent among adult marijuana users and represents an important potential comorbidity of marijuana use. In light of increasing marijuana policy change, it is critical to monitor changes in overall and specific tobacco product use.

## **Introduction**

Marijuana is the most commonly used federally illicit drug (Substance Abuse and Mental Health Services Administration, 2014). While the prevalence of past month marijuana use has declined among youth in the past decade, it has increased among young adults and adults (Substance Abuse and Mental Health Services Administration, 2013), with 19.1% of young adults ages 18-25 years reporting past month marijuana use in 2013 (Substance Abuse and Mental Health Services Administration, 2014). The health effects of marijuana are still widely debated (Collins, 2014; Hall, 2014; Hall & Degenhardt, 2014; Thompson & Tuscano, 2014; Volkow, Baler, Compton, & Weiss, 2014; Volkow, Compton, & Weiss, 2014; Wolff, Rouyer, & Geny, 2014), but evidence suggests that chronic use in adults is associated with cognitive impairment, chronic bronchitis and respiratory irritation, addiction, and earlier onset of psychotic disorders (like schizophrenia) in individuals who are prone to psychosis (Degenhardt, Hall, & Lynskey, 2003; Hall & Degenhardt, 2014; Volkow et al., 2014). Co-use of tobacco may also be an important health risk of marijuana use.

While much of the research on co-occurring marijuana and tobacco use has focused on adolescents, adult marijuana users have also been shown to have a significantly higher prevalence of tobacco use than non-users (Agrawal, Budney, & Lynskey, 2012; Ramo, Liu, & Prochaska, 2012; Richter et al., 2004), exposing them to the myriad of harmful effects of tobacco (U.S. Department of Health and Human Services, 2014). A recent review on clinical correlates of marijuana and tobacco use noted that between 41% and 94% of adult marijuana users consume tobacco (Peters, Budney, & Carroll, 2012). However, most of the studies cited to obtain this prevalence

estimate are more than ten years old and few use nationally representative data. In light of the known harms of tobacco use (U.S. Department of Health and Human Services, 2014) and the potential for co-use of tobacco and marijuana, more recent data about the prevalence of tobacco use, and about the use of individual tobacco products among marijuana users over the past decade are needed as marijuana legalization increases.

Four states (Alaska, Colorado, Oregon, and Washington) and the District of Columbia have policies making marijuana legal for recreational use in adults, and more than half of all U.S. state have legalized medical marijuana or cannabidiol (Association of State and Territorial Health Officials, 2014). It is unknown how these policy changes may further impact use patterns not only of marijuana, but also of tobacco. As marijuana use becomes more accepted by the public (Gallup, 2013; Hickenlooper, 2014) and legalization makes its use more visible, monitoring and surveillance of co-use of tobacco products among marijuana users becomes more critical.

A number of factors could make potential increases in marijuana use (or the visibility of use) concerning for the tobacco prevention and control community. First, although other modes of use exist, both marijuana and tobacco are primarily consumed in combusted form (Agrawal et al., 2012; Centers for Disease Control and Prevention, 2014; Volkow et al., 2014). If a primary public health goal is to move tobacco users away from combusted tobacco products (Malone, 2013), it will be essential to determine how legalized marijuana impacts social norms and behaviors related to smoking.

Second, data suggest that tobacco and marijuana have a complementary and synergistic relationship, wherein use of one reinforces and enhances use of the other. For example, one study found that young adults reported using both tobacco and marijuana

because marijuana use increased tobacco urges, tobacco use increased marijuana urges, and the act of smoking helped cope with marijuana urges (Ramo, Liu, & Prochaska, 2013). Data from animal models suggest that co-use of the psychoactive compound in marijuana (tetrahydrocannabinol or THC) and nicotine induces rewarding effects, such that use of both drugs (versus just one) may enhance the psychoactive high (Valjent, Mitchell, Besson, Caboche, & Maldonado, 2002). In addition to co-occurring use, marijuana and tobacco can also be co-administered in blunts (hollowed out cigars filled with marijuana) or spliffs (joints of marijuana mixed with loose-leaf tobacco) (Golub, Johnson, & Dunlap, 2005; Mariani, Brooks, Haney, & Levin, 2011; Soldz, Huyser, & Dorsey, 2003). This complementary and synergistic relationship, and particularly co-administration of the products together may expose marijuana users to tobacco products and increase the propensity for tobacco use (Patton, Coffey, Carlin, Sawyer, & Lynskey, 2005), nicotine dependence (Ream, Benoit, Johnson, & Dunlap, 2008), and marijuana dependence (Peters et al., 2012; Ream et al., 2008).

Third, legalization of marijuana may increase the development and promotion of new and existing products that overlap with tobacco products or allow for increased co-administration (e.g., cigars, vaporizers or other electronic delivery systems, etc.). Reports suggest people are already using the same devices to consume marijuana (hash oil) and nicotine liquid (CBS News, November 7, 2013). Research of the previously secret tobacco industry documents found that tobacco companies have been interested in the overlap between the tobacco and marijuana markets since at least the 1970s (Barry, Hiilamo, & Glantz, 2014). Recent reports indicate that e-cigarette manufacturers in particular may have an interest in the growing marijuana marketplace (Talley, 2014). It



is unclear how the sale of products that include both marijuana and tobacco, or facilitate use of both substances will impact tobacco use.

Based on these important areas of overlap between the two substances, understanding which tobacco products are used by current adult marijuana users, and how their patterns of use have changed over the past decade can provide an important baseline as marijuana use becomes more accepted by the public and legalization makes its use more visible. Accordingly, this study sought to use nationally-representative data to assess: (1) recent prevalence of overall tobacco use, and of cigarette, cigar, blunt, and smokeless product use among adult marijuana users and non-users, (2) correlates of cigarette-only, cigar-only, and polytobacco use among adult marijuana users, and (3) historical trends in tobacco product use among adult marijuana users over the past decade.

## **Methods**

### ***Data Source and Sample***

Data for this study came from 378,459 adults age 18 and older who responded to the National Survey on Drug Use and Health (NSDUH) between 2003 and 2012, with the majority of analyses focusing on current marijuana users. NSDUH is a face-to-face nationally representative household survey sponsored by the Substance Abuse and Mental Health Services Administration and conducted annually with U.S. civilians 12 years and older. Participants are recruited from each state and the District of Columbia using multistage area probability sampling and stratifying by demographic factors. The survey includes questions about tobacco use, drug and alcohol use, and mental health, and is conducted using computer-assisted interviewing to increase the validity of

responses. Response rates between 2003 and 2012 ranged between 73% and 76%. Additional details about the survey methodology can be found elsewhere (Harrison, Martin, Enev, & Harrington, 2007; Kennet & Gfroerer, 2005; Substance Abuse and Mental Health Services Administration, 2010).

Because of changes to the interview method, incentive structure, and survey name, trend analyses using NSDUH are limited to data from 2002 and later (Kennet & Gfroerer, 2005). Data were pooled in two-year time increments to stabilize estimates. For the purposes of this study, data from the most recent two-year time period (2011-2012) were used to characterize the prevalence and correlates of different tobacco product use among marijuana users (n=9,727) and non-users (n=67,275), and data from the last ten years (2003-2012) were used to assess trends in tobacco product use among marijuana users (n=44,072). Blunt use was not collected as a separate product among adults prior to 2004, and thus is not included in all time points for trend analyses.

### ***Measures and Definition of Concepts***

Current marijuana use was defined as any past 30-day use of marijuana, hashish, or blunts. Current tobacco use was defined as any past 30-day use of any of the following tobacco products: all or part of a cigarette, cigars (including big cigars, cigarillos, and little cigars), blunts, pipes, or smokeless tobacco (snuff or chewing tobacco). Tobacco use was also computed without the inclusion of blunts. Use of hookah or e-cigarettes were not collected as part of NSDUH and thus are not included in this study.

Current use of individual tobacco products was defined as use of that specific product within the past 30 days. Current use of cigars was computed separately from current use of blunts. *Any* use of a product was defined as any past 30-day use, either

alone or with other tobacco products. Use of *only* that product was defined as past 30-day use of just that product, and no other tobacco products. *Only* categories are mutually exclusive; *any* categories are not. Combusted tobacco products included cigarettes, cigars, blunts, and pipes; non-combusted products were synonymous with smokeless tobacco and included snuff and chewing tobacco.

Polytobacco use was defined as use of more than one tobacco product during the past 30-days. Mutually exclusive categories of tobacco products (e.g., cigarettes and blunts, cigars and blunts, etc.) were also computed to provide information about the most commonly occurring polytobacco use categories.

Past month alcohol use was defined as having had any drink of an alcoholic beverage in the past 30 days. Participants were also asked on how many days they had five or more drinks on the same occasion (at the same time or within a couple hours of each other). Binge drinkers were individuals who reported having five or more drinks on one to four occasions in the past month; heavy alcohol users were defined as those who reported having five or more drinks on five or more occasions in the past month. These were mutually exclusive categories.

Other past month illicit substance use was defined as any nonmedical use of any of the following products on one or more of the past 30 days: cocaine, crack, heroin, hallucinogens, inhalants, opiates, tranquilizers, stimulants, and sedatives.

Sex (male, female), age (18-25, 26-34, 35-49, 50+ years), race/ethnicity (White, Black, Hispanic, other), and education (< high school, high school or general equivalency degree, some college, college graduate or more) were also included in these analyses.

### ***Statistical Analysis***

To account for the complex sampling design, all analyses were conducted in SAS-callable SUDAAN (Version 9.2, RTI International) using poststratification sampling weights to adjust for nonresponse and coverage. Variables used in these analyses were imputation-revised variables made available publicly as part of the NSDUH data. Imputation was conducted using predictive mean neighborhood, which is a combination of model-assisted and nearest neighbor hot-deck imputation methods.

To obtain current prevalence estimates, weighted frequencies were computed across all tobacco products for adults with and without marijuana use for the most recent two-year time period (2011-2012). Among current marijuana users, we assessed correlates of current cigarette-only, cigar and/or blunt-only, or polytobacco use versus no tobacco use using a polytomous (multinomial) logistic regression model with a four level outcome variable (current cigarette-only use, cigar and/or blunt-only use, polytobacco use, and no tobacco use).

For time trends, data from 2003 to 2012 were grouped by two-year time increments to stabilize estimates. Blunt use was not collected among adults prior to 2004; therefore, data on blunt use are from 2005-2012. For each available time increment, prevalence estimates for cigarette, cigar, blunt, and smokeless use were computed overall, adjusting for sex, age, and race/ethnicity, and stratified by sex, race/ethnicity, and age in order to assess changes within each group. Trends in smokeless use stratified by sex, race/ethnicity, and age are not included in these analyses because the prevalence of use was so low. The percent change between the first time increment (2003-2004, or 2005-2006 for blunts) and the last time increment (2011-2012) was computed. Logistic

regression models were used to test for linear and non-linear time trends, using orthogonal polynomials to model time simultaneously in models as linear or quadratic.

