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THE EVOLVING PROFILE OF ALTERNATIVE TOBACCO USE IN
CALIFORNIA

A dissertation submitted in partial satisfaction of the requirements for the
degree of Doctor of Philosophy

in

Public Health (Epidemiology)

by

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2010

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Chair

University of California, San Diego

San Diego State University

2010

DEDICATION

This dissertation is dedicated to my amazing and beautiful wife, Patty. She has supported me, both emotionally and financially, while I have perused my higher education. Along with our son, she is the center of my world.

Patty, I love you so much. We did it!

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LIST OF ABBREVIATIONS

ALA, American Lung Association

BRFSS, Behavioral Risk Factor Surveillance System

CATI, computer assisted telephone interviewing

CDC, Centers for Disease Control

CTCP, California Tobacco Control Program

CTS, California Tobacco Surveys

FDA, United States Food and Drug Administration

FTC, Federal Trade Commission

HINTS, Health Information National Trends Survey

MSA, (Tobacco) Master Settlement Agreement

NCI, National Cancer Institute

NHIS, National Health Interview Survey

PAH, polycyclic aromatic hydrocarbons

PREP, potentially reduced-exposure (tobacco) product

RCP, Royal College of Physicians

TSNA, tobacco-specific nitrosamines

TUS-CPS, Tobacco Use Supplement to the Current Population Survey

WHO, World Health Organization

YRBS, Youth Risk Behavior Survey

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ABSTRACT OF THE DISSERTATION

The Evolving Profile of Alternative Tobacco Use in California

by

Joshua Robert Smith

Doctor of Philosophy in Public Health (Epidemiology)

University of California, San Diego, 2010
San Diego State University, 2010

Professor Wael Al-Delaimy, Chair

Tobacco control programs, smoking bans, and taxes have been utilized to reduce cigarette smoking in the United States. Found in all tobacco products, nicotine is highly addictive, and many anti-smoking laws can be subverted with other tobacco products. Additionally, many researchers are promoting the use of potentially reduced-exposure products (PREPs) for harm reduction to cigarette smokers. The purpose of this dissertation was to study the use of alternative tobacco products in California, including smokeless tobacco (both traditional products and PREPs), cigars, and hookah.

Some data are drawn from the California Tobacco Surveys (CTS), which are large, population-based random-digit-dial telephone surveys that collect representative statewide data on tobacco-related behaviors. Analysis of the 1990-2008 CTS was conducted to estimate prevalence and trends of cigar, smokeless tobacco, and hookah use in California adults as well as PREP use among current adult smokers. The remaining data were from a cross-sectional survey of high school students conducted to estimate hookah-use patterns and risk factors among this highly susceptible population.

From the 2008 CTS, male cigar current-use was 7.8% and female ever-use was 7.0%, the highest recorded levels since the inception of the CTS in 1990. Ever-use of hookah was 11.2% among males and 2.8% among females. Hookah use has increased by more than 40% since 2005 and is highly prevalent among young adults.

Among California smokers, hypothetical cigarette replacement receptiveness was 10.3% for health reasons and 15.2% for convenience reasons. Use of actual PREPs was also low (Snus, 2.2%; Ariva, 1.5%; other PREPs, 4.1%).

From the high school survey, hookah use (ever-use, 26.1%; previous month, 10.9%; current, 10.3%) was higher than adult use from the CTS. Subjects believed hookah is more socially acceptable and safer than other tobacco products. Users were more likely than non-users to report a hookah lounge in their community. Current users were more likely than former users to

have recently smoked a cigarette, report a hookah lounge in their community, and believe hookah is more socially acceptable than cigarettes.

The use of alternative tobacco products is not decreasing in California. Specifically, the use of hookah is concerning, as both adolescents and young adults are smoking hookah at a higher rate than other products. Hookah-specific interventions and the legality of 'hookah lounges' represent opportunities for immediate action.

CHAPTER 1

BACKGROUND AND SIGNIFICANCE

BACKGROUND AND SIGNIFICANCE

The use of tobacco is a major preventable cause of death in the United States. The Centers for Disease Control and Prevention (CDC) estimates that in 2008, 443,000 deaths in the United States were caused by tobacco use, equaling 5.1 million years of potential life lost¹. This means that for this year, 1 out of every 5 deaths was related to smoking cigarettes¹. Beginning with the first Surgeon General report in 1964,² the carcinogenic and cardiovascular effects of tobacco have been extensively studied and proven. In the 1970's, Doll and Peto published several studies demonstrating the undeniable effects of smoking on mortality from heart disease, lung cancer, chronic obstructive pulmonary disease, and vascular diseases.³⁻⁵ Today, after more than 50 years of study, the adverse effects of cigarette smoking are universally accepted. Additional adverse effects of smoking include cancers of the oral cavity, larynx, bladder, kidneys, pancreas, stomach, cervix, liver, penis, and rectum.⁶ Cigarettes smokers can expect to live shorter lives than non-smokers.⁶⁻⁸ The relative importance of cigarettes and tobacco to the collective public health is best demonstrated by the attention it has received from the U.S. Surgeon General. Out of the 53 official reports published since 1964, 34 specifically address smoking or tobacco (64%).⁹ Topics of cigarette-specific reports include health consequences, smoking trends, smoking cessation, and cigarette smoking among young people and minority populations. Other tobacco-related issues addressed by the Office of the Surgeon General

include nicotine addiction, smokeless tobacco, and secondhand tobacco smoke.⁹

Current Cigarette Smoking

United States, Adults and Adolescents

The Centers for Disease Control (CDC) estimates that in 2008 (the most recent year for which the CDC has released such data), there were 44 million smokers in the United States, comprising 20.6% of the total adult population.¹⁰ This fails to meet the Healthy People 2010 objective of <12% adult smoking prevalence by a considerable margin.¹¹

The Youth Risk Behavior Survey (YRBS), conducted by the CDC, is a large-scale, national survey to monitor health-related risk behaviors in adolescents. The YRBS estimates that in 2007 (most recent year of released data) 50.3% of high school aged adolescents (9th – 12th graders) had ever smoked a cigarette and that 20.0% of those same adolescents had smoked a cigarette in the past 30 days.¹²

California, Adults and Adolescents

The California Tobacco Survey (CTS) is a large population based random-digit-dial telephone survey in the state of California. It was established to assess the progress of and provide direction to the California Tobacco Control Program (CTCP), the major mass media and educational anti-smoking program for the California Department of Public Health. The

objective of these large, population-based random-digit-dial telephone surveys is to collect representative statewide data on tobacco-related behaviors, knowledge and attitudes towards smoking, and monitoring the effect of State-initiated programs on individual target populations. Established in 1990, the CTCP was the first comprehensive tobacco control program in the United States. In 2008, 11.6% of California adults were current smokers.¹³ The prevalence rate of current adult smokers in California was 44% lower than national estimates.^{10, 13}

Until recently, the CTS also monitored adolescent smoking behavior in the state of California (2005 was the last year in which the CTS collected adolescent data). In 2005, 23.9% of California adolescents aged 16 – 17 had ever smoked a cigarette and that 3.5% of the same group were *established smokers*, having smoked at least 100 cigarettes in their lifetime.¹⁴

Trends in Cigarette Smoking

United States

Although tobacco use remains high, national smoking rates have decreased over the last 10 years. In 1998, 24.1% of adults in the United States smoked cigarettes. By 2008, smoking had decreased by 14.5% to a prevalence of 20.6%.¹⁰

The YRBS reports that, in 1997, 70.2% of 9th – 12th graders in the U.S. had ever smoked a cigarette and 36.4% of them had smoked a cigarette in the last 30 days. In the United States from 1997 to 2007, there was a 28%

reduction in the measure of ever-smoking and a 45% reduction in the measure of smoking during past 30 days among these high-school aged adolescents.¹²

California

In California, the reduction in smoking prevalence is higher. Using data from the CTS, in 1990, 22.2% of California adults were current smokers, and by 2008, the prevalence rate had decreased by 38%.¹³ Also in 1990, 55.4% of California adolescents aged 16 – 17 had ever smoked a cigarette and 13.4% had smoked at least 100 cigarettes in their lifetime (established smokers). From 1990 to 2005 there was a 57% decrease in the prevalence rate of ever-smokers aged 16 – 17 and a 74% decrease in established smokers for the same age group.¹⁴

Factors Influencing Cigarette Reduction

Although the United States has not reached the Healthy People 2010 goal (less than 12%) for current cigarette smoking, there has been a noteworthy drop in smoking prevalence throughout the country.¹⁰ Although many specific factors have contributed to this decline, 3 general factors will be highlighted.

1. Restrictions on smoking
2. Cigarette taxes and the Master Settlement Agreement
3. Comprehensive Tobacco Control Programs

1. Restrictions on Smoking

In the United States, most states have passed laws banning the smoking of cigarettes in various public places. Traditionally, bans on smoking are in indoor settings, to protect non-smokers from the harmful effects of secondhand tobacco smoke. While all states have enacted some form of smoking restriction in public places, 28 states have enacted more comprehensive statewide workplace-smoking bans, including all restaurants and bars.¹⁵ The American Lung Association (ALA) grades each state on several factors, one of which is how comprehensive their laws are to protect non-smokers from secondhand tobacco smoke. Twenty states plus the District of Columbia have smoking bans awarding them an “A” (the highest grade given) from the ALA and 16 states have received a grade of “F” (the lowest grade).¹⁶ The state of California (grade ‘A’) has banned “the smoking of tobacco products in all (100 percent of) enclosed places of employment.”¹⁷ Smoking is also banned within 20 feet of these establishments. It should be noted that the California workplace-smoking ban has a few exemptions, one of which is “retail or wholesale tobacco shops and private smokers’ lounges.” In addition to indoor smoking bans in public places, smoking bans can also occur in the home. While the primary purpose of indoor smoking bans (both public and private) is to protect non-smokers from secondhand smoke, a secondary consequence of such laws is an inevitable reduction in smoking, which can either be in the prevalence of smoking¹⁸⁻²² or in the per capita consumption of cigarettes.²²⁻²⁶ A reduction in consumption may result when the smoker

decides that a cigarette is not worth the inconvenience (of going outside) or when the employer limits the employee's 'smoking brakes' or both. Regardless of the reasoning, workplace-smoking bans have had a significant impact on the reduction of smoking, both in prevalence and total consumption,^{18-21, 23-26} and home smoking bans have also had a strong influence on smoking. A review of 23 studies on home smoking bans published by Mills et al.²² determined that home smoking bans are significantly and consistently associated with increased cessation and decreased consumption.

2. Cigarette Taxes and the Master Settlement Agreement

On April 1, 2009, the federal excise tax on tobacco products was increased. For cigarettes, the tax increases from \$0.39 per pack to \$1.0066 per pack. This represents (158% increase) the largest federal cigarette tax increase in history. Combining federal and state taxes, the average cigarette tax is now \$2.21 per pack with a range of \$1.08 (South Carolina) to \$4.47 (Rhode Island).²⁷ It should be noted that federal taxes on other forms of tobacco use also increased with this action. However, the per-pound federal taxation of other forms of tobacco is considerably lower than that of cigarettes. Depending on the weight of the individual cigarette, they are taxed at a minimum of \$16.78 per pound. In comparison, the federal tax on chewing tobacco is \$0.5033 per pound and the tax on snuff is \$1.51 per pound.²⁸ By weight, the federal tax on cigarettes is more than 1,000% higher than it is for snuff and chewing tobacco.

In California, there are two taxes applicable to cigarettes. Both the '*cigarette tax*' and the '*cigarette and tobacco products surtaxes*' must be assessed on cigarettes. For other tobacco products, only the '*cigarette and tobacco products surtaxes*' is applicable. The combination of these two taxes comes to \$0.87 per pack for cigarettes, and for other tobacco products, it is simply a flat rate of 45.13%.²⁹

Most studies agree that cigarette taxes effectively reduce cigarette consumption. A study in Asia found that cigarette sales were inversely correlated with the introduction of various cigarette taxes over a 30-year period.³⁰ A 40-year study in the United States, looking at tax increases in all 50 states, also found that increasing cigarette taxes was associated with a decrease in cigarette consumption.³¹ In California, a tax-consumption price elasticity of (-) 0.42 has been documented.³² This means that cigarette sales will fall by 4.2% for every 10% increase in the price. However, cigarette prices do not affect all smokers in the same way, as moderate to heavy smokers and older smokers are less likely to reduce their consumption (compared to light smokers and younger smokers, respectively) following a price increase^{32, 33}

While the link between cigarette price and cigarette consumption is strong, there is less evidence that cigarette taxes affect prevalence. A study of adolescents and young adults found that cigarette taxes have little impact on the initiation of smoking but that they may have some impact on cessation.³⁴ Also, the YRBS found that there has been a reduction in 'smoking participation' among young people associated with state cigarette tax

increases. Additionally, results from the Behavioral Risk Factor Surveillance System (BRFSS) indicate that higher taxes can lead to reduced smoking prevalence, especially in less educated and low income smokers.³⁵

The Tobacco Master Settlement Agreement (MSA) of 1998 is the largest civil settlement in U.S. history. An agreement between the 4 largest tobacco companies and the attorney generals of 46 states, the MSA settled the lawsuits in these states to recover more than \$200 billion in cigarette-related healthcare costs.³⁶ Additionally, the tobacco companies agreed to several limitations on marketing, mostly involving advertisements that targeted young people. While the settlement did little harm to the tobacco companies' earnings,³⁷ there was an immediate increase in the price of cigarettes of \$0.45 per pack, or about 20%.^{38, 39} Apart from federal and state taxes on cigarettes, the MSA represents the single most influential increase on cigarette prices. The effect of the MSA was a reduction in cigarette consumption and prevalence.³⁸⁻⁴⁰

3. Comprehensive Tobacco Control Programs

While placing restrictions on smoking and raising taxes on tobacco products are goals of modern tobacco control programs, there are other components to these programs. The first anti-smoking promotion in the United States was the dissemination of the 1964 U.S. Surgeon General report detailing the dangers of cigarette smoking² However, the majority of anti-smoking endeavors are specific to individual states. Previously, state-level

tobacco control programs varied greatly in scope, but in 1990, the first comprehensive tobacco control program was initiated by the California Department of Public Health. Following guidance from the NIH,⁴¹ the CTCP outlines 6 effective components³² of a comprehensive program:

- 1) Placing strict limits on the tobacco industry's ability to market its products
- 2) Restricting smoking in public places to reduce exposure to secondhand smoke
- 3) Conducting a mass media campaign aimed at denormalizing tobacco use
- 4) Enforcing laws that ban sales of cigarettes to minors
- 5) Increasing excise taxes in order to increase cigarette price and reduce demand
- 6) Providing effective smoking education in schools

Following the inception of the California Tobacco Control Program, other states have established their own tobacco control programs. However, the American Lung Association (ALA) has given a grade of "F" (their lowest grade) to 41 states (including California) and the District of Columbia for their unacceptable levels of program funding.¹⁶

The effectiveness of comprehensive statewide programs is undeniable,^{42, 43} as properly funded, implemented, and evaluated, these programs form the core of national efforts to reduce the burden of tobacco use. In California, the effectiveness of the CTCP in reducing cigarette

smoking is independent of cigarette tax pricing influences.⁴⁴ Because cigarettes represent the majority of tobacco use, the primary target of the CTCP and other comprehensive tobacco control programs has been cigarettes. For example, components 4 and 5 (above) specifically target cigarettes and components 2 and 6 specifically involve smoking. To date, alternative tobacco products have received much less attention from these programs.

Reduction Factors: Cigarettes vs. Other Tobacco Products

While the factors involved in cigarette reduction certainly affect other forms of tobacco, it should be noted that there are several components that do not influence some non-cigarette tobacco products. Indoor smoking bans have no effect on chewing tobacco, snuff and other smokeless products. While there are federal and state taxes on all tobacco products, cigarettes are taxed at higher rates than non-cigarette tobacco products. Although there has been a significant reduction in smoking prevalence and per capita cigarette consumption, the cigarette-specific nature of most tobacco control programs means that other forms of tobacco use have not received equal attention. If the use of other forms of tobacco is increasing while cigarette smoking is decreasing, a reassessment of tobacco control policies and resources may be practical.

Increased Tobacco Use Factors

There are several antagonistic forces that challenge the current favorable trends in cigarette smoking:

1. Addictive nature of nicotine
2. Escalating tobacco marketing expenditures
3. Inadequate funding for comprehensive tobacco control

1. Addictive Nature of Nicotine

Although cigarette consumption and prevalence is declining in most populations throughout the United States, nicotine remains a powerfully addictive drug. In fact, the U.S. Surgeon General has determined that “The pharmacologic and behavioral processes that determine [nicotine] addiction are similar to those that determine addiction to drugs such as heroin and cocaine.”⁴⁵

After inhalation, nicotine is rapidly absorbed into the bloodstream and can affect the nervous system within 7 seconds.⁴⁶ The specific pharmacologic actions of nicotine are complex.⁴⁷ In the brain, nicotine diffuses quickly into brain tissue, binding to nicotinic cholinergic receptors. Upon binding, pleasure is felt when dopamine is released, which is an important component of dependence and the development of addiction. Repeated exposure then leads to receptor tolerance (neuroadaptation) and more receptors are recruited. Thus, habitual dopamine release requires ever-increasing amounts of nicotine to bind the growing receptor population. When large amounts of receptors are nicotine-free (cessation of nicotine intake), they return to a

‘responsive’ state and the individual experiences craving or withdrawal symptoms.⁴⁷

The nationwide reduction in cigarette smoking is not because nicotine has become any less addictive, and it is not because the nicotine content of cigarettes has diminished. The Massachusetts Department of Public Health found that from 1998 to 2004, the nicotine content of cigarettes actually increased by an average of 10%.⁴⁸ An increase in nicotine may amplify the addictive properties of cigarettes, leading to an increase in cigarette smoking consumption and prevalence (contradictory to actual trends).

2. Escalating Tobacco Marketing Expenditures

Cigarette Advertisement Expenditures

Figure 1.1 shows the history of cigarette advertisement expenditures for the 5 largest cigarette producing companies in the United States for the years 1990 – 2005 (2005 is the most recent year for which the Federal Trade Commission (FTC) has released such data).⁴⁹

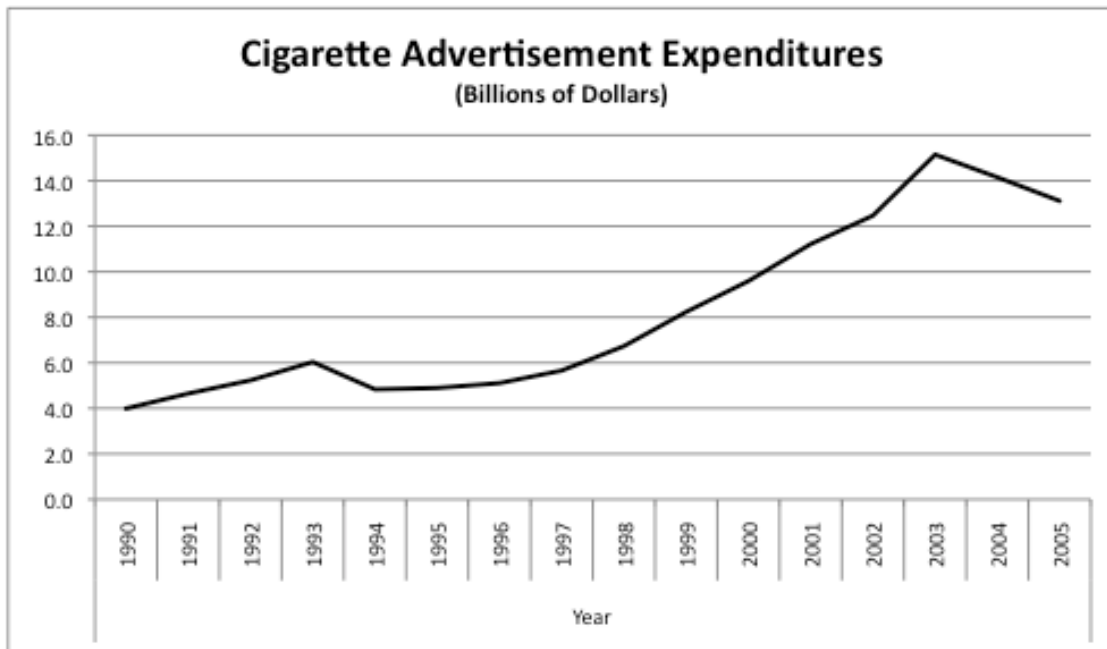


Figure 1.1. Cigarette Advertisement Expenditures by the Five Largest Cigarette Companies* in the United States, 1990-2005.⁴⁹

*The five largest cigarette companies in the United States are:

- Altria Group, Inc. (parent company of Philip Morris)
- Houchens Industries, Inc. (P.C. of Commonwealth Brands)
- Loews Corp. (P.C. of Lorillard Tobacco Co.)
- Reynolds American, Inc. (P.C. of R.J. Reynolds Tobacco Co.)
- Vector Group Ltd. (P.C. of Liggett Group and Vector Tobacco)

A steady rise in marketing expenditures can be seen since 1990. It should be noted that the most drastic increases in advertisement expenditures came in response to the MSA of 1998. Part of the MSA agreement was a series of limitations on cigarette advertisements.³⁶ Cigarette companies have most likely increased their marketing budgets in response to decreasing cigarette consumption.

Smokeless Tobacco Advertisement Expenditures

Figure 1.2 shows the advertisement expenditures for the 5 largest smokeless tobacco producers in the U.S. for the years 1990 – 2005 (2005 is the most recent year for which the FTC has released such data).⁵⁰

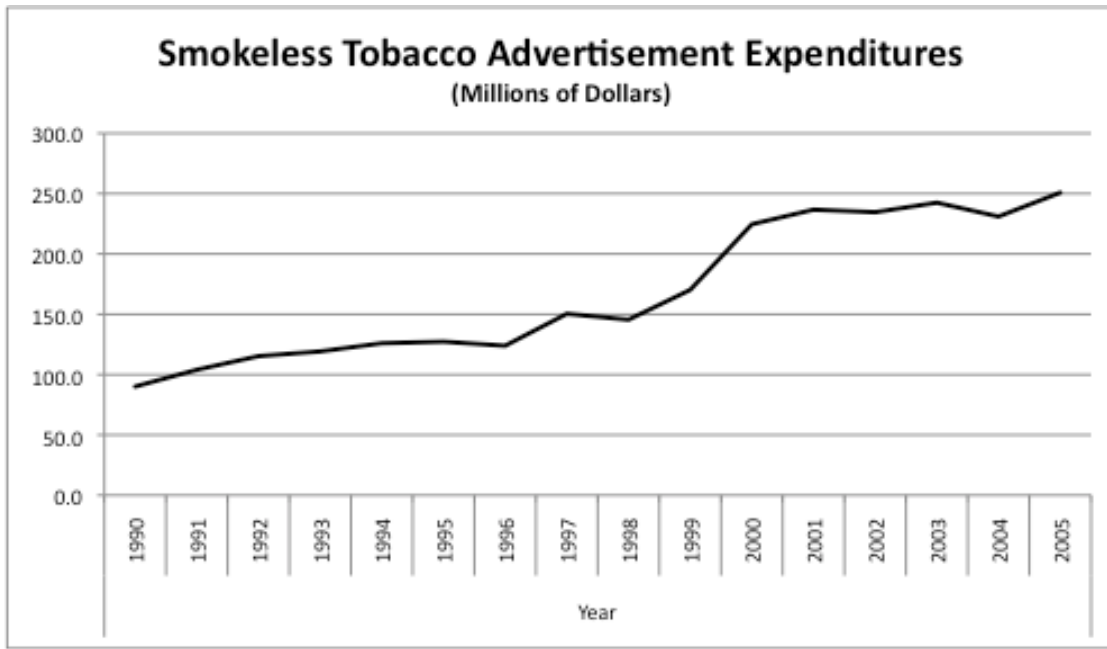


Figure 1.2. Smokeless Tobacco Advertisement Expenditures by the Five Largest Smokeless Tobacco Producers in the United States, 1990-2005.⁵⁰

*The five largest smokeless tobacco companies in the U.S. are:

- North Atlantic Trading Co., Inc (parent company of National Tobacco Co.)
- Swedish Match North America, Inc.
- Swisher International Group, Inc.
- UST, Inc. (P.C. of United States Smokeless Tobacco Company)
- Conwood LLC

Similar to cigarette spending trends, the advertising budgets for smokeless tobacco companies have steadily increased since 1990 with a major increase in spending coinciding with the MSA in 1998.

3. Inadequate funding for comprehensive tobacco control

While cigarette and tobacco marketing expenditures have more than doubled since the MSA of 1998, the same cannot be said for state-run tobacco control programs. As a result of the MSA, participating states agreed to use a 'significant' portion of the settlement dollars to fund tobacco control programs. However, a 2006 report by the Campaign for Tobacco-Free Kids⁵¹ shows that there has been a modest increase in funding for tobacco control programs but most states have used settlement funds for other purposes, thereby reneging on this commitment. That report states "the vast majority of states are still failing to keep the promise of the tobacco settlement and falling far short of funding such programs at even minimum levels recommended by the U.S. Centers for Disease Control and Prevention."⁵¹ Only three states (Maine, Delaware, and Colorado) have met the minimum recommendations for funding as outlined by the CDC.

In the United States, funding for tobacco control programs was reduced by 28.2% from 2002 to 2005.⁵¹ For the same years, the five largest cigarette companies increased their marketing expenditures by 5%⁴⁹ and the five largest smokeless tobacco producers increased their expenditures by 7%.⁵⁰ In 2005, the marketing department expenditures for the five largest cigarette companies were more than 24 times higher than the total spent on tobacco control programs in the United States (\$13.1 billion vs. \$538.2 million).⁵¹ The effectiveness of tobacco control programs is directly correlated to funding levels.⁵²

Although a leader in the development of comprehensive tobacco control programs, the State of California has also had its tobacco control funding reduced. In 2001, when the tobacco companies were increasing their marketing in response to the MSA, California cut its tobacco control funding by 40%³². Since 2001, funding for the CTCP has remained at this lower level, and the results are beginning to reflect this spending reduction. The 2005 report of the CTS details that many declines in prevalence have slowed or even reversed direction.^{14, 32} If funding and expenditures are the measuring criteria, the tobacco companies' commitment to keep people addicted to nicotine is greater than the nation's commitment to reduce tobacco use.