## **Results**

### ***Current tobacco product use, by marijuana use group***

In the most recent two years of surveillance, the prevalence of marijuana use among all adults was 7.3% (95% CI: 7.1%, 7.6%). As shown in Table 3.1, among current marijuana users (n=9,727), the prevalence of current tobacco use was 68.6% (95% CI: 66.6%, 70.6%) not including blunts as a tobacco product, and 78.3% (95% CI: 76.3%, 80.2%) including blunts as a tobacco product. Among non-marijuana users, the prevalence of current tobacco use was 25.3% (95% CI: 24.8%, 25.9%).

By product, 60.1% of marijuana users were current cigarette users (versus 20.8% of non-marijuana users), 20.6% were current cigar users (versus 4.2% of non-marijuana users), 42.0% were current blunt users (not applicable for non-marijuana users), 3.6% were current pipe users (versus 0.7% for non-marijuana users), and 5.6% were current smokeless tobacco users (versus 3.3% for non-marijuana users; Table 3.1). Current combusted tobacco product use (e.g., cigarettes, cigars, blunts, pipes) was more prevalent among both groups than non-combusted use, but was substantially higher among marijuana users compared to non-users (77.3% vs. 23.4%, respectively). A higher percentage of marijuana users used two or more tobacco products compared to non-users (39.8% versus 3.4%), with cigarettes and blunts being the most common two-product combination (17.1%). Among blunt users, 75.2% were using other tobacco products as well.

### ***Correlates of specific tobacco product use among marijuana users***

In a multinomial regression model among marijuana users, males had higher odds (vs. females) of current cigar and/or blunt-only use and of current polytobacco use, but not of current cigarette-only use, compared to non-tobacco users (Table 3.2). Those ages 26-49 years had higher odds (vs. those age 50+ years) of cigarette-only use, whereas those ages 18-35 had higher odds of cigar and/or blunt-only use, and those ages 18-49 years had higher odds of polytobacco use. Individuals who were Black (vs. White) had a lower odds of cigarette-only use, but a higher odds of both cigar and/or blunt-only use and polytobacco use, compared to non-tobacco users, while individuals who were Hispanic (vs. White) had a lower odds of cigarette-only, cigar and/or blunt-only, and polytobacco use. An inverse relationship existed between education and cigarette-only and polytobacco use, with the odds of use increasing as education level decreased. Heavy alcohol use and binge drinking (vs. no past month alcohol use) were associated with higher odds of cigarette-only and polytobacco use. Reporting any other past month illicit substance use was associated with increased odds of cigarette-only, cigar and/or blunt-only, and polytobacco use.

### ***Historical trend data***

#### *Trends in Marijuana Use:*

For context, over the past ten years, marijuana use increased significantly in the overall adult population, from 6.0% in 2003-2004 to 7.5% in 2011-2012 ( $p < .0001$ ) after adjusting for sex, age and race/ethnicity. By demographic characteristics, increases occurred among both males and females, Whites, Blacks, and Hispanics, and individuals ages 18-34 years, and ages 50 years and older (data not shown in tables).

#### *Trends in Tobacco Use, among Marijuana Users:*

Between 2003 and 2012, after adjusting for sex, age, and race/ethnicity, overall tobacco use among marijuana users, excluding blunts, declined from 74.3% to 69.6% (non-linear decrease,  $p < .0001$ ) (data not shown in tables). The adjusted prevalence of tobacco use, including blunts from 2005 onward, did not change (80.9% in 2005-2006 to 79.4% in 2011-12,  $p = 0.29$ ); the adjusted prevalence of combusted tobacco use did not change significantly either over the same timeframe (79.8% to 78.2%,  $p = 0.26$ ).

Adjusted past-month use of cigarettes declined non-linearly among marijuana users (from 66.6% in 2003-2004 to 60.9% in 2011-2012,  $p < .0001$ ), while adjusted past-month use of blunts increased linearly (from 38.5% in 2005-2006 to 42.9% in 2011-2012,  $p < .001$ ). Past month use of cigars or smokeless tobacco among marijuana users did not change significantly over time (Figure 3.1, Table 3.3).

Assessing stratified results, by sex, use of cigarettes and cigars declined linearly in male marijuana users ( $p < .0001$ ,  $p < .05$ , respectively), while use of blunts increased linearly ( $p < .05$ ; Table 3.3). Among females, use of cigarettes declined non-linearly ( $p < .0001$ ), while use of cigars and blunts did not change significantly. By race, cigarette use and cigar use declined significantly over time among White marijuana users ( $p < .0001$ ,  $p < .05$ , respectively; Figure 3.2; Table 3.3), while blunt use changed non-linearly. Cigarettes, cigars, and blunts did not change significantly among Black marijuana users, and compared to either Whites or Hispanics, blunt use remained significantly higher among Blacks at each time point (prevalence ranging from 72.6% to 74.0%; Figure 3.2, Table 3.3). Among Hispanic marijuana users, cigar use decreased significantly over time ( $p < .01$ ), while blunt use increased ( $p < .05$ ; Figure 3.2). By age, cigarette use declined significantly among 18-25 year olds and 26-34 year olds ( $p < .0001$ ,

$p < .05$ , respectively), while blunt use increased among 18-25 year olds and 35-49 year olds ( $p < .05$ ,  $p < .001$ , respectively, Table 3.3).

## **Discussion**

Findings from this study suggest that tobacco use prevalence is disproportionately higher among current marijuana users compared to non-users, with nearly seven out of every ten current marijuana users reporting current tobacco use, and significantly higher combusted tobacco and polytobacco use among marijuana users vs. non-users. While cigarette use remains disproportionately high in marijuana users, prevalence has decreased over the past decade. Blunt use has increased over time and cigar and smokeless tobacco use remain unchanged. More research is needed to determine how much of this decrease in cigarette smoking is due to a decision not to use tobacco versus a decision to initiate or switch to other tobacco products. As policies legalizing marijuana increase, these use patterns, as well as specific tobacco product use trends will be critical to monitor.

A particularly concerning finding is that blunt use has increased among the overall population of marijuana users, and particularly, among males, Hispanics, and people ages 18-25 years or 35-49 years. This is troubling, given that blunts may play a critical role in exposing users to nicotine (Dunlap, Benoit, Sifaneck, & Johnson, 2006; Sifaneck, Kaplan, Dunlap, & Johnson, 2003), leading to both increased nicotine and marijuana dependence (Peters et al., 2012; Ream et al., 2008; Stinson, Ruan, Pickering, & Grant, 2006). Although blunt use did not increase among Blacks, these data suggest that blunts have been, and continue to be, the most prevalent tobacco product used by Black marijuana users. However, it is important to note that overall marijuana use increased



among Blacks in the past decade, but blunt use remained the same, suggesting that blunts may comprise a lower proportion of marijuana use among Blacks now than in the past.

While blunt use among Blacks remains higher than in other racial/ethnic groups, the trend among Hispanics suggests that traditional preferences for blunts may be changing. A recent study by Timberlake et al. on blunt use by birth cohorts found that both Hispanics and White non-Hispanics had lower odds of blunt use compared to Blacks, but that the odds of blunt use among Hispanics had increased in cohorts born in the 1980's compared to the 1970's (Timberlake, 2013). Most studies of blunt use have focused on adolescent and Black populations (Sinclair, Foushee, Pevear, Scarinci, & Carroll, 2012); our data suggest that continued study among adults, and other racial/ethnic groups is important. Reasons for increases in blunt use warrant further exploration, and may include cultural influences or norms, the slower combustion rate compared to joints, or the lower cost of cigars compared to other rolling papers (Dunlap et al., 2006; Dunlap, Johnson, Benoit, & Sifaneck, 2005; Golub et al., 2005).

Since blunts are hollowed out cigars, it is surprising that trends in cigar use do not increase with increasing trends blunt use, but instead remain stable. More research is needed to assess whether or not blunt users also consider themselves cigar users. This classification is critically important to understanding surveillance data. Some studies have found that in addition to being used as the wrapper for blunts, cigars are also used as "chasers" following blunt or other marijuana use, both to enhance the high and disguise the marijuana smoke (Sifaneck, Johnson, & Dunlap, 2005). It may be that these practices are less common in adults, or that marijuana users are moving away from co-use with cigars and choosing other tobacco products instead.

Another important finding is the high prevalence of polytobacco use among marijuana users versus non-users. Other studies have documented a similar relationship between marijuana use and polytobacco use among adolescents or college students (Corral, Landrine, Simms, & Bess, 2013; Enofe, Berg, & Nehl, 2014; Yates et al., 2014), but few studies have explored polytobacco use among adult marijuana users. Given that use of both marijuana and tobacco may make quitting either substance more difficult (Peters et al., 2012; Ramo et al., 2012), use of multiple tobacco products may further complicate tobacco cessation outcomes. Learning more about the reasons for use of specific tobacco products among current marijuana users will be important to the development of future interventions to prevent and end tobacco use among this population.

In addition to the relationship between tobacco and marijuana, it is important to consider the role that alcohol use plays. In these data, heavy alcohol use (vs. no alcohol use) was associated with an increased odds of cigarette-only use and polytobacco use among marijuana users; there was no relationship between cigar and/or blunt use and past month alcohol consumption. While we know use of these three substances co-occurs in adolescence and young adulthood (Johnston, O'Malley P, Bachman, Schulenberg, & Meich, 2014; Johnston, O'Malley, Meich, Bachman, & Schulenberg, 2014; Substance Abuse and Mental Health Services Administration, 2014), few studies have sought to characterize the relationship between their use into later adulthood or among the general adult population. Data suggest overlapping genetic and environmental factors associated with use of tobacco, marijuana, and alcohol (Haberstick et al., 2011). A recent study of a small sample of non-treatment seeking marijuana users found that when quitting

marijuana, both alcohol use and cigarette use increased, indicating a complex relationship (Allsop et al., 2014). Our data suggest that the relationship between these substances may vary based on the type of tobacco product. Future research should seek to explore not only how marijuana, alcohol, and cigarettes relate, but also how these relationships may differ for individuals using non-cigarette tobacco products.

These data suggest a strong relationship between education and use of specific tobacco products. Among this sample of current marijuana users, lower levels of education were strongly associated with cigarette-only or polytobacco use, but not with cigar and/or blunt use. While we are unaware of similar studies among other populations of adult marijuana users, studies conducted among the general population have similar findings with regard to the association between lower education and polytobacco use (Centers for Disease Control and Prevention, 2010; Fix et al., 2014), and a recent study on patterns of blunt use in young adult Black men found that a higher percentage of blunt users had >13 years of education compared with cigarette smokers (Sinclair et al., 2012). More research is needed to determine why lower education is associated with cigarette-only and polytobacco use among current marijuana users.