Reduction in Cigarette Smoking vs. Reduction in all Tobacco Use

The reduction in cigarette smoking seen in the United States and in California may not be as simple as it first appears. Although cigarette smoking is decreasing, cigarettes are not a proxy for all tobacco. Smokers may be trading in their cigarettes for other, more socially acceptable, potentially safer forms of tobacco such as cigars, smokeless tobacco, and waterpipe tobacco (hookah). In comparison to cigarettes, lifetime tobacco use initiated by these other forms of tobacco may also have an impact on the collective national health and subsequent burden to the healthcare system.

Other Forms of Tobacco Use

In the late nineteenth and early twentieth centuries, alternate forms of tobacco, such as cigars and chewing tobacco were far more popular in the United States than cigarettes. Then, beginning in the 1920's, cigarettes started to gain in popularity and eventually came to dominate the tobacco market by the 1950's. Figure 1.3 shows the per capita consumption trends of these various forms of tobacco for the past 130 years.

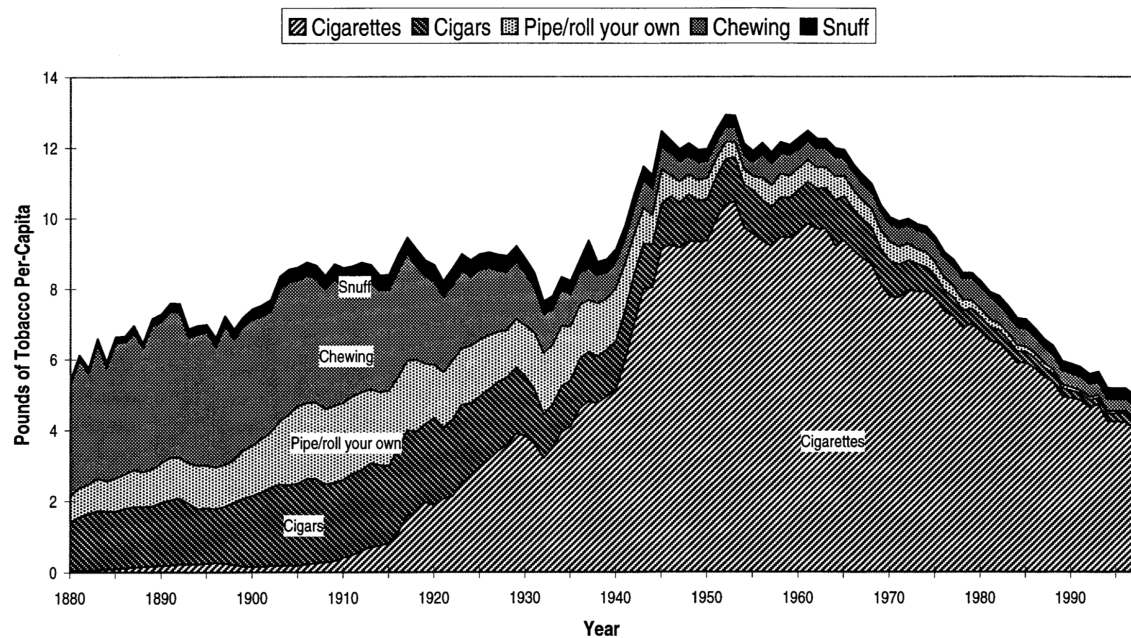


Figure 1.3. Per Capita Consumption of Different Forms of Tobacco in the United States, 1880 – 1997. (This figure is a reprint from the National Cancer Institute, Smoking and Tobacco Control Monograph No. 9⁵³)

As cigarette consumption continues to decrease, there may be risks for other forms of tobacco to gain in popularity.

Hookah

Recently, an older form of tobacco use, the hookah or waterpipe, appears to be increasing in popularity in the United States, especially among

adolescents and young adults.⁵⁴ Similar to other tobacco products, the use of a waterpipe to smoke tobacco is related to a variety of preventable diseases. It has been associated with many cancers such as lung cancer,^{55, 56} oral cancer,⁵⁷ and bladder cancer.^{58, 59} Hookah use has also been associated with coronary heart disease⁶⁰ and adverse pulmonary effects.⁶¹⁻⁶³ It has even been linked to eczema of the hand.⁶⁴ Hookah smoke has been shown to contain an abundance of the same cancer-causing substances that cigarette smoke contains.⁶⁵

A Hookah is a tool used to smoke tobacco and other substances. In different cultures, it may be known as hubble-bubble, narghile, shisha, or goza. A typical hookah pipe consists of a head (to hold tobacco), body, base or bowl (with water), and one or more hoses (with mouthpieces).⁶⁶ The general concept is that tobacco smoke, ignited by charcoal, is pulled through the bowl of water and into the hose by the smoker.

Hookah originated in the Middle East, India, and Africa more than 400 years ago.⁶⁷ Today, social establishments, or 'hookah lounges', are locations where groups of individuals may gather to socialize and smoke flavored tobacco through a communal waterpipe. Even though California Labor Code 6404.5 prohibits the use of tobacco in "enclosed places of employment",¹⁷ the presence and popularity of these establishments has increased greatly in the United States over the last 5 to 10 years.⁶⁶ There is a specific exemption in the California ban of smoking in bars, restaurants, and other public places allowing smoking in 'tobacco shops'.

Many aspects of hookah use are unique in comparison to other forms of tobacco use, leading to specific dangers and challenges. Most users know that hookah smoke is dangerous.⁶³ However, the majority believe the smoke from hookah to be safer than smoking cigarettes. In fact, one study found that more than 90% of beginning hookah users believe that cigarettes are more addictive than waterpipe smoking.⁶⁸ A common reason for this belief is that the smoke from a hookah passes through water, somehow rendering it less harmful than tobacco smoke that does not pass through water.⁵⁴ Additionally, some hookah smokers believe it to be safer than cigarettes because they do not see the warning labels associated with cigarette packaging.⁶⁹ Also, the mild or fruity flavor of the hookah smoke confuses some smokers into believing it to be safer.⁶⁹ The belief that hookah smoke is safer than cigarette smoke by those first experimenting with tobacco (adolescents) may lead to an increase in initial nicotine exposure and a higher likelihood for repeated use and addiction.

Hookah smoking is done for a much longer time than single cigarettes. An average hookah session may last anywhere from 45 to 60 minutes or even longer,⁷⁰ as opposed to the 5 – 10 minutes it takes to smoke a cigarette. Also, the average ‘puff’ from a hookah is significantly greater in volume than that of a cigarette. Research has shown that a single hookah puff can contain an amount of smoke comparable to an entire cigarette.⁷⁰ This increases the smoker’s exposure to tobacco carcinogens. Also, hookah smoke has been shown to contain significantly higher levels of heavy metals such as arsenic,

nickel, cobalt, chromium, and lead.⁷¹ Conservative estimates of a single hookah session are that it is the equivalent of smoking 10 – 20 cigarettes. However, the World Health Organization (WHO) calculates a much more drastic 100 cigarette equivalent for a single hookah session⁶⁷ (one cigarette per puff and 100 puffs per average session). Many hookah smokers are occasional, non-daily smokers. This aspect may lead the user into a false belief that they are in no danger of addiction or harmful effects.⁷² Also, hookah smoking is usually done indoors, often in ‘hookah lounges’ with many other hookah smoking groups. This means that even when a person isn’t actually smoking, he or she is exposed to the establishment’s secondhand tobacco smoke. Tests of secondhand hookah smoke have shown that it contains fine particles known to cause respiratory damage.^{73, 74}

During a hookah smoking session, many individuals share a single mouthpiece to pull smoke through the pipe. This aspect may increase the spread of infectious diseases such as tuberculosis, hepatitis, herpes, and others.⁷⁵ Also, smoking a hookah as an adolescent or young adult increases the likelihood of smoking cigarettes either concurrently or later in life.⁷⁶

To date, the majority of studies on hookah use have been done in the Middle East. In the United States, a study of Arab American adolescents aged 14 – 18 found that 27% of their study participants had ever experimented smoking tobacco with a hookah. This study also found that hookah smokers were twice as likely to be current cigarette smokers and 8 times more likely to

have experimented with cigarettes at any time, compared to non-hookah users.⁷⁶

A study in Michigan looked at hookah use in Arab and Non-Arab American high school students. They found that 38% of Arab Americans and 21% of non-Arab Americans had ‘ever’ used a hookah. They also found that 16% of Arab Americans and 11% of non-Arab Americans were ‘current’ hookah users. In comparison to hookah use, the Arab American students were less likely to be cigarette smokers while the non-Arab American students had a higher prevalence of cigarette smoking.⁷⁷

A random sample of college students at a large, urban university found that 40% of the study population had used a hookah in the last year, while 30% had used it in the past 30 days. This study also found that in general, students believe hookah to be less dangerous and less addictive than cigarettes.⁷⁸ Another study of college students found that 20% of first year students had used a hookah in the past 30 days.⁷⁹

A PubMed search of studies on “waterpipe”, “water pipe”, “hookah”, or “narghile” performed on July 28, 2009 revealed a total of five epidemiologic studies performed in the United States with the intent to describe waterpipe prevalence.⁷⁷⁻⁸¹ Only three of those studies were done on high school aged subjects,^{76, 77, 81} suggesting the need for further studies of adolescent hookah use in the United States. This lack of published studies using adolescent subjects was the basis for the need for part of the research contained in this dissertation. Since the date of that search for articles, other hookah use

studies have been published.^{82, 83} Primack et al.⁸³ reported hookah use among different types of college athletes, ranging from 27.6% to 35.1% ever-use of hookah. Jamil et al.⁸² reported ever hookah use among 19% of a small sample of White adults (n=245). However, neither of those studies involved adolescent populations.

Smokeless Tobacco

Smokeless tobacco originated thousands of years ago in South America and Southeast Asia. Over time, it spread throughout the world and took on many different forms with varying popularity.⁸⁴ Historically, the popularity of smokeless tobacco in the United States has been confined to two traditional products: Chewing tobacco and moist snuff. Modern chewing tobacco consists of shredded tobacco leaves that have been cured and enhanced with flavoring solutions. Typically, large amounts of chewing tobacco are placed in the cheek, producing a large bulge on one side of the users face.⁸⁵ Because this product produces a large amount of saliva, use of chewing tobacco is generally confined to an outdoor setting to allow expectoration. The need to spit the tobacco juices has resulted in an overall decrease in popularity of this product in recent decades.⁸⁶ Moist snuff is the single most popular method for smokeless tobacco use in the United States.⁸⁶ This product is prepared by fire (or air) curing tobacco leaves and then grinding them into a fine 'snuff'. The product is then placed between the lip and jaw (called a 'pinch' or 'dip') where nicotine is absorbed.⁸⁵ Use of this

product has increased in recent decades⁸⁶ because smaller amounts of saliva are produced, requiring less expectoration.

From the National Survey on Drug Use and Health, smokeless tobacco use in the United States is most common among young adult males with 32% of males reporting that they have ever used smokeless tobacco and 6.2% of males reporting that they have used the product within the last month. In contrast, just 0.4% of females report using smokeless tobacco in the previous month.⁸⁷ Those aged 18 – 25 have a higher prevalence of smokeless tobacco use than younger and older aged groups. Smokeless tobacco is also more common in those living in ‘completely rural’ counties and those living in the southern region of the United States. Additionally, smokeless tobacco users are more likely to smoke cigarettes than non users.⁸⁷

Smokeless tobacco is causally related to serious adverse health conditions. Oral leukoplakia, defined as thickening in the oral epithelial cells that becomes white in color, occurs in up to 60% of smokeless tobacco users,^{88, 89} and is considered a precursor to oral cancer.⁹⁰ Epidemiologic evidence for the link between smokeless tobacco and oral cancer is convincing.⁹¹ A recent case-control study in India using 282 oral cancer cases and 1410 matched controls found a more than three-fold risk (OR 3.1; 95%CI 2.1-4.6) for smokeless tobacco use and oral cancer using 282 oral cancer cases and 1410 matched controls.⁹² Similar findings were found in a recent cohort study in Sweden where a relative risk of 3.1 (95%CI 1.5-6.6) was found for smokeless tobacco use and the combination of oral and pharyngeal

cancers.⁹³ A meta-analysis of 12 studies performed in the United States found a combined relative risk of 1.74 (95%CI 1.32-2.31) for increased oral cancer risk for smokeless tobacco users.⁹⁴

While studies performed in the United States tend to indicate a strong link between oral cancer and smokeless tobacco, European studies suggest less risk.⁹⁵ It has been suggested that the different types of smokeless tobacco available on these two continents may play a role in this discrepancy.^{91, 95} Traditional smokeless tobacco of North America is usually fermented, while most of the smokeless tobacco used in Europe is unfermented.

There is also evidence that the pancreas is a specific target organ for the absorbed carcinogens found in smokeless tobacco.⁹⁶⁻⁹⁸ A case control study in the United States (n=154 cases of pancreatic cancer who were lifetime nonsmokers) found a dose-response relationship between increased use of smokeless tobacco and risk of pancreatic cancer.⁹⁷ Additionally, a prospective cohort study in Norway found an increased risk (OR 1.67, 95%CI 1.12-2.5) for pancreatic cancer in smokeless tobacco users.⁹⁸

In 1986, the Surgeon General issued an official report detailing the health consequences of smokeless tobacco use, stating that “the scientific evidence is strong that the use of smokeless tobacco can cause cancer in humans.”⁹⁹ Additionally, the National Cancer Institute (NCI) has “conclusively established the use of [smokeless tobacco] as a cause of oral cancer.”¹⁰⁰ The

finality with which the Surgeon General and the NCI have declared the link between smokeless tobacco and oral cancer is convincing.

Cigars, Origins and Trends

Cigars were one of the original forms of tobacco used by Native Americans as witnessed by early European settlers. These primitive cigars were simply twisted bundles of tobacco leaves encased in a palm or maize leaf.¹⁰¹ Cigar smoking in the United States has fluctuated significantly over the previous century in response to various factors. Figure 1.4 shows these trends and events.

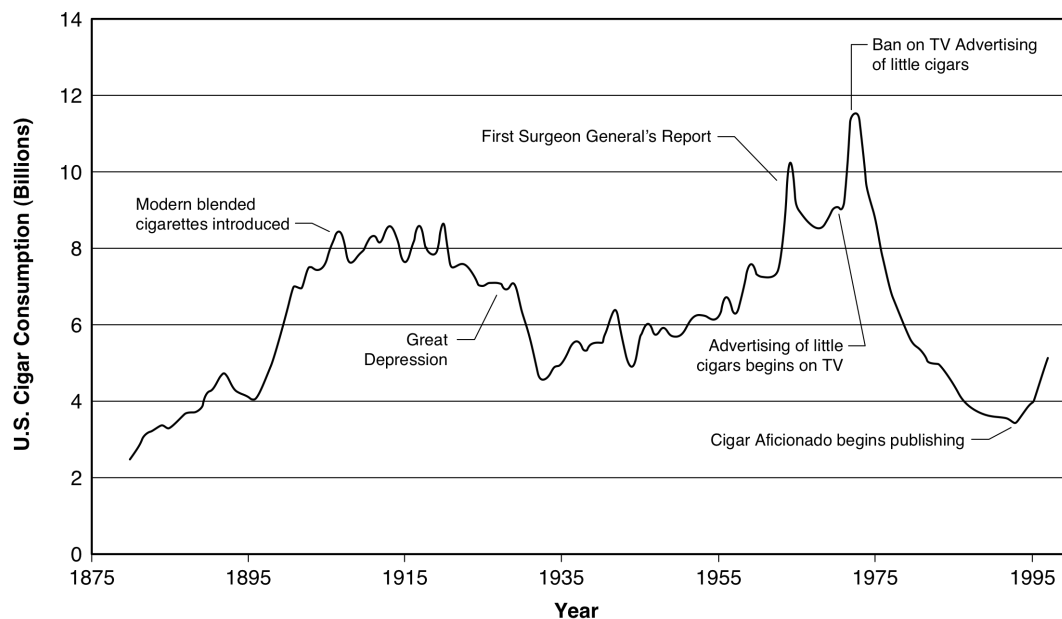


Figure 1.4. Total United States Cigar Consumption and Significant Events, 1880 – 1997 (this figure is a reprint from the National Cancer Institute, Smoking and Tobacco Control Monograph No. 9¹⁰¹)

In the modern era, the notable increase in cigar use has been attributed to the publishing of *Cigar Aficionado* in September 1992. Today, the majority of cigar use consists of large, premium cigars⁵³

Cigar use is similar to hookah use in several ways. First, it appears to be on the rise^{53, 102} although discrepancies in defining “current use” across studies have made its use difficult to measure.¹⁰² Second, cigar smokers believe cigar smoking to be less harmful than cigarettes¹⁰³⁻¹⁰⁵ despite the fact that the NCI,¹⁰⁶ the United States Surgeon General,¹⁰⁷⁻¹⁰⁹ and the American Cancer Society¹¹⁰ have all determined that the health risks of cigar smoking are similar to those of cigarette smoking. Cigars are also similar to hookah in that they circumvent California law prohibiting indoor smoking¹⁷ as “cigar bars” are classified as “Retail or wholesale tobacco shops and private smokers lounges.”¹⁷

Potentially Reduced-Exposure Tobacco Products (PREPs)

In recent years, several new tobacco products, referred to as potentially reduced-exposure tobacco products (PREPs) have been introduced in the United States with claims of ‘reduced harm’ and ‘safer alternative’,⁸⁵ compared to traditional cigarettes and traditional smokeless tobacco.¹¹¹

One such product, known as snus (pronounced ‘*snoose*’), has been used for a long time in Sweden. Several studies of snus use in Sweden have reported that snus is a safer alternative^{112, 113} to smoking cigarettes and that Sweden’s reduction in smoking is probably due to the popularity of snus. In

Sweden, daily smoking by males dropped from 40% in 1976 to 15% in 2002, with about 30% of these quitters turning to snus.¹¹³ In Sweden, snus is associated with reduced lung cancer and other beneficial health outcomes.^{112, 114, 115} Snus is used similarly to traditional moist snuff, either as loose grounds or in portioned packets.

The common characteristic of many PREPs is that they are unfermented (the majority of cigarette tobacco, traditional moist snuff and chewing tobacco are fermented to add flavor). The belief is that many of the polycyclic aromatic hydrocarbons (PAH) and tobacco-specific nitrosamines (TSNA) are produced during the fermentation phase of tobacco refinement. Several studies have shown that these products do contain lower levels of these carcinogens in their pre-consumption forms.¹¹⁶ However, the claim that these products are actually safer for human consumption is highly controversial and unproven within the public health community.

In 2007, the Royal College of Physicians (RCP) made the controversial suggestion that PREPs should be encouraged as safer, less harmful alternatives to traditional cigarettes.¹¹⁷ While some tobacco researchers are now advocating the use of PREPs as a harm-reduction method, especially for those strongly addicted to nicotine,^{114, 117, 118} other researchers make the argument that these products are not acceptable alternatives to cessation.^{119, 120} The argument against these reduced exposure products is that they will not lead to a decrease in tobacco use because people will remain addicted to nicotine. Also, tobacco companies will certainly abuse any claims of 'safer

alternative' to market their products. Some tobacco users may believe there is a 'safe' form of tobacco. Just as the National Cancer Institute and U.S. Surgeon General have determined that there is no such thing as a 'safer cigarette',¹²¹ the same rational may be applied to so called 'reduced-exposure' tobacco products.

The Public Health Challenge

While reducing the use of cigarettes should remain the primary goal of tobacco control programs, the use of other tobacco products should be reassessed in California and the rest of the United States. The factors affecting tobacco use may lead to the increased use of alternative tobacco products in relation to cigarettes. Therefore, tobacco control professionals may have to modify conventional strategies in the public health war against tobacco.

The purpose of this dissertation was to study the use of alternative, non-cigarette, tobacco products in California, including smokeless tobacco (both traditional products and PREPs), cigars, and hookah. Specifically, this dissertation had three main objectives.

1. To evaluate the prevalence and trends of the use of cigars, smokeless tobacco, and hookah among California Adults.
2. To evaluate the receptiveness and use of potentially reduced-exposure tobacco products among California adult smokers

3. To evaluate hookah use patterns and risk factors among a population of adolescents

Data for objectives 1 and 2 are drawn from the California Tobacco Surveys (CTS) (Please see above for a description of the CTS and Chapters 2 and 3 for an explanation of methodology). To achieve objective 3, a cross-sectional survey of high school students from three high schools in San Diego County was performed (see Chapter 4).

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CHAPTER 2

Hookah, Cigar, and Smokeless Tobacco Use: Predictors and Trends from the 2008 California Tobacco Survey

ABSTRACT

Background: Non-cigarette tobacco products are being promoted as an alternative to cigarettes but population prevalence and trend data are limited.

Purpose: To determine the prevalence, trends, and associations of hookah, cigars, and smokeless tobacco in California.

Methods: Data from a random-digit-dial telephone survey from the California Tobacco Surveys, 1990-2008 were collected. Standardized prevalence trends and demographic predictors of use of non-cigarette tobacco were determined using multivariate regression models.

Results: There was more than a 40% increase in ever-use of hookah between 2005 and 2008 for both genders. Between 1990 and 2008, current use of cigars among males increased by 81.4%. Cigar and hookah use is especially increasing among young, educated, non-Hispanic white, and cigarette smokers. Smokeless tobacco use remains low and is decreasing in young males.

Conclusions: Among both genders, cigar and hookah use were the highest ever recorded by this survey; hookah use is rapidly increasing among young adults.

INTRODUCTION

The use of tobacco is a major preventable cause of death in the United States. The Centers for Disease Control and Prevention (CDC) estimates that in 2008, 443,000 deaths in the United States were caused by tobacco use, equaling 5.1 million years of potential life lost.¹ Although tobacco use remains high, national smoking rates have actually decreased over the last 10 years. In 1998, 24.1% of adults in the United States smoked cigarettes; by 2008, smoking had decreased by 14.5% to a prevalence of 20.6%.² In California, cigarette smoking has decreased even more drastically than the national levels. According to the California Tobacco Surveys (CTS), in 1999, 16.1% of California adults smoked cigarettes and by 2008, just 11.6% of California adults were smokers, representing a 28% decrease in smoking prevalence.³ The decrease in smoking rates observed in California and the rest of the United States are most likely due to a combination of factors, including indoor/outdoor smoking bans, tobacco control media campaigns, tobacco sales restrictions, and cigarette taxes.⁴ While effective at controlling cigarette use, many of these factors do not influence the use of other, non-cigarette tobacco products such as cigars, smokeless tobacco, and hookah (waterpipe tobacco). Because nicotine is highly addictive, the decline in cigarette smoking may be accompanied by an increase in the use of other tobacco products, especially those products believed to be safer than cigarettes.

Historically, alternative forms of tobacco have included cigars, pipes, and smokeless tobacco (both moist snuff and chewing tobacco). An older,

international form of tobacco use, the hookah, appears to be gaining popularity in the United States.⁵ While the hookah (also known as waterpipe tobacco, hubble-bubble, narghile, shisha, or goza) originated in India and the Middle East more than 400 years ago,⁶ its popularity in the United States and California is a relatively new phenomenon.

Hookah use is related to a variety of preventable diseases, including lung cancer,^{7, 8} oral cancer,⁹ bladder cancer,^{10, 11} coronary heart disease,¹² and adverse pulmonary effects.¹³⁻¹⁵ Nevertheless, hookah use appears to be on the rise especially in adolescents and young adults.^{5, 16-21} Fueling the accelerated use of hookah is the belief that hookah use is less harmful than cigarettes,^{19, 22-25} even though studies suggest that hookah smoke may be more dangerous than cigarette smoke.²⁶⁻²⁸

Cigar use is similar to hookah use in several ways. First, it appears to be on the rise^{29, 30} although discrepancies in defining “current use” across studies have made it difficult to compare and assess overall use.³⁰ Second, cigar smokers believe cigar smoking is less harmful than cigarette smoking³¹⁻³³ despite the fact that the National Cancer Institute (NCI),³⁴ the United States Surgeon General,³⁵⁻³⁷ and the American Cancer Society³⁸ have all determined that the health risks of cigar smoking are similar to those of cigarette smoking.

Hookah and cigars are also similar in that they circumvent California law prohibiting tobacco smoking in “enclosed places of employment” (California Labor Code 6404.5)³⁹ An exception is made for these “cigar bars” and “hookah lounges” because they are classified as “retail or wholesale

tobacco shops and private smokers lounges.”³⁹ Hookah lounges are being established rapidly, further suggesting that this behavior is becoming more popular, especially among young persons.⁴⁰

Smokeless tobacco is related to adverse health conditions and cancers, usually in the mouth. Occurring in up to 60% of smokeless tobacco users,^{41, 42} the most common condition being *oral leukoplakia*. This precursor to oral cancer is a change in the oral epithelial cells that become thickened and may be white in color.⁴³ Epidemiologic evidence for the link between smokeless tobacco and oral cancer is convincing,⁴⁴ and there is also evidence that the pancreas is a specific target organ for the carcinogenic effects of smokeless tobacco.⁴⁴⁻⁴⁶

The decline in cigarette use, the addictive properties of nicotine, and the belief that other tobacco products may be safer than cigarettes may result in the increased use of these alternative tobacco products. While reducing the use of cigarettes should remain the primary goal of tobacco control programs, the use of other tobacco products should be assessed as tobacco use continues to evolve in California and the rest of the United States. California has been at the forefront of tobacco control in the United States and presents an early estimate of tobacco use trends. This study assessed the temporal trends and current use of alternative tobacco products (cigars, smokeless tobacco, and hookah) by California adults using data from the 1990 – 2008 CTS. To our knowledge, this is the largest representative survey collecting hookah-use data a second time from the same source population, with the

ability to evaluate 3-year time trends. Furthermore, the CTS is one of the largest population surveys to have trends of cigar and smokeless tobacco use over an 18-year period.