Strengths of this study include the robust sample size and the use of multiple years of nationally representative data to assess trends among specific tobacco products. However, these data are subject to at least three limitations. First, while data from NSDUH have been shown to be reliable, they are self-reported and not verified biochemically. Given the sensitive nature of the questions, data are also subject to social desirability bias, though NSDUH uses audio computer-assisted self-interviewing (ACASI) to provide respondents with a private and confidential mode for responding to

questions in order to increase the validity of responses about illicit drug use and other sensitive behaviors. Second, as a household survey, NSDUH does not collect data from un-domiciled individuals, who may have higher substance use. Third, while multiple cross-sections were utilized for trend analyses, data are not longitudinal and no inferences about within-person patterns of use are possible. Fourth, data were limited to the questions included in NSDUH. We were unable to assess the mode of marijuana use (e.g., combusted, non-combusted) or the type of use (medical versus recreational). Assessing whether or not combusted marijuana users have higher rates of combusted tobacco use versus non-combusted users may be an important question in studies of the potential additive health effects from marijuana and tobacco. We were also unable to assess use of electronic nicotine delivery systems (ENDS). Given the potential overlap with marijuana products, future research should seek to determine the proportion of marijuana users concurrently using electronic delivery systems – either for nicotine and/or marijuana.

In conclusion, tobacco use remains highly prevalent among adult marijuana users and represents a major comorbidity of marijuana use. In light of increasing policies making marijuana use legal for adults, and because co-use of marijuana and tobacco is prevalent, increased monitoring and surveillance is warranted to assess changes in tobacco product use. Intervention research to identify ways to prevent marijuana users from starting to use tobacco and to support them in quitting tobacco products is also needed.

**Table 3.1: Current prevalence of past 30-day tobacco use overall, and by product, among adults age 18 and older with and without past 30-day marijuana use, NSDUH, 2011-2012**

	Past 30-day Marijuana Use N=9,727 Wt % (95% CI)	No Past 30-day Marijuana Use N=67,275 Wt % (95% CI)
<b>Any Current Tobacco Use (w/o blunts):</b>	68.6 (66.6, 70.6)	25.3 (24.8, 25.9)
<b>Any Current Tobacco Use (w/blunts):</b>	78.3 (76.3, 80.2)	--- <sup>a</sup>
<b>Combusted Tobacco Use:</b>		
<b>Any Current Combusted Tobacco Use:<sup>b</sup></b>	77.3 (75.3, 79.2)	23.4 (22.8, 24.0)
<b>Current Cigarette Use:</b> Any Cigarette Use	60.1 (58.1, 62.1)	20.8 (20.3, 21.4)
Only Cigarette Use	25.2 (23.3, 27.2)	17.9 (17.4, 18.4)
<b>Current Cigar Use:</b> Any Cigar Use	20.6 (19.2, 22.1)	4.2 (3.9, 4.4)
Only Cigar Use	2.3 (1.8, 3.0)	2.0 (1.8, 2.2)
<b>Current Blunt Use:</b> Any Blunt Use	42.0 (40.2, 43.8)	--- <sup>a</sup>
Only Blunt Use	9.7 (8.7, 10.9)	--- <sup>a</sup>
<b>Current Pipe Use:</b> Any Pipe Use	3.6 (3.0, 4.3)	0.7 (0.6, 0.8)
Only Pipe Use	--- <sup>a</sup>	--- <sup>a</sup>
<b>Non-Combusted Tobacco Use:</b>		
<b>Any Current Smokeless Tobacco Use:</b>	5.6 (5.0, 6.3)	3.3 (3.1, 3.5)
<b>Current Smokeless Tobacco Use Only:</b>	1.0 (0.7, 1.4)	1.9 (1.8, 2.1)
<b>Polytobacco Use:</b>		
<b>Number Tobacco Products Used Past Month:</b>		
No tobacco use	21.7 (19.8, 23.7)	74.7 (74.1, 75.2)
1 product	38.5 (36.4, 40.6)	21.9 (21.4, 22.4)
2 products	27.2 (25.8, 28.6)	2.9 (2.7, 3.1)
3+products	12.6 (11.7, 13.6)	0.5 (0.4, 0.6)
<b>Current Combusted and non-Combusted Tobacco Use</b>	4.6 (4.0, 5.2)	1.4 (1.2, 1.5)
<b>Current Cigarette + Cigar Use Only</b>	3.9 (3.3, 4.5)	1.5 (1.4, 1.7)
<b>Current Cigarette + Blunt Use Only</b>	17.1 (16.1, 18.2)	--- <sup>a</sup>
<b>Current Cigar + Blunt Use Only</b>	3.32 (2.92, 3.77)	--- <sup>a</sup>
<b>Current Cigarette + Blunt + Cigar Use Only</b>	7.6 (6.9, 8.4)	--- <sup>a</sup>

Note: "Any" use refers to use of that product, either alone or in conjunction with other tobacco products. "Only" use refers to use of only that tobacco product, with no use of other tobacco products. "Only" groups are mutually exclusive, "any" groups are not. Tobacco products include cigarettes, cigars, blunts, pipes and smokeless tobacco.

<sup>a</sup> Not computed amongst non-marijuana users, since blunts contain marijuana.

<sup>b</sup> Combusted tobacco products include cigarettes, cigars, blunts, and pipes.

<sup>c</sup> Only use is defined as use of only that tobacco product, and no past 30-day use of other tobacco products (defined as cigarettes, cigars, pipes, and smokeless tobacco).

**Table 3.2: Multinomial Logistic Regression Models assessing correlates of current cigarette-only, cigar and/or blunt-only, or polytobacco use, vs. non-tobacco use (n=2,616), among adult marijuana users, NSDUH, 2011-2012**

		<b>Current cigarette-only<sup>a</sup> use (vs. non-tobacco use) n=2,065 AOR (95% CI)</b>	<b>Current cigar and/or blunt-only<sup>b</sup> use (vs. non-tobacco use) n=582 AOR (95% CI)</b>	<b>Current polytobacco use<sup>c</sup> (vs. non-tobacco use) n=4,351 AOR (95% CI)</b>
<b>Sex</b>	Male	0.9 (0.7, 1.1)	2.6 (2.0, 3.4)***	1.5 (1.3, 1.8)***
	Female	Ref	Ref	Ref
<b>Age</b>	18-25	0.8 (0.6, 1.1)	1.9 (1.1, 3.5)*	3.3 (2.1, 5.0)***
	26-34	1.5 (1.1, 2.1)**	1.9 (0.9, 3.7)	3.0 (1.9, 4.6)***
	35-49	2.1 (1.5, 2.8)***	1.4 (0.7, 2.8)	1.9 (1.2, 3.2)**
	≥50	Ref	Ref	Ref
<b>Race/Ethnicity</b>	White, NH	Ref	Ref	Ref
	Black, NH	0.4 (0.3, 0.6)***	2.4 (1.6, 3.5)***	1.5 (1.1, 1.9)**
	Hispanic	0.5 (0.3, 0.6)***	0.6 (0.4, 0.9)*	0.7 (0.6, 0.9)*
	Other, NH	1.0 (0.7, 1.5)	1.1 (0.6, 2.3)	1.2 (0.8, 1.6)
<b>Education</b>	<High School	3.6 (2.5, 5.0)***	1.3 (0.7, 2.3)	6.5 (4.8, 8.9)***
	High School or GED	2.7 (1.9, 3.7)***	1.4 (0.8, 2.2)	4.4 (3.2, 6.2)***
	Some College	2.1 (1.5, 3.0)***	1.6 (0.9, 2.6)	2.5 (1.9, 3.3)***
	College or more	Ref	Ref	Ref
<b>Past Month Alcohol Use</b>	Heavy alcohol use	1.9 (1.4, 2.6)***	1.5 (0.8, 2.7)	2.4 (1.9, 3.2)***
	Binge, but not heavy use	1.4 (1.1, 1.8)*	1.4 (0.9, 2.5)	1.6 (1.2, 2.1)**
	Past month use, but not binge	1.0 (0.8, 1.4)	1.2 (0.7, 1.8)	1.1 (0.7, 1.4)
	No past month alcohol use	Ref	Ref	Ref
<b>Other past month illicit substance use</b>		1.4 (1.1, 1.8)*	1.7 (1.2, 2.5)**	2.4 (1.9, 3.0)***

\*<.05 \*\*<.01 \*\*\*<.0001

a Current cigarette-only use was defined as past 30-day use of cigarettes, but not of cigars, blunts, pipes, or smokeless tobacco.

b Current cigar and/or blunt-only use was defined as past 30-day use of cigars and/or blunts, but not of cigarettes, pipes, or smokeless tobacco (so past 30-day use of cigars only, blunts only, or cigars and blunts only).

c Current polytobacco use was defined as past 30-day use of two or more of the following products: cigarettes, cigars, blunts, pipes, smokeless tobacco.

**Table 3.3: Trends in tobacco product use among past 30-day marijuana users, overall, and by sex, age, and race/ethnicity, NSDUH, 2003-2012**