METHODS

Data collection and study population

Data from this study are drawn from the eighth California Tobacco Survey (CTS), conducted between May 1, 2008 and February 22, 2009. The objective of these large, population-based random-digit-dial telephone surveys is to collect representative statewide data on tobacco-related behaviors, knowledge and attitudes towards smoking, and monitoring the effect of State-initiated programs on individual target populations. Detailed data collection methodology is described elsewhere.⁴⁷ Westat, Inc. conducted the surveys with supervised, trained telephone interviewers using Computer Assisted Telephone Interviewing (CATI). An initial screener survey (with an adult respondent aged 18 years or older) was used to determine the eligibility of other members of the household. All adult household members aged 18 – 29 years were selected for participations. A random sample of adult household members aged 30 years and older was selected for participation based on their race/ethnicity and smoking status (current and former smokers, African Americans, and Asians were oversampled). A total of 3,180 (out of 6,819 selected) young adults aged 18 – 29 years completed the survey with a 46.6% cooperation rate. Major reasons for non-participation included refusals (17%),

maximum call attempts (17%), and non-responses (15%). Of the 12,599 older adults (30+ years) selected for participation, 7,217 completed surveys resulting in a 57.3% participation rate. Among older adults, refusals (20%), maximum call attempts (11%), other non-responses (7%) accounted for a majority of non-participants. For this study, prevalence data are reported for all adult respondents and separately for young adults aged 18 – 24 years because lifetime tobacco use frequently starts in adolescence or young adulthood ⁴⁸. Survey procedures were approved by the University of California, San Diego Human Research Protection Program.

Measures

Relevant data from this survey include self-report of demographic information (age, gender, ethnicity, and education), cigarette smoking status (never, former, current), cigar use (ever and current), smokeless tobacco use (ever and current), and hookah use (ever).

To establish ever-use of tobacco products, respondents were asked *‘Have you ever smoked cigars, cigarillos, or little cigars?’*, *‘Have you ever used chewing tobacco or snuff?’*, and *‘Have you ever smoked a Hookah pipe?’*. Current use of cigars and smokeless tobacco was determined by asking *‘Do you now smoke cigars every day, some days or not at all?’* and *‘Do you now use chewing tobacco or snuff every day, some days, or not at all?’*.

Respondents were classified as current users of cigars and smokeless tobacco if they reported using the item *‘every day’* or *‘some days’*. Since the

use of alternative tobacco products in previous CTS reports⁴⁹ has been much higher among males than females, prevalence rates are stratified by gender. Among males, current and ever use of cigars and smokeless tobacco is reported (current use of hookah was not collected). However, because current use of alternative tobacco use is insufficiently low in females, only ever-use of alternative tobacco products is reported for that group.

Statistical Methods

Survey responses were weighted to assure that the study sample estimates are representative of the California adult population. Base weights were calculated according to the probability of a household being selected and were then adjusted to population totals for gender, ethnicity, and education to account for non-responses.⁵⁰ Confidence intervals for all point estimates and test statistics were calculated by the jackknife method using replicate weights from 51 jackknife subsamples.⁵¹ All calculations were performed using SUDAAN statistical software. To adjust for the possible confounding effects of changing demographics over time, prevalence rates from previous surveys were standardized to the 2008 California adult population with respect to gender, age, education, and race for comparison to the current survey. 2008 prevalence estimates for cigar, smokeless tobacco, and hookah use with 95% confidence intervals are reported. To assess longer-term trends, the percentage change in alternative tobacco use was estimated from 1990 (the first year of the CTS). Shorter-term trends were evaluated with percent change

from 2005 (the most recent prior CTS). Logistic regression was used to calculate adjusted odds ratios for the association of alternative tobacco use with demographic factors and cigarette smoking. Among males, the dependent variable was current use (ever-use for hookah) of tobacco products; among females, the dependent variable was ever-use for all outcome variables.

RESULTS

Demographic and tobacco use characteristics for the 2008 CTS are reported in Table 2.1. The unweighted number of respondents within each category is given along with the final weighted percent of each stratum. Of the 10,397 participants, 55.1% were female, 34.4% were aged 45 – 64, 51.9% had some college education, and 49.6% were non-Hispanic white. Weighted percents for demographics are representative of the State of California with respect to these characteristics. Weighted estimates of tobacco use show 7.1% had ever used a hookah, 20.3% had ever smoked a cigar (current use, 4.1%), and 8.7% had ever used smokeless tobacco (current use, 1.1%).

Table 2.1. General socio-demographic and tobacco use characteristics of the 2008 California Tobacco Survey study population

	Unweighted N (%) ^a	Weighted % ^b
Total	10,397 (100%)	100%
Gender		
Male	4,667 (44.9%)	49.4%
Female	5,730 (55.1%)	50.6%
Age		
18 – 24	2,113 (20.5%)	13.3%
25 – 44	2,823 (27.4%)	39.9%
45 – 64	3,543 (34.4%)	30.8%
65 +	1,821 (17.7%)	16.0%
Education		
< High School Grad	961 (9.3%)	14.2%
High School Grad	2,393 (23.1%)	25.3%
Some College	5,377 (51.9%)	42.7%
College Grad	1,628 (15.7%)	17.8%
Ethnicity		
Non-Hispanic White	5,156 (49.6%)	46.7%
Hispanic	2,058 (19.8%)	32.5%
African American	1,588 (15.3%)	5.9%
Asian/ Pacific Islander	1,336 (12.9%)	12.1%
Other	259 (2.5%)	2.8%
Ever Smoked Hookah	963 (9.3%)	7.1%
Cigar Use		
Ever	2,380 (22.9%)	20.3%
Current	547 (5.3%)	4.1%
Smokeless Tobacco Use		
Ever	1,010 (9.7%)	8.7%
Current	113 (1.1%)	1.1%

a. Represents over-sampling of current smokers and certain demographic groups

b. Weighted to be representative of California with respect to gender, age, ethnicity and education

Prevalence and Trends

Table 2.2 shows the percentage of ever-use of cigars, smokeless tobacco, and hookah for all adult males and females from the 1990, 2005, and 2008 CTS (2005 was the first year in which data on hookah use were collected by the CTS). Also, current use of cigars and smokeless tobacco are given for males (current use among females is negligible). Additionally, percent change

from the 1990 and 2005 surveys are given to show both long term and recent trends.

Table 2.2. Standardized Prevalence, 95% Confidence Intervals and Percent Change in Cigar, Smokeless Tobacco, and Hookah Use, California Adults 1990-2008 (N=10,397)

	1990	2005	2008	Percent Change from 1990	Percent Change from 2005
<u>Cigars</u>					
Ever-Use, Male	40.9 (39.1 – 42.7)	32.9 (29.8 – 36.0)	32.9 (30.0 – 35.8)	- 19.6*	0.0
Ever-Use, Female	5.8 (5.1 – 6.5)	6.1 (5.2 – 7.0)	7.0 (5.8 – 8.2)	20.7	14.8
Current Use, Male	4.3 (3.7 – 4.9)	7.0 (5.9 – 8.1)	7.8 (6.1 – 9.5)	81.4*	11.4
<u>Smokeless Tobacco</u>					
Ever-Use, Male	17.1 (16.1 – 18.1)	15.4 (13.7 – 17.1)	15.5 (13.2 – 17.8)	- 9.4	0.6
Ever-Use, Female	1.8 (1.6 – 2.0)	1.9 (1.3 – 2.5)	1.6 (1.2 – 2.0)	- 11.1	- 15.8
Current Use, Male	2.4 (2.0 – 2.8)	2.1 (1.6 – 2.6)	2.0 (1.3 – 2.7)	- 16.7	- 4.8
<u>Hookah</u>					
Ever-Use, Male	--	7.9 (6.8 – 9.0)	11.2 (9.8 – 12.6)	--	41.8*
Ever-Use, Female	--	1.9 (1.5 – 2.3)	2.8 (2.1 – 3.5)	--	47.4

* Confidence limits do not overlap indicating significant change over time period.

Cigars

In 2008, 32.9% (95%CI 30.0 – 35.8) of males and 7.0% (5.8 – 8.2) of females had ever smoked a cigar and 7.8% (6.1 – 9.5) of males were defined as current cigar smokers. From 1990 to 2008 (Table 2.2) male ever-use of cigars significantly decreased by 19.6% from 40.9% (95%CI 39.1 – 42.7) to 32.9% (30.0 – 35.8) and during the same time period, male current use of cigars significantly increased by 81.4% from 4.3% (3.7 – 4.9) to 7.8% (6.1 –

9.5). Although not statistically significant, female ever-use of cigars has risen by 20.7% during the same 18-year time period.

Smokeless Tobacco

In 2008, 15.5% (13.2 – 17.8) of males (Table 2.2) had ever used smokeless tobacco and 2.0% (1.3 – 2.7) of males were current users. These measures of use were similar to those observed in 1990 (Ever-use, 17.1; Current use, 2.4) and 2005 (Ever-use, 15.4; Current use, 2.1). Ever-use and current use of smokeless tobacco remains negligible for females.

Hookah

In 2008, 11.2% (9.8 – 12.6) of males and 2.8% (2.1 – 3.5) of females had ever smoked tobacco from a hookah. In comparison to 2005, this was a 41.8% increase for males (7.9; 6.8 - 9.0) and a 47.4% increase for females (1.9; 1.5 - 2.3). The increase observed in males was statistically significant.

Young Adults (ages 18 – 24 years)

Table 2.3 shows stratified results for young adults only (ages 18 – 24 years). Within this population, there has been little change in the prevalence of ever-use of cigars for males since 2005 or 1990. While there has been no change in current use of cigars among males since 2005, the 2008 prevalence rate is statistically higher than the 1990 rate for young males. This increase occurred before 2005. Ever-use of cigars has fluctuated over time in young

adult females with wide confidence intervals making it difficult to provide definitive statements of trend.

Table 2.3. Prevalence, 95% Confidence Intervals and Percent Change in Cigar, Smokeless Tobacco, and Hookah Use in Persons Aged 18 – 24 years, California 1990-2008 (N=2,113)

	1990	2005	2008	Percent Change from 1990	Percent Change from 2005
<u>Cigars</u>					
Ever-Use, Male	29.1 (26.3 – 31.9)	29.4 (25.9 – 32.9)	28.3 (25.1 – 31.5)	- 2.7	- 3.7
Ever-Use, Female	6.5 (2.8 – 10.2)	10.5 (8.4 – 12.6)	8.1 (6.3 – 9.9)	24.6	- 22.9
Current, Male	4.0 (2.6 – 5.4)	10.5 (8.1 – 12.9)	9.9 (8.3 – 11.5)	147.5*	- 5.7
<u>Smokeless Tobacco</u>					
Ever-Use, Male	24.7 (21.7 – 27.7)	14.3 (11.5 – 17.1)	13.0 (11.0 – 15.0)	- 47.4*	- 9.1
Ever-Use, Female	3.5 (2.5 – 4.5)	3.7 (2.1 – 5.3)	1.5 (0.9 – 2.1)	- 57.1*	- 59.5*
Current, Male	5.6 (3.9 – 7.3)	2.7 (1.3 – 4.1)	2.4 (1.6 – 3.2)	- 57.1*	- 11.1
<u>Hookah</u>					
Ever-Use, Male	--	19.7 (16.7 – 22.7)	24.5 (21.4 – 27.6)	--	24.4
Ever-Use, Female	--	8.1 (5.9 – 10.3)	10.0 (8.0 – 12.0)	--	23.5

* Confidence limits do not overlap indicating significant change over time period.

The use of smokeless tobacco has significantly decreased among young adults (both males and females) since 1990. In the last 18 years, male ever-use of smokeless tobacco has decreased by 47.4% and male current use has decreased by 57.1%. A 59.5% reduction in female ever-use of smokeless tobacco has occurred since 2005 (Table 2.3).

Young adults showed substantially increased use of hookah from 2005 to 2008, although this was not statistically significant (Table 2.3). For males,

there was a 24.4% increase since 2005 and the increase among females was 23.5%. Currently, one in four young men and one in ten young women in California reported ever using a hookah.

In 2008, hookah use among males aged 18 – 24 was more than twice as high as hookah use among all adult males (table 2.2). Among females, hookah use by those aged 18 – 24 was more than three times higher than use among all adult females.

Predictors of Alternative Tobacco Use

Adjusted logistic regression was used to test associations of demographic variables and cigarettes smoking status with alternative tobacco products. All measures of association are adjusted for all other variables in the table.

Table 2.4 shows the results from adjusted logistic regression modeling for demographic factors and cigarette smoking status with alternative tobacco product use in males. For hookah, ‘ever-use’ was the dependent variable (current use unavailable) and for cigars and smokeless tobacco, ‘current use’ was the dependent variable. Young adults, aged 18 – 24 years, were more likely to have smoked a hookah than all other age groups. Male hookah smoking was more common among those aged 18 – 24 years, among those with at least some college education and among current and former cigarette smokers. Male hookah smoking was less likely among African-American and Asian/Pacific Islanders, compared to non-Hispanic whites. Male cigar smoking

was more common among those with at least a high school education and among current cigarette smokers. Male cigar smoking was less likely among those aged 65 years and older and among Asian/Pacific Islanders. Similar to current cigar use, male smokeless tobacco use was more common among those with a high school education or some college education and among current cigarette smokers. Male smokeless tobacco use was less likely among those aged 65 years and older and among African-Americans.

Table 2.4. Adjusted^a Odds Ratios and 95% Confidence Intervals for Selected Factors and Use of Alternative Tobacco, Adult California Males, 2008 (n=4,667)

	Hookah ^b (ever)		Cigars (current)		Smokeless Tobacco (current)	
	OR	95%CI	OR	95%CI	OR	95%CI
Age						
18-24 ^c	1.0		1.0		1.0	
25-44	0.27*	0.17 – 0.44	0.81	0.48 – 1.36	1.35	0.61 – 3.02
45-64	0.13*	0.07 – 0.23	0.59	0.31 – 1.11	0.88	0.30 – 2.56
65 +	0.04*	0.02 – 0.08	0.19*	0.07 – 0.56	0.07*	0.03 – 0.21
Education						
< High School Grad ^c	1.0		1.0		1.0	
High School Grad	2.32	0.91 – 5.91	2.65*	1.20 – 5.83	7.79*	1.14 – 53.15
Some College	3.35*	1.63 – 6.92	3.26*	1.61 – 6.59	5.94*	1.14 – 31.05
College Grad	3.45*	1.61 – 7.42	2.98*	1.29 – 6.86	0.60	0.01 – 46.20
Ethnicity						
Non-Hisp White ^c	1.0		1.0		1.0	
Hispanic	0.56	0.31 – 1.02	0.59	0.29 – 1.20	0.41	0.09 – 1.79
African-American	0.40*	0.25 – 0.64	0.83	0.48 – 1.46	0.28*	0.08 – 1.00
Asian/Pacific Island	0.51*	0.33 – 0.79	0.41*	0.22 – 0.76	0.31	0.07 – 1.32
Smoking Status						
Never ^c	1.0		1.0		1.0	
Former	4.39*	2.58 – 7.49	1.91	0.82 – 4.48	1.49	0.40 – 5.61
Current	4.87*	3.09 – 7.67	3.94*	2.33 – 6.65	2.27*	1.02 – 5.07

a. Adjustment for all other variables in the table

b. Current use of hookah was unavailable in CTS

c. Indicates reference category

* Indicates significant finding

Table 2.5 shows the results from adjusted logistic regression modeling for demographic factors and smoking status with ever-use of alternative tobacco products among females. Current use of hookah was unavailable and

current use of cigars and smokeless tobacco was negligible among females (0.5% and 0.05%, respectively). Similar to males, female hookah use was more common among those aged 18 – 24 years, among those with some college education, and among former and current cigarette smokers, and less likely among Hispanics and Asian/Pacific Islanders, compared to non-Hispanic whites. Female cigar use was more common among those with at least a high school education and among former and current smokers, but less likely among those aged 45 and older and among Asian/Pacific Islanders. For smokeless tobacco, female use was more common among current cigarette smokers and less likely among Hispanics.

Table 2.5. Adjusted^a Odds Ratios and 95% Confidence Intervals for Selected Factors and Use of Alternative Tobacco, Adult California Females, 2008 (n=5,730)

	Hookah (ever)		Cigars (ever)		Smokeless Tobacco (ever)	
	OR	95%CI	OR	95%CI	OR	95%CI
Age						
18-24 ^c	1.0		1.0		1.0	
25-44	0.25*	0.13 – 0.48	1.06	0.66 – 1.69	1.03	0.53 – 2.03
45-64	0.07*	0.03 – 0.13	0.52*	0.34 – 0.82	0.56	0.28 – 1.12
65 +	0.01*	0.00 – 0.02	0.23*	0.09 – 0.62	0.31	0.06 – 1.61
Education						
< High School Grad ^c	1.0		1.0		1.0	
High School Grad	1.19	0.54 – 2.64	3.51*	1.82 – 6.79	1.03	0.32 – 3.29
Some College	3.15*	1.48 – 6.70	5.16*	2.66 – 10.01	1.72	0.64 – 4.64
College Grad	2.98	0.60 – 14.87	3.24*	1.19 – 8.84	1.03	0.21 – 5.00
Ethnicity						
Non-Hisp White ^c	1.0		1.0		1.0	
Hispanic	0.42*	0.21 – 0.84	0.55	0.26 – 1.15	0.29*	0.11 – 0.78
African-American	0.50	0.24 – 1.05	0.74	0.44 – 1.25	1.32	0.64 – 2.72
Asian/Pacific Island	0.47*	0.23 – 0.96	0.49*	0.29 – 0.82	0.16	0.02 – 1.14
Smoking Status						
Never ^c	1.0		1.0		1.0	
Former	2.22*	1.03 – 4.79	3.57*	2.20 – 5.79	1.49	0.40 – 5.61
Current	5.01*	2.67 – 9.40	4.44*	2.83 – 6.97	2.27*	1.02 – 5.07

a. Adjustment for all other variables in the table

b. Current use of hookah is unavailable and female current use of cigars and ST is negligible.

c. Indicates reference category.

* Indicates significant finding

DISCUSSION

Using a large sample of 10,397 California adults, we demonstrate that the use of other tobacco products such as cigars and hookah is not declining. Although ever-use of cigars has decreased, current use of cigars is increasing and hookah use is on the rise among males. Prevalence rates have increased for cigar and hookah among females, although confidence intervals overlap between survey years. Young adult males and females have shown a tendency for increased hookah use, but smokeless tobacco use is decreasing in this group of the population.

We have also found that being a former smoker is associated with hookah use (and cigar use in females) suggesting that some of those giving up cigarettes are switching to another tobacco product. In other instances, those who have never used cigarettes are initiating the use of alternative forms of tobacco. However, the health effects associated with cigarettes and other forms of tobacco are similar³⁴⁻³⁸ and the resulting healthcare burden may be of concern.

As male current use of cigars trends upward, females are increasingly exposed to the behavior. While female use of cigars remains low, a gradual, non-significant increase is observed since 1990. This is of concern since any use of tobacco can lead to continued use of other tobacco products and addiction.⁵² Eight California Tobacco Surveys have been conducted during the past two decades, and the prevalence rates for current use of cigars among

males (7.8%) and ever-use of cigars among females (7.0%) are the highest ever recorded by the CTS.

Results from the cigar-use logistic regression analyses are similar to other studies,⁵³⁻⁵⁵ showing that cigar smokers tend to be young, educated, and white. Although cigar smokers are more likely to be current or former cigarette smokers, a post hoc analysis reveals that this may be changing. Since 1990, the greatest surge in current cigar use among males has occurred in never (158% increase) and former (133%) smokers, while use among current smokers has increased by 78%.³ This may be reflective of the belief that cigars are safer or less addictive than cigarettes.^{30, 32, 56} Similar to the 2005 prevalence rates, cigar use in 2008 among young adults remains higher than the initial rate of 1990. With an overall cigar prevalence of 4.1%, California falls short of the Healthy People 2010 objective for current cigar use.⁵⁷

Data from the 2005 National Health Interview Survey show that cigar smoking decreased slightly from 1998 (2.4%) to 2005 (2.2%) on the national level,⁵⁸ although that report combines males and females and uses a different definition of 'current use' (smoked at least 50 lifetime cigars and currently smokes cigars 'some days' or 'everyday'). Indicating that the rising popularity of cigars in California, as witnessed in this report, might not be representative of the entire United States, this is an example of why the tobacco research community should develop a universal definition for current cigar use. Overall, it is difficult to evaluate the level of cigar use throughout the United States

because most large studies of tobacco use (national and sub-national) have largely ignored cigar use.

Although hookah prevalence data has only been collected in the two most recent CTS surveys (2005 and 2008), the >40% increase among males is alarming, especially considering this is only over three years. To our knowledge, the 2008 CTS is the first report of a repeated, randomly sampled hookah prevalence rate from the same, state-level source population. While hookah use is gaining popularity among all adults, we found that it is just as popular as cigars in those aged 18 – 24. The popularity of hookah among young people might be explained by the social nature of the behavior as most hookah users report engaging in this behavior with multiple peers.^{59, 60} If present trends continue, the popularity of hookah will most likely surpass all other alternative forms of tobacco in this age group, and may even approach cigarette use.

Hookah users are similar to cigar smokers in both genders, in that they are young, white, educated, and current or former cigarettes smokers, which is consistent with other reports.^{59, 60} Additional research on demographic associations of cigar and hookah use is indicated by these findings, as ethnicity and education may be socioeconomic indicators correlated with disposable income. Eissenberg, et al.¹⁷ found a non-significant increase in weekly spending for hookah users compared to non-users and Smith-Simone, et al.⁵³ found that current hookah and cigar users had significantly more disposable income than non-users.

In most studies reporting risk perception, hookah is perceived to be less harmful than cigarettes.^{19, 22, 25, 56, 59-61} The belief that hookah smoke is safer than cigarette smoke by those first experimenting with tobacco (adolescents and young adults) may theoretically lead to an increase in initial nicotine exposure and a higher likelihood for repeated use. This is especially true because most smokers are occasional, non-daily smokers, believing they are in no danger of addiction.⁶² Contradictory to the belief in risk reduction, there are several aspects of hookah smoking that are potentially as dangerous or more dangerous than cigarettes. Hookah smoking is done for a much longer time than single cigarettes,²⁴ and a single puff from a hookah pipe may contain an amount of smoke comparable to an entire cigarette,^{24, 26} increasing exposure to nicotine and tobacco carcinogens. Furthermore, hookah smoke has been shown to contain high levels of heavy metals such as arsenic, nickel, cobalt, chromium, and lead.²⁷ Hookah smoking is usually done indoors, often in cafes with many other hookah-smoking groups meaning that even those not smoking hookah are exposed to the entire establishment's secondhand hookah tobacco smoke, which contains a considerable amount of fine particles known to cause respiratory damage.^{63, 64}

Hookah and cigars are similar in that there are special circumstances for their indoor use at 'cigar bars' and 'hookah lounges'. Cigarette smoking is banned throughout California in all indoor places of employment. By completely banning one product for health reasons and allowing others, we are essentially telling tobacco users (and non-users) that cigars and hookah

are a safer alternative to cigarette use, although little research exists on this topic. In a study by Roskin et al.,²² some hookah users believed the behavior safer than cigarette smoking because cigarettes had warning labels and had received national attention for adverse health effects, while hookah had no such warning labels or notoriety. Cigarette bans combined with the allowance of hookah lounges may offer similar implications. The American Lung Association⁴⁰ argues that indoor smoking bans have actually bolstered the popularity of hookah lounges because of their exemption from most state laws.

The most encouraging trend reported in this study is the use of smokeless tobacco by young adults. Ever-use of smokeless tobacco has been significantly reduced among young males and females and current use has been significantly reduced among young males. However, this trend is less encouraging if young adults are simply experimenting with other tobacco products, such as hookah, and this measure does not account for any of the newer non-traditional smokeless tobacco products such as snus.

The CTS is the largest representative sample of randomly selected California adults designed for the purpose of collecting tobacco use data. The statistical weighting is used to generalize results to the entire population of California adults and statements of prevalence can be made for California with a high degree of assurance. Because hookah use was collected in the previous (2005) CTS, a three-year difference in hookah use in the same source population can be estimated. To our knowledge, this is the largest study in which hookah use has been estimated from the same population-

based sample. Other studies of hookah use have employed convenience sampling^{53, 59-61} (hookah lounges) or smaller-scale prevalence surveys in colleges.^{17, 19, 65, 66} Those studies lack the representativeness and power of the current study. While hookah use can only be estimated for two time points over the last three years, cigarette, cigar, and smokeless tobacco use can be evaluated over 18 years.

Only those households with landline home phone numbers were eligible for inclusion in the CTS. Those households relying solely on cell phones were not accessible as part of the target population and therefore not eligible for this study, and such households may differ from households with landlines. In comparison to respondents who did not have a cell phone in addition to their landline, those who also had cell phones in addition to landlines were more likely to be young and educated and less likely to be Hispanic, compared to other ethnicities. However, alternative tobacco use was not affected by having a cell phone in addition to a landline after controlling for age, education and ethnicity. Because the CTS is an extensive survey covering many aspects of cigarette and tobacco use, the number of questions on alternative tobacco use was limited in scope. Therefore, specific data concerning patterns of use and risk perception were not available. Similar to other large telephone-based surveys, response rates for the CTS have declined in recent years. However, research indicates that declining response rates probably do not result in inaccurate tobacco use prevalence estimates.⁶⁷

As the use of alternative tobacco products, especially cigars and hookah, continues to increase and the use of conventional cigarettes continues to decrease, the tobacco control community needs to monitor hookah and cigar use more closely, while developing standard definitions of current use. In future studies, the potential reasons for increased use of cigars and hookah, such as social influence and risk perception must be identified. If hookah and cigar use is increasing because users believe it to be a safer alternative to cigarettes, educational interventions regarding the dangers of hookah and cigar use will be needed. Finally, policy makers should strongly consider laws that would ban ‘cigar bars’ and ‘hookah lounges’, thus eliminating the implication that these products are safer and more socially acceptable than cigarettes.

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CHAPTER 3

Receptiveness and Use of Potentially Reduced Exposure Products (PREPs) among California Smokers

ABSTRACT

PURPOSE: To evaluate the receptiveness of California adult smokers to cigarette replacement with smokeless products intended to be healthier or more convenient. Additionally, this study assesses the knowledge and use of potentially reduced-exposure products (PREPs) among smokers.

METHODS: This is a cross sectional study of California adult cigarette smokers (n=2,740) drawn from the 2008 California Tobacco Survey (CTS). Receptiveness to cigarette replacement with hypothetical products as well as knowledge and use of actual PREPs was determined.