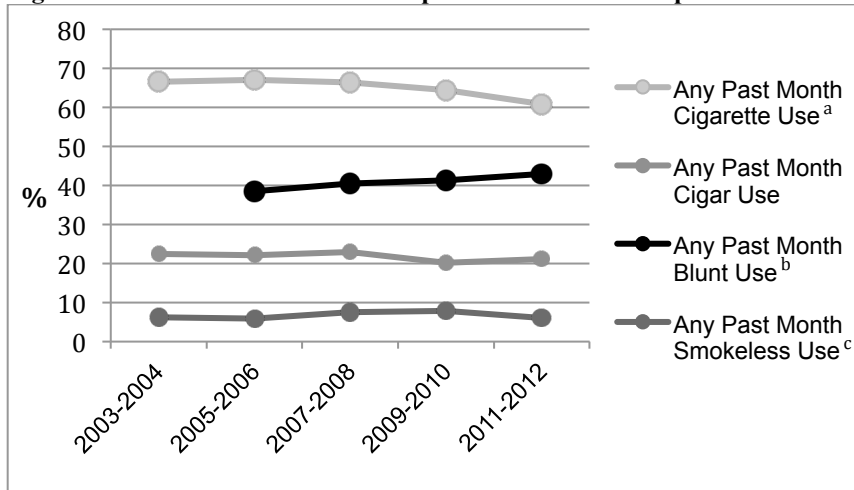
	2003-2004 Wt% (95% CI) n=8,305	2005-2006 Wt% (95% CI) n=8,091	2007-2008 Wt% (95% CI) n=8,360	2009-2010 Wt% (95% CI) n=9,589	2011-2012 Wt% (95% CI) n=9,727	% Change	p-value for trend
<b>Overall trends, adjusted:<sup>a</sup></b>							
Any Cigarette Use	66.6 (64.9, 68.2)	67.1 (65.3, 68.9)	66.5 (64.2, 68.7)	64.5 (62.7, 66.3)	60.9 (59.1, 62.7)	-8.6%	<.0001*, <.05**
Any Cigar Use	22.4 (20.8, 24.0)	22.1 (20.8, 23.5)	22.9 (21.3, 24.5)	20.2 (19.0, 21.5)	21.1 (19.8, 22.5)	-5.8%	0.06
Any Blunt Use	-- <sup>b</sup>	38.5 (36.9, 40.1)	40.5 (39.2, 41.9)	41.4 (39.7, 43.2)	42.9 (41.4, 44.4)	11.4%	<.001*
Any Smokeless Use	6.2 (5.5, 6.9)	5.9 (5.3, 6.7)	7.6 (6.7, 8.5)	7.9 (7.1, 8.9)	6.0 (5.3, 6.7)	-3.2%	<.01**
<b>Stratified trends:</b>							
<b>By Sex:</b>	<b>n=3,264</b>	<b>n=3,158</b>	<b>n= 3,211</b>	<b>n=3,808</b>	<b>n=3,727</b>		
<b>Females</b>	69.2 (66.4, 71.8)	70.7 (67.9, 73.3)	68.9 (65.6, 72.0)	64.1 (60.4, 67.6)	59.4 (55.9, 62.7)	-14.2%	<.0001*, <.05**
Any Cigarette Use	14.3 (12.5, 16.3)	14.3 (12.5, 16.3)	13.6 (11.9, 15.6)	13.6 (12.0, 15.4)	13.0 (11.5, 14.7)	-9.1%	0.25
Any Cigar Use	-- <sup>b</sup>	39.1 (36.2, 42.0)	40.2 (37.3, 43.3)	39.7 (36.2, 43.3)	30.2 (37.5, 43.0)	2.8%	0.69
Any Blunt Use							
<b>Males</b>	<b>n=5,041</b>	<b>n=4,933</b>	<b>n=5,149</b>	<b>n=5,781</b>	<b>n=6,000</b>		
Any Cigarette Use	66.5 (64.6, 68.4)	65.9 (63.7, 68.1)	65.4 (62.3, 68.4)	64.3 (62.0, 66.5)	60.5 (58.2, 62.7)	-9.0%	<.0001*
Any Cigar Use	27.0 (25.0, 29.1)	26.7 (24.9, 28.6)	28.2 (26.0, 30.5)	23.5 (21.8, 25.3)	24.7 (23.1, 26.5)	-8.5%	<.05*
Any Blunt Use	-- <sup>b</sup>	39.2 (37.0, 41.3)	41.7 (39.5, 44.0)	42.0 (39.5, 44.5)	42.9 (40.9, 44.9)	9.7%	<.05*
<b>By Race:</b>	<b>n=5,801</b>	<b>n=5,498</b>	<b>n=5,524</b>	<b>n=6,239</b>	<b>n=6,114</b>		
<b>White</b>	68.8 (66.8, 70.7)	68.0 (65.8, 70.0)	69.0 (66.2, 71.7)	65.2 (62.6, 67.6)	60.3 (57.5, 63.0)	-12.4%	<.0001*, <.05**
Any Cigarette Use	20.3 (18.7, 22.0)	20.0 (18.5, 21.5)	21.8 (20.0, 23.7)	17.6 (16.2, 19.2)	18.7 (17.1, 20.5)	-7.9%	<.05*
Any Cigar Use	-- <sup>b</sup>	30.2 (28.3, 32.1)	33.7 (32.1, 35.2)	33.0 (30.8, 35.3)	31.9 (30.0, 33.9)	5.6%	<.05**
Any Blunt Use							
<b>Black</b>	<b>n=1,094</b>	<b>n=1,140</b>	<b>n=1,217</b>	<b>n=1,374</b>	<b>n=1,549</b>		
Any Cigarette Use	62.8 (58.2, 67.2)	65.4 (60.6, 69.9)	57.3 (52.0, 63.4)	60.3 (54.7, 65.6)	60.2 (56.5, 63.9)	-4.1%	0.11
Any Cigar Use	32.3 (27.4, 37.7)	34.2 (30.0, 38.5)	31.7 (27.7, 35.9)	30.5 (26.3, 34.9)	30.4 (27.3, 33.7)	-5.9%	0.26
Any Blunt Use	-- <sup>b</sup>	73.5 (68.7, 77.8)	72.6 (67.0, 77.5)	73.3 (68.0, 78.0)	74.0 (69.9, 77.8)	0.7%	0.81
<b>Hispanic</b>	<b>n=822</b>	<b>n=847</b>	<b>n=924</b>	<b>n=1,167</b>	<b>n=1,236</b>		
Any Cigarette Use	63.2 (57.5, 68.6)	63.6 (57.3, 69.4)	64.8 (58.9, 70.2)	62.7 (57.8, 67.2)	57.5 (52.8, 62.1)	-9.0%	0.11
Any Cigar Use	25.3 (20.1, 31.5)	24.4 (19.6, 29.8)	21.4 (17.5, 25.9)	21.9 (17.6, 27.0)	17.8 (15.2, 20.8)	-29.6%	<.01*
Any Blunt Use	-- <sup>b</sup>	48.6 (41.8, 55.4)	46.6 (41.0, 52.2)	51.1 (46.1, 56.1)	57.8 (52.5, 62.9)	18.9%	<.05*
<b>By Age:</b>	<b>n= 6,271</b>	<b>n=6,083</b>	<b>n=6,316</b>	<b>n=7,186</b>	<b>n=7,146</b>		
<b>18-25 years</b>	73.1 (71.7, 74.5)	73.0 (71.5, 74.4)	70.1 (68.4, 71.8)	67.1 (65.5, 68.6)	63.0 (61.6, 64.4)	-13.8%	<.0001*, <.01**
Any Cigarette Use	29.9 (28.5, 31.4)	29.0 (27.7, 30.3)	28.9 (27.4, 30.4)	26.4 (24.9, 28.0)	25.5 (24.1, 26.9)	-14.7%	<.0001*
Any Cigar Use	-- <sup>b</sup>	57.3 (55.5, 59.2)	59.7 (57.8, 61.6)	60.8 (58.9, 62.6)	60.4 (58.5, 62.4)	5.4%	<.05*
Any Blunt Use							
<b>26-34 years</b>	<b>n=979</b>	<b>n=968</b>	<b>n=1,031</b>	<b>n=1,174</b>	<b>n=1,236</b>		
Any Cigarette Use	69.5 (65.4, 73.3)	68.6 (64.3, 72.6)	73.1 (70.0, 76.0)	69.9 (66.0, 73.6)	64.4 (60.3, 68.2)	-7.3%	<.05**
Any Cigar Use	20.3 (17.1, 24.0)	25.5 (21.4, 30.1)	22.9 (19.5, 26.7)	19.5 (16.4, 22.9)	20.2 (17.5, 23.2)	-0.5%	0.23
Any Blunt Use	-- <sup>b</sup>	41.1 (36.2, 46.2)	43.0 (39.5, 46.6)	41.1 (37.1, 45.3)	43.0 (39.5, 46.6)	4.6%	0.66
<b>35-49 years</b>	<b>n=925</b>	<b>n=870</b>	<b>n=827</b>	<b>n=951</b>	<b>n=927</b>		
Any Cigarette Use	60.5 (56.4, 64.5)	65.3 (61.4, 69.0)	62.4 (57.7, 66.9)	60.4 (56.2, 64.4)	63.5 (59.3, 67.6)	5.0%	0.84
Any Cigar Use	15.6 (12.7, 18.9)	13.8 (11.2, 16.8)	19.4 (15.5, 24.1)	15.9 (12.9, 19.4)	17.4 (13.7, 21.9)	11.5%	0.30
Any Blunt Use	-- <sup>b</sup>	18.4 (15.2, 22.0)	22.4 (19.0, 26.2)	24.1 (20.2, 28.6)	27.8 (23.9, 32.0)	51.9%	<.001*

<b>50+ years</b>	<b>n=130</b>	<b>n=170</b>	<b>n=186</b>	<b>n=278</b>	<b>n=418</b>		
Any Cigarette Use	54.5 (43.3, 65.3)	47.4 (39.6, 55.4)	50.0 (39.7, 60.2)	52.8 (45.0, 60.5)	43.4 (38.0, 49.1)	-20.4%	0.13
Any Cigar Use	13.0 (7.5, 21.5)	11.7 (7.0, 18.7)	10.9 (5.9, 13.0)	8.9 (5.9, 13.0)	14.2 (10.5, 18.9)	9.2%	0.72
Any Blunt Use	-- <sup>b</sup>	11.3 (6.2, 19.9)	9.9 (5.7, 16.6)	11.5 (8.2, 15.9)	15.6 (11.2, 21.2)	38.0%	0.24

\*Linear trend \*\*Quadratic trend <sup>a</sup> Adjusted for sex, age, and race/ethnicity. <sup>b</sup> Data on blunt use among adults was not collected in 2003, therefore no estimates were produced for 2003-2004 blunt use.



**Figure 3.1: Historical trends\* in the prevalence of tobacco product use among past 30-day marijuana users, NSDUH, 2003-2012\*\***

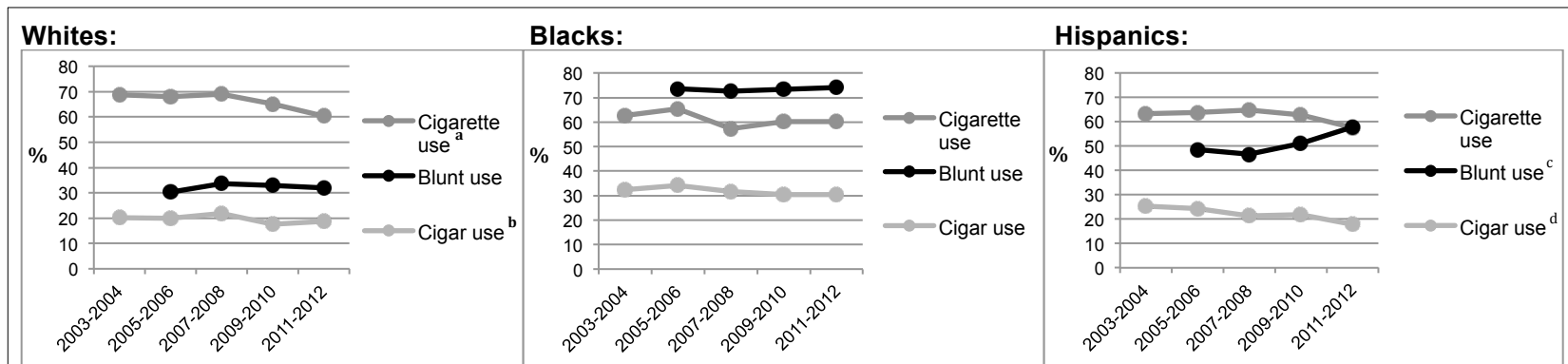


\* Adjusted for sex, age, and race/ethnicity.

\*\*Blunt use was not collected among adults on the 2003 NSDUH.

<sup>a</sup> Non-linear decrease,  $p < .0001$ , <sup>b</sup> Linear increase,  $p < .001$ , <sup>c</sup> Non-linear Change,  $p < .01$  (quadratic change only)

**Figure 3.2: Historical trends in the prevalence of tobacco product use among past 30-day marijuana users, by race/ethnicity, NSDUH, 2003-2012\***



\* Blunt use was not collected among adults on the 2003 NSDUH.

<sup>a</sup> Non-linear decrease,  $p < .0001$  <sup>b</sup> Linear decrease,  $p < .05$  <sup>c</sup> Linear increase,  $p < .05$  <sup>d</sup> Linear decrease,  $p < .01$

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## CHAPTER 4:

### Differences in the Relationship of Marijuana and Tobacco by Frequency of Use:

#### A Qualitative Study with Adults Aged 18-34 Years

##### Abstract

**Introduction:** Co-use of marijuana and tobacco is increasing among adults in the U.S., but little research has been conducted to examine why co-use occurs. In light of changing marijuana policies, understanding the relationship between marijuana and tobacco is critical. Accordingly, this study aimed to assess how adult co-users of marijuana and tobacco qualitatively conceptualize and describe their use.

**Methods:** Forty-eight past-month marijuana and tobacco users aged 18-34 years completed semi-structured key informant interviews in Washington State (U.S). Interviews were digitally recorded, transcribed verbatim, and coded across frequency of use strata (high tobacco/high marijuana, high tobacco/low marijuana, low tobacco/high marijuana, and low tobacco/low marijuana), where high tobacco use was daily use, and high marijuana use was use on 20 or more of the past 30 days.

**Results:** Participants described the relationship between tobacco and marijuana as: sequential use (e.g., using within short succession), co-administration (e.g., using at the same time), or substitution (e.g., using in different times/places or when one substance was not available or appropriate to use). Participants reported liking the act of smoking in general – whether it was tobacco or marijuana. Descriptions varied by frequency of use of each substance; the high tobacco use groups described the strongest co-use relationships; the low tobacco/high marijuana group described more substitution.

***Discussion:*** Participants described a variable relationship between tobacco and marijuana use, based on frequency of use. These data can be used to inform future surveillance, and to develop possible theoretical frameworks upon which co-use occurs.

## **Introduction**

Co-use of marijuana and tobacco is prevalent in the U.S., with 69.6% of adult marijuana users reporting past month tobacco use, and 17.5% of adult tobacco users reporting past month marijuana use (Schauer, Berg, Kegler, Donovan, & Windle, 2015). Between 2003 and 2012, past month co-use of marijuana and tobacco increased significantly among U.S. adults, with the highest use occurring in people aged 18-34 years (Schauer et al., 2015). Co-use is concerning because tobacco and marijuana may have additive or interactive effects, potentially leading to more severe health consequences (Barsky, Roth, Kleerup, Simmons, & Tashkin, 1998; Hall & Solowij, 1998; Ramo, Liu, & Prochaska, 2012; Taylor et al., 2002), and increased use, dependence, and difficulty quitting either substance (Copersino et al., 2006; Peters, Budney, & Carroll, 2012; Ramo et al., 2012; Ramo & Prochaska, 2012).

Little research has been conducted to examine why co-use of tobacco and marijuana occurs, though hypotheses exist. First, although other modes of use exist, both marijuana and tobacco are primarily consumed in combusted form (Agrawal, Budney, & Lynskey, 2012; Centers for Disease Control and Prevention, 2014b; Volkow, Baler, Compton, & Weiss, 2014). Legalization of marijuana may promote other overlapping modes of use between marijuana and tobacco, including vaping, and use of heat-not-burn technologies (CBS News, November 7, 2013; Vonder Haar, 2014). Common route of administration could serve as a cue for use. Second, data suggest that tobacco and marijuana have a complementary and synergistic relationship, wherein use of one substance may chemically reinforce and enhance use of the other. This may be because nicotine and THC work synergistically to enhance rewarding effects in the brain,

enhancing the psychoactive high (Valjent, Mitchell, Besson, Caboche, & Maldonado, 2002). Third, marijuana and tobacco can be co-administered in blunts (hollowed out cigars filled with marijuana) or spliffs (joints of marijuana mixed with loose-leaf tobacco, also called mulling) (Golub, Johnson, & Dunlap, 2005; Mariani, Brooks, Haney, & Levin, 2011; Soldz, Huyser, & Dorsey, 2003), which may expose marijuana users to tobacco products and increase the propensity for tobacco use (Patton, Coffey, Carlin, Sawyer, & Lynskey, 2005), nicotine dependence (Ream, Benoit, Johnson, & Dunlap, 2008), and marijuana dependence (Peters et al., 2012; Ream et al., 2008), perpetuating co-use for dependence-related reasons.

These hypothesized reasons for co-use behaviors have been put forth by researchers, and do not necessarily reflect reasons co-users might provide to explain their use of both marijuana and tobacco. Furthermore, little testing has been conducted to examine factors that might moderate these potential reasons. It is conceivable that reasons for co-use may vary based on how frequently people are consuming each substance – which could point to a need for different interventions or approaches to mitigate co-use. Finally, few efforts have been made to link these hypothesized reasons for use to established theoretical constructs that could be used to explain co-use behaviors, and could provide a foundation upon which to build interventions to prevent or decrease co-use of marijuana and tobacco.

Qualitative methods are well suited to explore the relationship between tobacco and marijuana use, as discussions with co-users could help confirm and add to the reasons hypothesized in the existing literature. However, no such qualitative studies have been conducted with adult participants. The few qualitative studies published on this

topic address adolescent populations, and most have occurred outside the U.S. (Akre, Michaud, Berchtold, & Suris, 2010; Amos, Wiltshire, Bostock, Haw, & McNeill, 2004; Hight, 2004; Sifaneck, Johnson, & Dunlap, 2005). Findings from those studies suggest a strong link between marijuana and tobacco use, including substitution when marijuana is unavailable and combined use to reduce cost and increase the high. Since patterns of substance use change in adulthood (Moss, Chen, & Yi, 2014), themes among adults may be different. Understanding how co-users conceptualize and characterize use of both substances can help provide context for the high prevalence of and increases in co-use. This study sought to use qualitative methods to explore how adults describe their co-use of marijuana and tobacco, including defining the relationship between the two substances and reasons for co-use.

## **Methods**

### ***Recruitment and Sampling***

The sample for this study consisted of adults between the ages of 18 and 34 years who reported past 30-day use of a tobacco product and past 30-day use of marijuana, and resided in Washington State (WA), where recreational marijuana use was legalized in 2012 for adults aged 21 and older. This age range extends beyond the traditional young adult age range (18-24 years) and covers the ages with the highest prevalence of use (Schauer et al., 2015). In particular, individuals in the 26-34 year old age range, who have increasing prevalence of co-use (Schauer et al., 2015), are included in our sample.

We purposively recruited participants across four different co-use strata, to assess potentially differing perceptions of the relationship between tobacco and marijuana, based on how often they used each substance. Participants were recruited through online

postings on Craigslist and flyers posted near smoke shops, vape shops, and retail marijuana outlets in the larger Seattle metro area. Because a primary goal of this study was to assess the relationship of tobacco and marijuana (versus other drugs), five potential participants were excluded—two due to frequent use of other drugs (e.g., heroin, cocaine, crack, hallucinogens) and three due to marijuana use for primarily medical purposes.

Recruitment flyers contained the study inclusion and exclusion criteria and a study-specific email address and phone number. Interested participants were contacted via telephone and screened to assess eligibility criteria and past 30-day use frequency to assign them into frequency strata. Our goal was to recruit 10 or more participants in each co-use stratum to achieve saturation of themes. Saturation was achieved when no new major themes were identified in subsequent interviews (Hennink, Hutter, & Bailey, 2011). Participants received a \$25 gift card incentive for participation. The Emory Institutional Review board approved this study.

### ***Interviews and Measures***

One-on-one, semi-structured, in-depth interviews were conducted in person (n=45) or via telephone (n=3), based on participant preference. Upon providing informed consent, participants completed a 1-page questionnaire including questions to confirm frequency of use (e.g., number of days of marijuana and tobacco use in the past 30 days), types of tobacco and marijuana products consumed in the past month, number of days that the substances were consumed together (either at the same time or on the same day), average number of days of use per month over the past 12 months (to assess whether current use patterns were stable), number of days of past month alcohol use and past

month binge drinking, number of days of past month other illicit drug use, and demographics (sex, age, race/ethnicity).

The interview guide covered initiation of tobacco and marijuana use, the relationship between the two – both in the past and now, perceived benefits and harms of tobacco vs. marijuana, and quitting or reducing use of one or both products. This study focuses the relationship between tobacco and marijuana, including how people described the relationship, reasons for co-use, times of use, and relationship with alcohol use. Interviews were digitally recorded and lasted between 32 minutes and 79 minutes (average: 46 minutes).

Current tobacco use was defined as any past 30-day use of cigarettes, cigars/little cigars/cigarillos, pipes, hookah/waterpipe, smokeless tobacco/chewing tobacco/dip, snus/snuff, e-cigarettes/vaporizers, or dissolvable tobacco products. Current marijuana use was defined as any past 30-day use of any form of marijuana (e.g., combusted, vaporized, edible, drink). High marijuana use was defined as use on  $\geq 20$  of the past 30 days. Low/Moderate marijuana use is use on  $<20$  of the past 30 days. High tobacco use was defined as any daily use of tobacco. Low/moderate tobacco use was nondaily use (use  $\leq 29$  of the past 30 days). Cut points for high versus low/moderate use were based on commonly reported cut points used in data reported from national surveillance systems to differentiate between daily or near daily use (Centers for Disease Control and Prevention, 2014a; Substance Abuse and Mental Health Services Administration, 2014).

### ***Analysis***

Audio-recordings of the interviews were de-identified and transcribed verbatim. Transcripts were coded in MaxQDA (Version 10, 2013, VERBI Software, Berlin,



Germany). An initial codebook was developed by the primary coder (GLS) after reading a selection of 12 transcripts and identifying both deductive (from the interview guide) and inductive (participant identified) themes. The codebook was further refined by having a second researcher (CH) separately code eight interviews using the initial codebook and then comparing codes. Discrepancies in coding were resolved through discussion and codes were amended or added to the codebook accordingly. The primary coder then coded all of the interviews; with the second coder analyzing one-third of them (n=16) to ensure appropriate application of the codes from the codebook (Hennink et al., 2011). Using comparative analyses, themes were analyzed over the entire sample and by frequency strata, assessing for themes within and across strata. Themes were examined by sex, age, and race/ethnicity. Matrices were used to help organize data for sub-analysis (Miles & Huberman, 1994).

## **Results**

### ***Demographics***

Overall, 50.0% of the sample was male, 68.7% were White, and the average age was 25.6 years. Among the 48 participants, 15 participants were high tobacco (T)/high marijuana (M) users (high/high), 10 participants were high tobacco, low/moderate marijuana users (high T/low-M), 12 participants were low/moderate tobacco, high marijuana users (low-T/high-M), and 11 participants were low/moderate users of both substances (low/low). Across all groups, combusted use of tobacco and marijuana was the most commonly reported, with most participants reporting their primary form of tobacco use was cigarettes, roll-your-own cigarettes, or cigars (2 participants reported electronic cigarettes and 2 participants reported hookah). Participants in the low/low

group reported the greatest variety of tobacco products used in the past 30 days.