RESULTS: 10.3% of California smokers were 'highly receptive' (would 'definitely' replace) to cigarette replacement for health reasons and 15.2% for convenience reasons. Knowledge and use of actual PREPs was low with 2.2% of smokers reporting use/potential use of snus, 1.5% reporting use/potential use of Ariva, and 4.1% reporting use/potential use of other PREPs. 'Receptive' smokers (would 'definitely' or 'probably' replace cigarettes) had no more knowledge or use of PREPs than 'unreceptive' smokers. However, when regression analyses were restricted to smokers who had knowledge of the product(s), compared to unreceptive smokers, the odds of using Ariva were 4.43 (95%CI 1.00-19.60) times higher among smokers receptive to cigarette replacement for health reasons and 3.98 (95%CI 1.36-11.60) times higher among smokers receptive for convenience reasons.

CONCLUSIONS: Knowledge and use of PREPs is extremely low among California smokers and they are not receptive to replacing their

cigarettes with hypothetical smokeless tobacco products for health reasons and are slightly more receptive for convenience reasons. The concept of harm reduction using smokeless tobacco products is not supported among California smokers.

INTRODUCTION

Cigarette smokers may modify their smoking behavior for reasons of health or convenience.¹ In the latter case, they are likely to do it because of indoor smoking bans in almost all public spaces and places of employment that forces smokers to confine their smoking to special, often inconvenient, designated places. Therefore, switching to a smokeless tobacco product for continued indoor use may be an option for such smokers. Although traditional smokeless tobacco products such as snuff and chewing tobacco have been available for hundreds of years, they require spitting, a behavior in which many smokers are not willing to engage.² Several products, such as snus and other potentially reduced-exposure products (PREPs) that do not require spitting are being introduced to the North American market after previously being introduced in Europe.³⁻⁷ Because these PREPs are smokeless, they eliminate secondhand tobacco smoke, and there are claims that they may reduce harm in the users themselves.^{4, 8-16} Therefore, some argue that a cigarette smoker may be convinced to use a smokeless PREP to reduce adverse health effects.¹¹

The permeation of smokeless PREPs into the U.S. marketplace produces new investigative opportunities for the tobacco research community. It is important to know if smokers are even receptive to giving up their cigarettes. It is also important to determine if smokers are aware of PREPs being marketed as less harmful or more convenient. Finally, for those

smokers who may be receptive to giving up their cigarettes, it would be valuable to know if they have experimented with PREPs.

PREP proponents^{9, 10, 17-22} argue that those addicted to nicotine should at least limit adverse tobacco health consequences by using a different nicotine delivery product such as PREPs. Also, research from Sweden indicates that using snus may increase smoking cessation.²³⁻²⁵ Opponents of the use of PREPs²⁶⁻³³ argue that there is no safe form of tobacco and PREP advocacy may lead to use in some individuals who would otherwise never use tobacco, which could then lead to cigarette use.^{29, 31} Additionally, snus may be culturally specific to Sweden and not transferrable to the U.S.³³ However, the harm reduction argument becomes superfluous if current smokers are not receptive to giving up their cigarettes. Data from the 2003 and 2005 Health Information National Trends Survey (HINTS) indicate that awareness and use of smokeless PREPs is quite low nationally.⁶ Although snus is being marketed in the United States,⁷ data from the 2002 Tobacco Use Supplement to the Current Population Survey (TUS-CPS) indicate that U.S. smokers may not initiate smokeless tobacco use similar to Swedish smokers.³³ However, that study does not include snus or any of the newer, non-traditional smokeless tobacco products. While the HINTS and TUSCPS studies indicate that receptivity and awareness of smokeless PREPs is low, those studies use relatively older data while the marketing of these products is more recent. Historically, 'light' cigarettes were assumed to be safer than regular cigarettes.³⁴⁻³⁶ Although PREP manufacturers can no longer make

explicit claims of harm reduction in the United States, their marketing suggests to consumers that the products are less harmful than cigarettes.^{37, 38} Any changes in public awareness and use of PREPs made in the time since the HINTS and TUS-CPS surveys should be evaluated.

The purpose of this study was to evaluate the level of interest among California adult cigarette smokers to cigarette replacement with other tobacco products that are defined as less harmful or more convenient. In addition, the three-year change in this interest was evaluated from the relatively large, random-digit-dial sample of California smokers. We assessed the knowledge and use of actual tobacco products intended to be less harmful or more convenient than cigarettes among California adult smokers. Finally, California smokers who are receptive to cigarette replacement (either 'definitely' or 'probably' willing) were compared unreceptive smokers (either 'definitely not' or 'probably not' willing) with regard to PREP use.

METHODS

Study Sample

The eighth California Tobacco Survey (CTS) was conducted in 2008. The objective of this large, random-digit-dial, population-based survey was to collect representative statewide data on tobacco-related behaviors, knowledge and attitudes towards smoking, and to monitor the effect of State-initiated programs at the population level using specific behavioral outcomes. Data collection and inclusion/exclusion criteria are described elsewhere.³⁹ After a

screening survey of randomly selected households, a total of 10,397 adults (out of 19,418 selected for participation) completed an extended survey on tobacco use and behavior (53.5% participation rate). A total of 2,740 current smokers completed the extended survey and are reported here. Survey procedures and analyses were approved by the University of California, San Diego Human Research Protection Program.

Survey Information

Current smokers were asked the following two questions: *'Would you replace your cigarettes with smokeless tobacco, dip, or chew if you thought it had fewer health consequences?'* and *'Would you switch from cigarettes to a new tobacco product, if you could get the dose of nicotine that you need from the new product without smoking or spitting?'* Responses included *'Definitely Yes'*, *'Probably Yes'*, *'Probably Not'*, and *'Definitely Not'*. The first question addresses the issue of health, and the second question addresses the issue of convenience, as this hypothetical product would be usable in places with smoking bans. Respondents were defined on two levels; as *'highly receptive'* (answered *'definitely yes'* to either question) and *'receptive'* (answered *'definitely yes'* or *'probably yes'*) for each question.

Adults were also asked the following PREP use questions: *Have you heard of snus? (YES/NO), Have you (used snus), (might you use snus), or (will you never use snus)? Have you heard of Ariva? (YES/NO), Have you (used Ariva), (might you use Ariva), or (will you never use Ariva)? Have you*

heard of any of the following tobacco products: Eclipse, Accord, Exalt, Revel, Omni or Advance? (YES/NO), and Have you (used any of these products), (might you use any of these products), or (will you never use any of these products)? Because of low frequency of ‘used’ and ‘might use’ responses were combined into a single response. Responses to these questions were evaluated across demographic groups. Additionally, these questions were evaluated for association with those defined as ‘receptive’ to cigarette replacement.

Statistical Analyses

To account for the two-stage survey design, responses were weighted to the adult population of California. Base weights were calculated according to the probability of a household being selected and were then adjusted to population totals for gender, ethnicity, and education to account for non-responses.⁴⁰ Confidence intervals for point estimates and all test statistics were calculated by the jackknife method using 51 replicate weight jackknife samples.⁴¹

For the two cigarette replacement questions, response frequencies and 95% confidence intervals were calculated for all responses for various demographic groups and a chi-square analysis was used to test for differences across strata. Response frequencies, 95% confidence intervals, and percentage change were reported for being ‘*highly receptive*’ (2005 to 2008). Response frequencies and 95% confidence intervals were also

calculated for the PREP questions. Demographic factors were tested for significance with a chi-square analysis. Multivariate logistic regression analyses were used to assess the association between smokers '*receptive*' to cigarette replacement and their knowledge/use of these products. The '*definitely yes*' and '*probably yes*' (vs. '*probably not*' and '*definitely not*') answers were combined for the *receptive* dependent variable to ensure sufficient dichotomous responses for the variable in logistic regression. For PREP *knowledge*, regression included all adult smokers. For PREP *use*, the regression was performed separately using all adult smokers and only those smokers who have knowledge of the product(s). Demographic factors (gender, age, ethnicity, and education) were tested for association with being '*receptive*' and associated factors were controlled for in each regression analysis. Odds ratios, 95% confidence intervals, and p-values are reported for regression analyses. An $\alpha=0.05$ level of significance was used for all chi-square and logistic regression measures, as well as prevalence comparisons. SUDAAN statistical package was used to determine weighted proportions, odds ratios, and 95% confidence intervals.

RESULTS

Overall, California smokers may be more open to cigarette replacement for reasons of convenience (compared to health) although many confidence intervals overlap (Table 3.1). Cigarette smokers in California were generally not interested in replacement for health reasons (10.3% definitely yes), and

there is little difference in this frequency with regard to gender and age group. However, there were significant differences with respect to ethnicity and education for the health scenario. Hispanics, African Americans, and Asians/Pacific Islanders appear to be more open to replacement for health reasons than non-Hispanic whites. Also, those with less than a high school education appear to be more receptive than other education categories in both scenarios.

Similar to the health question, differences among gender and age group were not apparent in the convenience question, but response frequencies were significantly different across ethnicities and education levels. Hispanics appear to be the most interested in cigarette replacement in the convenience scenario, while Asians/Pacific Islanders appear to be the least interested group. Similar to the health-related replacement question above, those with less than a high school education are more open to replacement for convenience reasons than those with more education.

Overall, the receptiveness of California adult smokers to cigarette replacement in both scenarios appears to be increasing although most confidence intervals from 2005 to 2008 overlap (Table 3.2). The increase in receptiveness for health reasons by those aged 65 years and older was statistically significant.

Table 3.1. Percentages and 95% Confidence Intervals of Cigarette Replacement Questions for Various Demographic Groups of California Adult Smokers; 2008 California Tobacco Survey (n=2,740)

'Would you replace your cigarettes with smokeless tobacco, dip, or chew if you thought it had fewer health consequences?'

	<u>Definitely Yes</u>	<u>Probably Yes</u>	<u>Probably Not</u>	<u>Definitely Not</u>
Overall	10.3% (7.6-13.0)	6.7% (5.2-8.2)	11.4% (10.0-12.8)	71.6% (68.8-74.4)
Gender				
Male	9.8% (7.7-11.9)	6.3% (4.6-8.0)	12.6% (11.0-14.2)	71.3% (68.5-74.1)
Female	11.1% (4.6-17.6)	7.4% (5.3-9.5)	9.3% (7.3-11.3)	72.2% (65.7-78.7)
Age Group				
18 – 24	6.3% (2.2-10.4)	6.2% (3.2-9.2)	11.7% (7.9-15.5)	75.8% (69.3-82.3)
25 – 44	12.6% (6.8-18.4)	5.3% (3.2-7.4)	11.2% (8.9-13.5)	71.0% (65.2-76.8)
45 – 64	8.6% (6.4-10.8)	8.9% (6.7-11.1)	10.9% (8.8-13.0)	71.5% (67.7-75.3)
65+	11.3% (6.9-15.7)	7.4% (4.3-10.5)	13.5% (9.2-17.8)	67.7% (61.4-74.0)
Ethnicity*				
Hispanic	18.4% (10.1-26.7)	6.8% (4.0-9.6)	11.7% (8.3-15.1)	63.1% (55.3-70.9)
Non-Hispanic white	5.6% (4.5-6.7)	6.1% (4.7-7.5)	12.3% (10.7-13.9)	76.0% (73.8-78.2)
African American	14.0% (6.1-21.9)	9.5% (3.9-14.1)	8.1% (4.8-11.4)	68.4% (59.4-77.4)
Asian/PI	11.0% (3.1-18.9)	8.6% (2.3-14.9)	10.7% (3.7-17.7)	69.7% (57.9-81.5)
Education*				
< high school grad	22.1% (9.6-34.6)	7.0% (3.7-10.3)	9.6% (6.0-13.2)	61.3% (51.8-70.8)
High school grad	9.1% (7.0-11.2)	6.7% (4.3-9.1)	11.5% (8.7-14.3)	72.7% (69.2-76.2)
Some college	7.2% (5.1-9.3)	7.7% (5.1-10.3)	11.7% (9.1-14.3)	73.5% (69.6-77.4)
College graduate	5.7% (2.6-8.8)	4.7% (1.9-7.5)	12.5% (9.5-15.5)	77.1% (72.3-81.9)

'Would you switch from cigarettes to a new tobacco product, if you could get the dose of nicotine that you need from the new product without smoking or spitting?'