Cigarettes smoked per day (cpd), on smoking days, varied widely between groups and within group (Range: 2-20 cpd for high/high, 5-15 cpd for high T/low-M, 1-3 cpd for low-T/high-M, and 1-5 cpd for low/low).

### ***Relationship between Tobacco and Marijuana***

The relationship between tobacco and marijuana varied by frequency of use across the major themes. Virtually all participants in the two high-T groups reported a close relationship between the substances. For example, one participant said smoking weed and a cigarette was “like peaches and cream, or like coffee and cream - it’s just one of those things that goes with it.” Another said, “To be high and then smoke a cigarette is pretty good. They go hand in hand pretty well.”

The low-T/high-M group was mixed; participants who reported no relationship tended to either not like tobacco or its effects with marijuana, or were former high/high users who had cut down on tobacco use and no longer found a relationship between the two. For example, one participant who was formerly a high/high user said they weren’t related because “I’m trying to get them more distance apart, because I don’t like smoking (cigarettes).”

Few participants in the low/low group saw any relationship between the two substances. Many were self-described “social users” and used whatever substance their friends were using. For example, one participant said, “They’re related for me only in the sense that if I’m around a group of people and I’m offered both, I will do both.” Similar to the low-T/high-M group, a few participants in the low/low group reported a past relationship when their use was higher but had cut down use of both substances such that

they were no longer related/interrelated. In all frequency groups, a small proportion of participants expressed some level of self-contradiction wherein they initially said they did not see a relationship between the two substances but then went on to describe one.

### ***Patterns of Co-Use and Reasons for Co-Use***

Participants described three main patterns of co-use: sequential use, substitution, and co-administration. Under each of these patterns, they described specific reasons for use (described in detail below). In addition, an underlying reason for use that was identified across all groups, and associated with each of the use patterns was an affinity for *the act of smoking* – regardless of whether it was tobacco or marijuana. Participants in all groups reported liking different aspects of smoking in general – the hand-to-mouth, the oral fixation, the sensation of smoke (e.g., the harsh, burning sensation), the feeling of breathing smoke, and exhaling the smoke (e.g., smoke tricks). For example, a low/low participant said, “I like to smoke, so if I can’t do it one way, then I’ll do it another way.” Another said, “I just like the way that it feels, there’s something about the slight burn into my lungs that I like, and it’s just been a habit for so long, whether it was marijuana or tobacco.” A low-T/high-M participant said, “There’s something that just feels really good about actual smoke, like smoking, and combustion - I mean I just like that process.” A high-T/low-M participant shared, “I like the actual like kick in the throat - the feel of it in my throat.” A high/high participant described, “I like the act of smoking. You kind of regulate your breathing. You become aware of surroundings.” The act of smoking often overlapped with the other themes that guided how participants talked about the relationship of tobacco and marijuana.

### ***Sequential Use***

While sequential use was a pattern of use discussed by all frequency groups, it was most common in the two groups with high tobacco users (high/high and high-T/low-M), with virtually all participants in those groups describing use of marijuana and tobacco in a sequence or closely tied pattern. A high/high participant said, “When I smoke marijuana, it’s like I automatically have to smoke a cigarette right after that.” Many participants in the high tobacco groups reported they would never smoke weed without having a cigarette. Most participants who reported sequential use reported ending with tobacco products (vs. using tobacco and then marijuana). One participant described tobacco as, “the dessert course,” another said having a cigarette after weed was, “like the cherry on top [of the sundae],” and another said it was like “the punctuation to a sentence.” Only a couple participants reported ending with marijuana – and none reported it as a consistent pattern.

Participants described a few reasons for the sequence, including habit or addiction to nicotine, a perception that tobacco would enhance the high, or a perception that tobacco counteracts or counterbalances the psychoactive effects of marijuana (e.g., marijuana as a downer, nicotine as an upper).

*Habit/Addiction:* Many participants described a habit of sequential use as adults that started during their adolescence or at the time of initiation. For example, a high/high participant described how his pattern of use has been a blunt followed by a cigarette since he was 15 years old. Another high/high participant described the physical nicotine addiction: “I like to have a cigarette after smoking a bowl, it’s just like, I’m craving a cigarette now. It helps to reduce the craving a little bit.” Another said, “To me, it’s knowing that I’m going to eventually have that craving [for a cigarette], so I might as

well get it out of the way, before I crave it later.” For some, sequential use was also attributed to their identity as a cigarette smoker. As described by one high/high participant: “Because I’m a smoker, I would always have a cigarette after, just because I would want a cigarette.”

*Enhanced high:* Many participants talked about a belief or perception that using tobacco and marijuana sequentially would enhance the high. A high/high participant said, “[People] say if you smoke marijuana and you smoke a cigarette afterwards, it increases your high by twenty percent.” A number of participants reported this as the primary reason they had initiated a pattern of co-use. One high/high participant shared, “I mean think it (co-use) first started when somebody told me that I would get higher if I smoked a cigarette afterwards. I was like, I’m 17 – I totally believe you.” Another said, “There’s a lot of suggestion when you’re a kid that if you get high and then you smoke a cigarette, you’ll get higher.” In the high/high group, at least half of the participants cited the enhanced high they experienced as a reason they continued to use sequentially. In most of the cases when participants reported no sequential use of tobacco and marijuana, it was because they did not like the synergistic effects, and felt dizzy or nauseous from using them in close proximity. A low-T/high-M participant said, “I don’t like to smoke them near each other - because my throat would hurt, and because the buzz from the cigarette would just make the high more intense – which I don’t like.”

*Counteracting Effects:* Another common reason cited for sequential use was to counteract the effects of marijuana with tobacco. As described by a high/high participant, “Nicotine is somewhat of a stimulant. Marijuana is pretty relaxing. And then, when I smoke a cigarette it kind of balances.” A high-T/low-M participant said, “I use cigarettes

as a stimulant, when I'm stoned and want to be awake and not just fall asleep on the couch." Participants also described this counterbalancing effect as a way to transition from a psychoactive high back to a task or activity requiring focus. A high/high participant said, "[Cigarettes] just kind of give [the weed] a cap, and it kind of helps transition into the next thing." Another said, "I'll have a bowl and then it'll be time to smoke a cigarette and then go about my day."

### ***Substitution***

While substitution was a use pattern that individuals in all frequency groups described, it was most commonly discussed among individuals in the low-T/high-M and low/low groups. Reasons for substitution included liking the act of smoking – regardless of the product being smoked, limitations on when or where use of one substance was deemed appropriate or desirable, and as a way to cut down on or try to quit one substance.

*Liking the act of smoking – regardless of the product:* For most participants, substitution was tied at least in part to liking the act of smoking (e.g., needing to smoke something). For example, low/low participant said, "I'd probably smoke more, smoke more weed if I didn't have my E-cig, just because I like smoking." A low-T/high-M participant shared, "At any moment, whether I'm watching a sunset or something, I just want to be smoking something. I would always prefer it to be weed, but I would settle for a [nicotine] vaporizer."

*Limitations on when/where can use one substance:* Many participants talked about wanting to smoke weed more than tobacco, but not being able to during the day or when needing to work/function, and thus substituting with tobacco. For example, a

high/high participant said, “I can’t really go to work stoned, so, I don’t really mix those together - work and smoking weed, but work and smoking cigarettes is OK.” A low-T/high-M participant described: “Sometimes I am in the mood to smoke something. If I have marijuana and I don't have any tobacco, then definitely, I would smoke marijuana and wouldn't feel the need to get any tobacco. But if I have tobacco and no marijuana - I would rather have weed, but I'll just smoke the tobacco.” Another said, “If I could smoke weed everywhere I would. I would quit tobacco, definitely. But I don’t want to smoke [marijuana] in public.” A high-T/low-M participant said, “I like the action of smoking, it’s a nice one, but I don’t always want to be high.”

*As a way to cut down on or quit one substance:* Some participants reported using weed as a way to cut back on or try to quit tobacco use. For example, a low-T/high-M participant said, “I try to cut down on both as much as I can, but when I have a craving for a cigarette, I’ll smoke cannabis.” A high-T/low-M participant said, “I try and save the cigarettes just for when I’m at work, so I’m not like smoking them all the time, because it’s really bad for my lungs.” Another said, “If anything, [smoking weed] would kind of stifle my crave for cigarette because just like the act of smoking anything is kind of what I really enjoy.” Participants also described substitution in the context of past quit attempts. One participant said, “When I took breaks from smoking cigarettes the way that I compensated was if I wanted a cigarette I would just hit a bowl instead. It was sort of like a replacement, it wasn’t the same thing but it gave a similar feeling.” A high/high participant said, “I think smoking marijuana has decreased my tobacco use, because I smoked a lot more cigarettes when I wasn’t smoking marijuana.”

### ***Co-Administration***

Participants in all frequency use groups talked about co-administration of marijuana in blunts, spliffs, or other forms (e.g., mixed in waterpipes or in a bong) as a pattern of use. Co-administration was most common in the high tobacco groups, but a minority of participants in those groups reported use of blunts or spliffs as their primary way of using tobacco or marijuana; most reported co-administration in social settings. Despite not regularly using them, a number of people in both of the high-T groups described blunts as their most preferred way of using marijuana, but reported they had limited use because blunts are hard to roll or use too much marijuana for an individual user. A majority of individuals in the two low-T groups reported no past month use of blunts or spliffs, usually because they did not like the two substances together, or were trying to cut back on or avoid tobacco use. For example, a low/low participant said, “Since I stopped regularly smoking cigarettes, I haven’t had a spliff. I want one, but I feel like it has the cigarette in it, so, no.” Others were self-described “purists” and did not like to combine tobacco and marijuana (but some would still use them sequentially). For example, a low-T/high-M participant said, “I’m a little bit of a naturalist, and so I think you should enjoy [tobacco and marijuana] more purely.”

### ***Relationship with Alcohol***

People who drank described one of two relationships between alcohol, tobacco, and marijuana: (1) alcohol and marijuana are substitutes, and tobacco goes with both of them, or (2) all three substances go together. Participants who felt alcohol and marijuana were substitutes tended to have negative feelings about the physical and psychological effects from combining the two, but liked the effects of alcohol or marijuana combined with tobacco. While participants in all frequency groups described this relationship, it



was most common among those in the high-T/low-M group. For example, a high-T/low-M participant said, "I never smoke marijuana when I'm drinking. Especially if you are drinking first and smoke marijuana after drinking, it feels awful. They don't go well together. You can get really dizzy, and nauseous, and sick. So almost never do I drink and smoke marijuana together. When I drink, all I'll smoke is the cigarettes." Another described use of marijuana and alcohol together as, "an uncomfortable amount of intoxication," and said he would rather smoke weed than drink. And another said, "I don't like to be drunk and high, because that's too much to deal with, so I will do one or the other. Much like alcohol, smoking marijuana makes you want to smoke cigarettes, it lowers your inhibitions."

While some participants in all frequency groups reported consuming all three substances together, that relationship was most common among individuals in the high/high group. For example, one high/high participant said, "They all go hand in hand. If I have a drink, and get intoxicated, there's a hundred percent likelihood that I will use tobacco and marijuana." Individuals describing this relationship seemed to view the heightened intoxication as a positive. For example, a low-T/high-M participant said, "I use marijuana and tobacco together when I'm drunk or on drugs. It feels so right, you're just sitting there with your cigarette and the buzz feels good." They also described a sequence of use that incorporated all three substances, and was often tied to social activities. For example, describing a typical night with friends, a high/high participant said, "I'll take a little puff of weed at home. And then, we'll just get a drink and smoke some cigarettes [at the bar]. And then a couple of us will go smoke some weed and then

that cycle repeats itself.” Another said, “First, I’ll smoke a joint and I’ll halfway smoke a cigarette, and then hopefully I have enough money left over to get a beer.”

## **Discussion**

This study sought to characterize how adults aged 18-34 years who use both marijuana and tobacco describe the relationship between the two substances and their reasons for co-use. Participant narratives about the relationship between marijuana and tobacco differed based on their frequency of use, with those who were high users of both substances, or high users of tobacco and low users of marijuana reporting the strongest relationship. The relationship between marijuana and tobacco was more variable for those who were high marijuana users, but not high tobacco users, and few low/low users described a strong relationship between the two substances. Exceptions to this were participants who had previously had higher use frequency of one or both of the substances. Findings from this study suggest possible theory-based constructs that could be explored to improve our understanding of why co-use of marijuana and tobacco occurs and provide possible frameworks for future interventions to prevent or decrease co-use behaviors.

This is the first study that we are aware of to find that the affinity for the general act of smoking perpetuated co-use. Other studies have suggested that the shared route of administration may be associated with co-use (Agrawal et al., 2012; Vandrey, Budney, Hughes, & Liguori, 2008), but participants in this study seemed to suggest that their use of both substances was rooted in a desire to smoke in general. Smoking one substance may, in turn serve as a physical cue to continue smoking, suggesting the theory-based constructs relating to classic or operant conditioning may be appropriate to explain co-use

behavior. Classic and operant conditioning theories suggest that certain cues and responses developed through experience and reinforcement lead to repeated behavioral patterns that can be more rewarding than the physical effects of the substance itself (Mook, 1995; West, 2013). Under these models, co-use of marijuana and tobacco may be perpetuated by a shared behavioral cue: smoking. While other routes of administration exist for both marijuana and tobacco, a majority of use for both substances occurs through smoking or inhalation (Agrawal et al., 2012). Analysis of data from U.S. adults who participated in the National Epidemiological Study on Alcohol Related Conditions (NESARC) found that smoking tobacco (e.g., cigarettes, cigars, pipes) was associated with 3.3 to 4.5 times the risk of marijuana use, as well as marijuana abuse and dependence, while use of smokeless forms of tobacco was not associated with elevated rates of marijuana use, abuse, or dependence (Agrawal & Lynskey, 2009). The authors hypothesize that the respiratory adaptations from smoking one product may have facilitated use of the other; because the sensation of inhaled smoke was less unpleasant (Agrawal & Lynskey, 2009).

Co-users in this study also suggested their co-use was due in part to a perception of an increased high, or to a desire to counteract the effects of the high. A number of studies among adolescents have identified a phenomenon of co-use of tobacco with marijuana to increase, enhance, or boost the high (Lee, Battle, Lipton, & Soller, 2010; Ream et al., 2008). This rationale for co-use may be described by positive reward theories, rooted in the idea that positive reinforcement from an action or behavior (either physical, emotional, or social) may perpetuate behavior (Koob & Le Moal, 2001; West, 2013). In this case, the pleasurable affect individuals reported receiving from the

combination of using nicotine and cannabinoids may further increase and perpetuate co-use behaviors.

In heavy users of both substances, the relationship between tobacco and marijuana may be founded upon classic addiction models. Participants in the high tobacco use groups described the relationship, in part, as a habituated pattern of or addiction to using the two together or to nicotine alone. Increases in the frequency and intensity of substance use are a major behavioral characteristic associated with the development of addiction (Koob & Volkow, 2010). Some research suggests marijuana use may exacerbate withdrawal from nicotine, cuing subsequent tobacco use. In one study cigarette smokers were more likely to report cannabis use disorder than individuals using smokeless tobacco (Agrawal & Lynskey, 2009). The relationship may be bi-directional, wherein smoking marijuana prompts tobacco smoking, but marijuana use aids in tobacco withdrawal (Balerio, Aso, Berrendero, Murtra, & Maldonado, 2004; Ramo, Liu, & Prochaska, 2013). This could also explain why weaker relationships were described in lower tobacco use groups. Future studies should seek to examine smoking in general as a cue for use of different smoked substances and to assess classic addiction models as an underlying link for co-use.

In the lower tobacco use groups, participants tended to describe more of a substitution phenomenon, suggesting that economic models may be appropriate to explain some co-use behaviors. In participants who previously used tobacco more frequently, substitution could be a compensatory behavior adopted to help them reduce tobacco use. In participants without a previous history of frequent tobacco use, it could be a self-regulation tool to keep cigarette-smoking in-check. A study of young adults found

that spontaneous marijuana cessation was linked to a sudden increase in the use of tobacco and other substances (Copersino et al., 2006), supporting the idea that co-use may promote substitution. As identified in this study, the mechanism for that may be an affinity for the act of smoking. The substitution phenomenon may also exist because of differences in the times and places when marijuana use is acceptable or desired, or the ability to access marijuana or use it publicly. Similar to our results, a qualitative study of adolescents in Scotland found that participants described a close link between marijuana and tobacco, with some participants reporting that they used cigarettes when they didn't have or couldn't get marijuana (Amos et al., 2004). Participants reporting this theme in our study tended to be adults under age 21 - for whom marijuana remains illegal in WA State.

Findings from this study can be used to inform measurement development work to assess reasons for use and to quantify the magnitude of the relationship between the two substances in surveillance systems. Future studies should seek to survey a nationally representative sample of co-users to determine the population-based prevalence of the themes identified in this study, and whether variation exists in themes by state, based on marijuana policy. Measurement of theory based constructs related to classic or operant conditioning, positive reinforcements or rewards from co-use, classic addiction principles (e.g., withdrawal), and economic approaches to use of tobacco or marijuana should also be included in future quantitative studies to facilitate improved understanding of theoretical constructs that help explain co-use behaviors.

The following limitations should be considered when interpreting results from this study. First, these are qualitative findings from co-marijuana and tobacco users in

Washington State and are not intended to be generalizable, but rather to inform future generalizable studies (Hennink et al., 2011). Second, our findings are based on self-reports from a relatively small sample of co-users and do not include biochemical verification of tobacco or marijuana use, or follow-back verification of the number of days of use in the past month. Third, these findings are limited to a specific adult age range (18-34 years) for which marijuana use is highest. Future studies could seek to identify and compare themes among older adult co-users.

Participants in this study described a variable relationship between tobacco and marijuana use, based on their frequency of use of the two substances. These findings can be used to inform future studies to develop measurement tools to assess reasons for marijuana and tobacco co-use, and to begin to formulate possible theoretical frameworks upon which co-use occurs.

**Table 4.1: Strata for qualitative recruitment, based on frequency of use**

<b>STRATUM 1 (high/high):</b> High Tobacco Use High Marijuana Use	<b>STRATUM II (low-T/high-M):</b> Low/Moderate Tobacco Use High Marijuana Use
<b>STRATUM III (high-T, low-M):</b> High Tobacco Use Low/Moderate Marijuana Use	<b>STRATUM IV (low/low):</b> Low/Moderate Tobacco Use Low/Moderate Marijuana Use

**Note:** High marijuana (M) use was defined as use on  $\geq 20$  of the past 30 days. Low/Moderate marijuana use was defined as use on  $<20$  of the past 30 days. High tobacco (T) use was defined as any daily use of tobacco. Low/moderate tobacco use was defined as nondaily use (use  $<20$  or the past 30 days).

**Table 4.2: Demographic composition of qualitative sample, overall, and by frequency strata**

	n	% Male	% Non White	Ave. Age	Age range
<b>Overall Sample</b>	48	50.0	31.3	25.6	18 to 34
High-T/High-M	15	53.3	40.0	27.0	18 to 34
High-T/Low-M	10	40.0	10.0	25.6	18 to 31
Low-T/High-M	12	33.3	41.7	23.2	18 to 34
Low-T/Low-M	11	72.7	27.3	26.4	18 to 34

\*Where T=tobacco and M=marijuana, and high tobacco (high-T)= daily tobacco use (30 of past 30 days) and high marijuana (high-M)= near daily use (20+ of past 30 days)

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## CHAPTER 5:

### Summary and Conclusions

Tobacco use has been shown to be prevalent among people using other substances, including alcohol and illicit drugs (Richter, Ahluwalia, Mosier, Nazir, & Ahluwalia, 2002; Substance Abuse and Mental Health Services Administration, 2014). Some data suggest a particular overlap between tobacco and marijuana (Agrawal, Budney, & Lynskey, 2012; Ramo, Liu, & Prochaska, 2012; Richter et al., 2004), the most widely used federally illicit substance in the U.S. (Substance Abuse and Mental Health Services Administration, 2014). Given the numerous and well-documented harms related to tobacco (U.S. Department of Health and Human Services, 2014), co-occurring tobacco use is an important and concerning comorbidity of marijuana use. In light of changing marijuana policies (Association of State and Territorial Health Officials, 2015) and increasing acceptance of and use of marijuana among adults (Gallup, 2013; Substance Abuse and Mental Health Services Administration, 2014), this study sought to quantify and characterize the overlapping use of marijuana and tobacco in adults.

Findings from quantitative component of this study suggest that co-use is increasing in adults, especially among specific populations, including individuals aged 26-34 and 50+ years, and Whites, Blacks, and Hispanics. Compared to tobacco-only and marijuana-only users, a higher percentage of co-users were male, younger in age, of lower income, and unmarried. While co-users were somewhat unique demographically compared to tobacco-only and marijuana-only users, they were similar to marijuana-only users in terms of race (both had a higher percentage of Blacks vs. tobacco-only users) and employment status (both had a higher percentage of part-time employment), and similar

to tobacco-only users in terms of education (both had high prevalence of lower educational attainment compared to marijuana-only users) and self-reported health status (both had a higher percentage reporting poor or fair health compared to marijuana-only users).

Our results suggest that tobacco use is more prevalent among the population of marijuana users than the converse, but that co-use of marijuana is increasing among the population of current tobacco users. From 2003-2012, the prevalence of marijuana use among tobacco users increased from about 14% to about 18%. These increases may be due to changing policies making marijuana use legal (and more accessible) for medical or recreational reasons. Though it declined between 2003-2012, the prevalence of tobacco use among marijuana users remains extremely high, with nearly 70% of adult past month marijuana users reporting past month use of a tobacco product (not including blunts) – compared with about 25% tobacco use prevalence among non-marijuana users. These data support previous data suggesting disparities in tobacco use among substance users (Richter et al., 2002; Secades-Villa et al., 2013), and point to a need for interventions that address both tobacco and marijuana use prevention, and either harm reduction or cessation. In addition, cohort studies are warranted to assess how tobacco and marijuana use patterns may differ among the generation growing up today, in an era of marijuana legalization, and to identify disparities that may emerge or decline as a result of policy changes.

Findings also indicate a significantly higher prevalence of alcohol and other illicit substance use among co-users compared to marijuana-only and tobacco-only users, suggesting that this is a population of polysubstance users. Genetic, psychosocial, and

environmental mechanisms linked to use of one substance may increase the propensity for use of another (or multiple) substance(s) (Kendler, Prescott, Myers, & Neale, 2003; Kendler, Schmitt, Aggen, & Prescott, 2008). While out of scope for the current study, continued research on genetic and environmental factors that lead to increased polysubstance use is warranted.

Although national surveillance systems do not currently contain data on specific marijuana product usage (e.g., joints, pipes, dabs, etc.), we were able to assess trends in tobacco product usage among adult marijuana users. Among adult marijuana users, data suggest that cigarette use is declining, while co-administering tobacco and marijuana in blunts is increasing, particularly among Hispanics – though blunt use remains highest among Blacks. A growing body of research exists exploring blunt use (Delnevo, Bover-Manderski, & Hrywna, 2011; Dunlap, Benoit, Sifaneck, & Johnson, 2006; Golub, Johnson, & Dunlap, 2005; Mariani, Brooks, Haney, & Levin, 2011; Sinclair, Foushee, Pevear, Scarinci, & Carroll, 2012; Timberlake, 2013). To date, findings suggest a strong cultural link between blunt use among Blacks and hip-hop culture (Golub et al., 2005). However, little research exists exploring reasons for increased blunt use among Hispanics. In addition, both lab-based and longitudinal research is needed to help describe the extent to which blunt use exposes users to nicotine and leads to subsequent regular patterns of tobacco use. Blunt users have reported this in a handful of studies (Dunlap et al., 2006; Sifaneck, Kaplan, Dunlap, & Johnson, 2003; Soldz, Huyser, & Dorsey, 2003; Timberlake, 2009). If true, the patterns of increasing blunt use among certain populations are concerning and could be linked to subsequent increases in tobacco-related disparities. Research is also needed about how blunt and spliff users

conceptualize their use related to tobacco and marijuana to inform national surveillance about co-administered forms of marijuana.

Previous research on the co-use of marijuana and tobacco has been limited largely to adolescent and young adult (18-24 years) populations. While young adults ages 18-25 had the highest prevalence of co-use in this study (13.7%), their use remained stable between 2003 and 2012, whereas use among adults ages 26-34 years increased from 6.6% to 8.0%. These findings suggest that broadening the scope of co-use studies to include age ranges beyond the traditional adolescent and young adult populations is warranted.

Our qualitative study provides an important contribution to our understanding of co-use patterns and reasons for use outside of the traditional 18-24 year old age range. Participants reported using marijuana and tobacco in a variety of ways, including sequentially, at the same time, or as substitutes – and for a variety of reasons, including to enhance the high, help counterbalance the effects of one or both substances, ease cravings or addiction to nicotine, help cut back on use of one or both substances, or because use of one of the two substances is not appropriate or allowed in certain settings. Participants also reported a strong affinity for the act of smoking, regardless of the substance. The ways participants reported using marijuana and the reasons for use varied by frequency of use of each substance, with high tobacco using groups reporting the strongest relationship between the two substances, and low tobacco-high marijuana use participants reporting more substitution. Thus, these qualitative findings suggest that increases in co-use among the older 26-34 year old age range may be due to increases in marijuana use to help cut back on or dramatically reduce tobacco use, or to help cope with nicotine



cravings, or cravings to smoke something. Future studies should seek to assess these possible reasons for use quantitatively, among a larger population of individuals.

To our knowledge, this is the first study to identify an affinity for smoking in general (e.g., the act of smoking) as a specific reason for co-use of marijuana and tobacco. Additional research is needed to assess this among a broader population, and to determine how strong this reason for use is compared to other reasons participants described. If the enjoyment of smoking in general is a prevalent reason for co-use, intervention strategies to prevent or reduce co-use (or use of tobacco or marijuana individually) may need to move away from a specific product focus, and focus more on developing strategies to intervene on the mode of use.

Because co-use of marijuana and tobacco has been largely understudied – especially among adults, theory-based approaches have not been widely utilized to explain or describe co-use behavior. While we were unable to assess particular theoretical constructs in our quantitative study because they are not included as part of national surveillance systems, results from our qualitative study suggest possible theoretical models that may help explain co-use behaviors. For example, participants described sequential use patterns, wherein smoking one substance cued use of the other, suggesting that classic or operant conditioning models (Mook, 1995; West, 2013) may explain some co-use behavior. Participants also described co-using marijuana and tobacco because of a perception that the effects were synergistic and lead to an enhanced high, indicating that positive rewards theories, or theories of positive reinforcement (Koob & Le Moal, 2001; West, 2013) may be useful to explain co-use. Participants also reported co-use because of an addiction to nicotine, or to the pattern of using both substances together, suggesting

that addiction models (Parssinen & Kerner, 1980; Volkow & Fowler, 2000) may help explain co-use. Participants in the low/low frequency strata described social norms and influences prompting them to use whatever substances their friends were using, suggesting that social norms and social network constructs (Ajzen, 1985; Bandura, 1986; Kadushin, 2011) may be appropriate to explain co-use in some frequency strata. Finally, participants reported substituting marijuana and tobacco in different settings, or at different times based on product availability or perceived appropriateness of use, suggesting that behavioral economic models – which seek to link psychosocial factors to economic decisions (Simon, 1955; Tversky & Kahneman, 1981) – may be appropriate. Future studies of co-use should seek to use and build on these theoretical models so that theory can be more broadly incorporated into our understanding of concurrent use of marijuana and tobacco, and can inform interventions to decrease co-use.

Another interesting finding from both the quantitative and qualitative portions of this study is the close link between alcohol and tobacco and marijuana use. While some participants reported using alcohol and marijuana as substitutes – but using both with tobacco, other participants reported combining the three substances, often in a social or partying setting. Few studies explore the use of these three substances among the broader adult population; most focus on the relationship between two of the three substances (e.g., tobacco and alcohol, alcohol and marijuana) (Harrison & McKee, 2008; Jiang, Lee, & Ling, 2014; Stein, Caviness, & Anderson, 2014) and/or are restricted to an adolescent or young adult population (Barrett, Darredeau, & Pihl, 2006; Chung, Kim, Hipwell, & Stepp, 2013; Stephens et al., 2009). A few recent studies have found that early adolescent use of alcohol, tobacco, or marijuana is linked to increased substance use problems and

polysubstance use in adulthood (Moss, Chen, & Yi, 2014; Nelson, Van Ryzin, & Dishion, 2015). Another recent study among Asian-American adolescents in California documented a practice of “boosting” whereby adolescents were using tobacco products to “boost” the effects of marijuana and alcohol (Lipperman-Kreda & Lee, 2011). While participants in our study did not articulate this in the context of all three substances (alcohol, marijuana and tobacco), “boosting” may be a reason for use of all three substances at once. Our study did not seek to explore the association of alcohol to marijuana and tobacco use in depth. Future qualitative studies could seek to do this among an adult sample.

While outside the scope of the current study, data on the prevalence and trends of tobacco and marijuana cessation among co-users are needed, as are descriptions of quitting intentions and practices among co-users. Prevention-based interventions exist for use in adolescence (e.g., the Family Check-Up [Stephens, Roffman, Fearer, et al., 2007]), but few interventions have been proposed for concurrent marijuana and tobacco use in adulthood. A recent study identified participant interest in an integrated tobacco and marijuana cessation program after conducting focus groups with co-users (Becker et al., 2013). While traditional substance use interventions may be proposed, innovative population-based programs including phone and online-based helplines also warrant exploration, as they have been shown to be effective for both tobacco and marijuana individually (Gates, Norberg, Copeland, & Digiusto, 2012; Stead, Perera, & Lancaster, 2009; Zhu et al., 2002). Future research should also seek to explore desired participant outcomes for use each substance. For example, co-users may want complete cessation

from one substance (e.g., tobacco), while having harm-reduction related goals for the other (e.g., marijuana).

The current study has a number of strengths. First, whereas a majority of studies on co-use focus on an adolescent or young adult population, this study focused on a broader adult population. Second, it used a mixed methods approach to look at national trends and provide contextual information that can help explain reasons for some of those trends. Third, it included temporal trend data to provide historical information on the prevalence of overall co-use, and individual tobacco product use among adult marijuana users, versus focusing on a single cross-section of time. Fourth, it assessed changes to individual tobacco products being used by marijuana users, providing specific areas for increased intervention (e.g., related to blunt use) and highlighting specific disparities in product use.

The following limitations should be considered when interpreting results from this study. First, all data were self-reported and no biochemical verification was used to confirm use for either the national quantitative data or the qualitative data. However, the validity and reliability of substance use reports on the National Survey on Drug Use and Health have been shown to be high (Harrison, Martin, Enev, & Harrington, 2007; Substance Abuse and Mental Health Services Administration, 2010). Furthermore, conducting the qualitative data collection in Washington State, where marijuana use has been legalized medically for residents age 18 years and older, and recreationally for adults age 21 years and older, may have increased participant comfort in disclosing use. Second, this study does not take mental health diagnosis into account, though self-reported quality of health was considered as a covariate in quantitative analyses. Mental

health status has been shown to be associated with both tobacco and marijuana use individually, and with polysubstance use (Centers for Disease Control and Prevention, 2013; Jane-Llopis & Matytsina, 2006; Moore et al., 2007). Trends in co-use among individuals with mental health comorbidities may differ from trends in the general population, as might qualitative themes identified from the qualitative study in Washington State. Finally, though data suggest that medical only use of marijuana is likely small (Schauer, King, Bunnell, Promoff, & McAfee, In Press), we were unable to assess differences in use or in the relationship between marijuana and tobacco among medicinal marijuana users, since questions about reasons for use were not included on national surveillance systems. Accordingly, we limited qualitative data to individuals who reported their use was primarily for recreational reasons. Trends in co-use and themes in reasons for co-use may differ among adults using marijuana only for medical reasons.

When taken together, these findings suggest that co-use is increasing among adults in the U.S. In particular, an overwhelming majority of adult marijuana users also report past-month use of a tobacco product. Given its extensive and well-documented morbidity and mortality, tobacco use represents a major comorbidity of marijuana use. Efforts should be taken to help adults who use marijuana to avoid concomitant or continued tobacco use, as it can increase dependence on both marijuana and tobacco and make quitting more difficult. Individuals aged 18-34 years, where co-use prevalence is highest, report three main patterns of use (sequential use, substitution, and co-administration), each with specific underlying reasons supporting the use pattern. Reasons for co-use provide possible avenues for future, theory-based interventions.

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