	<u>Definitely Yes</u>	<u>Probably Yes</u>	<u>Probably Not</u>	<u>Definitely Not</u>
Overall	15.2% (12.4-18.0)	20.8% (18.3-23.3)	16.8% (15.1-18.5)	47.1% (44.1-50.1)
Gender				
Male	13.6% (11.3-15.9)	21.8% (18.5-25.1)	16.3% (14.1-18.5)	48.3% (44.4-52.2)
Female	18.1% (12.1-24.1)	19.1% (15.9-22.3)	17.8% (15.0-20.6)	45.0% (40.0-50.0)
Age Group				
18 – 24	9.1% (6.6-13.6)	19.6% (14.2-25.0)	20.1% (14.3-25.9)	51.1% (43.7-58.5)
25 – 44	16.3% (10.5-22.1)	19.1% (15.4-22.8)	16.0% (12.8-19.2)	48.6% (42.8-54.4)
45 – 64	17.4% (14.1-20.7)	23.8% (20.5-27.1)	16.5% (13.7-19.3)	42.4% (38.3-46.5)
65+	13.2% (7.9-18.5)	21.4% (15.2-27.6)	16.3% (12.0-20.6)	49.1% (41.9-56.3)
Ethnicity*				
Hispanic	21.2% (13.1-29.3)	17.4% (13.3-21.5)	14.1% (10.2-18.0)	47.4% (40.4-54.4)
Non-Hispanic white	12.4% (10.7-14.1)	24.3% (21.4-27.2)	20.2% (18.1-22.3)	43.1% (40.1-46.1)
African American	14.5% (8.7-20.3)	19.0% (11.9-26.1)	14.9% (8.1-21.7)	51.6% (41.2-62.0)
Asian/PI	10.0% (3.7-16.3)	19.8% (9.0-30.6)	11.6% (4.3-18.9)	58.5% (46.0-71.0)
Education*				
< high school	27.5% (15.6-39.4)	19.9% (13.0-26.8)	11.5% (6.2-16.8)	41.2% (33.6-48.8)
High school grad	14.0% (11.4-16.6)	21.7% (18.0-25.4)	15.8% (13.3-18.3)	48.5% (43.2-53.8)
Some college	13.3% (10.3-16.3)	20.7% (16.4-25.0)	20.4% (16.8-24.0)	45.6% (40.5-50.7)
College graduate	7.8% (4.4-11.2)	19.9% (15.9-23.9)	19.2% (15.9-22.5)	53.1% (48.1-58.1)

* Chi-square test reveals significant differences across strata at $\alpha=0.05$ level

Table 3.2. Change in 'Receptiveness' (response 'definitely yes') of California Adult Smokers to Cigarette Replacement by Hypothetical Smokeless Tobacco Products for Health or Convenience; 2005-2008 California Tobacco Surveys

'Would you replace your cigarettes with smokeless tobacco, dip, or chew if you thought it had fewer health consequences?'

	<u>'Definitely Yes' in</u> <u>2005</u>	<u>'Definitely Yes' in</u> <u>2008</u>	<u>% Change</u>
Overall	8.2% (6.4-10.0)	10.3% (7.6-13.0)	25.6
Gender			
Male	8.6% (6.3-10.9)	9.8% (7.7-11.9)	14.0
Female	7.6% (5.4-9.8)	11.1% (4.6-17.6)	46.1
Age Group			
18 – 24	7.2% (3.6-10.8)	6.3% (2.2-10.4)	- 12.5
25 – 44	10.3% (6.9-13.7)	12.6% (6.8-18.4)	22.3
45 – 64	6.2% (4.3-8.1)	8.6% (6.4-10.8)	38.7
65+	4.5% (2.4-6.6)	11.3% (6.9-15.7)	151.1*
Ethnicity			
Hispanic	12.1% (7.1-17.1)	18.4% (10.1-26.7)	52.1
Non-Hispanic white	6.0% (4.7-7.3)	5.6% (4.5-6.7)	- 6.7
African American	9.2% (3.0-15.4)	14.0% (6.1-21.9)	52.2
Asian/Pacific Islander	8.6% (1.3-15.9)	11.0% (3.1-18.9)	27.9
Education			
Less than high school	13.2% (8.0-18.4)	22.1% (9.6-34.6)	67.4
High school diploma	7.2% (5.1-9.3)	9.1% (7.0-11.2)	26.4
Some college	6.3% (3.9-8.7)	7.2% (5.1-9.3)	14.3
College graduate	5.1% (2.2-8.0)	5.7% (2.6-8.8)	11.8

'Would you switch from cigarettes to a new tobacco product, if you could get the dose of nicotine that you need from the new product without smoking or spitting?'

	<u>'Definitely Yes' in</u> <u>2005</u>	<u>'Definitely Yes' in</u> <u>2008</u>	<u>% Change</u>
Overall	11.9% (10.2-13.6)	15.2% (12.4-18.0)	27.7
Gender			
Male	11.0% (8.6-13.4)	13.6% (11.3-15.9)	23.6
Female	13.3% (11.1-15.5)	18.1% (12.1-24.1)	36.1
Age Group			
18 – 24	8.5% (5.2-11.8)	9.1% (6.6-13.6)	7.1
25 – 44	11.6% (9.0-14.2)	16.3% (10.5-22.1)	40.5
45 – 64	13.9% (10.3-17.5)	17.4% (14.1-20.7)	25.2
65+	12.1% (7.1-17.1)	13.2% (7.9-18.5)	9.1
Ethnicity			
Hispanic	10.9% (7.0-14.8)	21.2% (13.1-29.3)	94.5
Non-Hispanic white	12.9% (10.8-15.0)	12.4% (10.7-14.1)	- 3.9
African American	11.5% (5.5-17.5)	14.5% (8.7-20.3)	26.1
Asian/Pacific Islander	6.6% (3.7-9.5)	10.0% (3.7-16.3)	51.5
Education			
Less than high school	13.6% (8.5-18.7)	27.5% (15.6-39.4)	102.2
High school diploma	12.2% (9.5-14.9)	14.0% (11.4-16.6)	14.8
Some college	10.9% (8.3-13.5)	13.3% (10.3-16.3)	22.0
College graduate	10.1% (6.4-13.8)	7.8% (4.4-11.2)	- 22.8

* Indicates statistically significant 3-year change

Overall knowledge of PREPs is low and use of these products is extremely low (Table 3.3). Many of the demographic groups demonstrated significant differences in knowledge and use of PREPs. Older smokers appear to have more knowledge of snus and Ariva, while younger smokers have actually used them or might use them at a higher rate. Younger smokers have more knowledge and use of the 'other PREPs' than older smokers. Also, Hispanics appear to have less knowledge of snus and Ariva and less use of snus than other ethnicities. Those with less than a high school education appear to have the least knowledge of snus and Ariva and the least use of snus. Finally, males have used or might use snus at significantly higher rates than females.

Table 3.4 shows the adjusted ORs from the logistic regression for *receptive* smokers compared to unreceptive smokers (separate analysis for health and convenience scenarios) with regards to PREP knowledge and use. To control for potential confounders, gender, age, ethnicity, and education were independently tested for association to receptiveness in both scenarios, and adjustment included education and ethnicity for health receptiveness and age for convenience receptiveness. Generally, those who are hypothetically receptive to PREPs have no more knowledge or use of these products than those defined as 'unreceptive'. The exception is receptive smokers for convenience reasons are more likely to use/possibly use Eclipse, Accord, Exalt, Revel, Omni, or Advance than unreceptive smokers. When the

regression models are restricted to smokers who have heard of the products,

Ariva is associated with receptivity.

Table 3.3. Percentages and 95% Confidence Intervals for Awareness and Use of Potentially Reduced-Exposure Tobacco Products (PREPs) Among California Adult Smokers; 2008 California Tobacco Survey (n=2,740)

	<u>Snus</u>		<u>Ariva</u>		<u>Other PREPs</u>	
	Heard Of*	Used / Might Use*	Heard Of*	Used / Might Use	Heard Of*	Used / Might Use*
Overall	14.9% (14.3-15.5)	2.2% (2.0-2.4)	8.6% (8.2-9.0)	1.5% (1.3-1.7)	15.1% (14.2-16.0)	4.1% (3.8-4.4)
Gender						
Male	15.6% (14.8-16.4)	3.2% (2.9-3.5)	8.9% (8.3-9.5)	1.8% (1.5-2.1)	15.0% (14.2-15.8)	4.4% (4.0-4.8)
Female	13.6% (12.9-14.3)	0.6% (0.4-0.8)	8.1% (7.5-8.7)	1.0% (0.8-1.2)	15.4% (13.3-17.5)	3.7% (3.3-4.1)
Age Group						
18 – 24	16.1% (14.5-17.7)	4.9% (4.0-5.8)	5.0% (3.8-6.2)	1.3% (0.7-1.9)	19.6% (17.7-21.5)	8.9% (7.7-10.1)
25 – 44	12.7% (11.8-13.6)	2.5% (2.1-2.9)	8.2% (7.4-9.0)	1.8% (1.4-2.2)	15.3% (13.5-17.1)	2.7% (2.4-3.0)
45 – 64	15.4% (14.5-16.3)	1.1% (0.9-1.3)	10.5% (9.7-11.3)	1.2% (1.0-1.4)	14.0% (13.3-14.7)	4.2% (3.7-4.7)
65+	21.7% (19.9-23.5)	0.6% (0.3-0.9)	10.6% (9.5-11.7)	1.3% (1.0-1.6)	10.5% (9.2-11.8)	2.8% (2.1-3.5)
Ethnicity						
Hispanic	6.5% (5.5-7.5)	0.1% (0.0-0.2)	7.1% (6.1-8.1)	1.3% (0.9-1.7)	15.2% (12.6-17.8)	3.0% (2.5-3.5)
Non-Hispanic white	19.5% (18.7-20.3)	3.3% (2.9-3.7)	9.0% (8.6-9.4)	1.9% (1.7-2.1)	14.9% (14.3-15.5)	5.1% (4.6-5.6)
African American	18.0% (16.2-19.8)	2.1% (1.3-2.9)	14.6% (12.3-16.9)	0.6% (0.4-0.8)	15.9% (14.1-17.7)	1.9% (1.4-2.4)
Asian/PI	14.1% (11.7-16.5)	4.2% (2.8-5.6)	6.7% (3.8-9.6)	0% (0)	15.3% (12.6-18.0)	4.7% (3.3-6.1)
Education						
< high school grad	7.9% (6.3-9.2)	0.7% (0.5-0.9)	5.5% (4.5-6.5)	0.8% (0.4-1.2)	16.8% (12.6-21.0)	2.1% (1.5-2.7)
High school grad	16.0% (14.9-17.1)	1.8% (1.5-2.1)	9.2% (8.5-9.9)	1.8% (1.5-2.1)	15.5% (14.5-16.5)	4.3% (3.8-4.8)
Some college	17.6% (16.6-18.6)	4.7% (4.1-5.3)	8.5% (9.7-9.3)	1.4% (1.2-1.6)	15.2% (14.3-16.1)	5.4% (4.8-6.0)
College graduate	14.8% (13.7-15.9)	0.8% (0.5-2.1)	11.1% (10.0-12.2)	1.9% (1.4-2.4)	12.2% (11.1-13.3)	3.8% (3.1-4.5)

* indicates significant differences across demographic strata at $\alpha=0.05$ level (Chi-square)

Table 3.4 Adjusted Odds Ratios for Use of Potentially Reduced-Exposure Tobacco Products (PREPs) Among California Adult Smokers Defining Themselves as ‘Susceptible’ to Cigarette Replacement for Health or Convenience Reasons; 2008 California Tobacco Survey (n=2,740)

	<u>‘Susceptible’ for Health[†]</u>			<u>‘Susceptible’ for Convenience[±]</u>		
	Odds Ratio	95% CI	P	Odds Ratio	95% CI	P
Snus						
Heard Of	0.95	0.60 – 1.49	0.82	1.00	0.72 – 1.39	0.98
Used / Might Use (all)*	1.98	0.80 – 4.90	0.14	1.52	0.71 – 3.28	0.28
Used / Might Use (heard)**	2.58	0.90 – 7.35	0.08	1.55	0.66 – 3.63	0.31
Ariva						
Heard Of	0.83	0.47 – 1.48	0.53	0.83	0.54 – 1.26	0.37
Used / Might Use (all)*	2.02	0.69 – 5.92	0.20	2.37	0.94 – 5.97	0.07
Used / Might Use (heard)**	4.43 [@]	1.00 – 19.60	0.05	3.98 [@]	1.36 – 11.60	0.01
Other PREPs						
Heard Of	1.32	0.89 – 1.95	0.17	1.36	0.99 – 1.87	0.06
Used / Might Use (all)*	1.24	0.59 – 2.61	0.58	1.85 [@]	1.05 – 3.26	0.03
Used / Might Use (heard)**	1.69	0.66 – 4.37	0.28	2.28 [@]	1.16 – 4.52	0.02

† Adjusted for education and ethnicity

± Adjusted for age

* Logistic regression using all California adult smokers from 2008 CTS.

** Logistic regression using California adult smokers who have heard of that product(s)

@ Significant OR at $\alpha=0.05$ level

DISCUSSION

California smokers are generally not interested in replacing their cigarettes with hypothetical smokeless tobacco products though there is a non-significant indication that being ‘highly receptive’ may have increased 2005 to 2008. Knowledge and use of these products is extremely low among California smokers when hypothetical questions are replaced with questions on actual usage. California smokers who may be ‘receptive’ to cigarette

replacement have not demonstrated increased knowledge or use of PREPs compared with 'unreceptive' smokers.

The hypothetical nature of the cigarette replacement questions makes the results hard to compare with other studies. The 2003/2005 Health Information National Trends Surveys (HINTS) had one hypothetical PREP question, although this hypothetical product was targeting replacement with a 'safer cigarette'. In contrast to findings from the current study, HINTS data show that non-Hispanic whites were more receptive than other ethnicities to PREP use for health reasons.⁶

It is possible that some smokers are unreceptive to cigarette replacement for health-related reasons because they do not believe that smoking is harmful to them. In the 2008 CTS, smokers were asked to agree or disagree with the following statement: '*My smoking is harming my own health.*' While a great majority of smokers agree that their cigarettes are harming them, there was a significant, positive association between being receptive and agreeing with this statement. However, there was no interaction between this association and demographic factors and PREP use was not affected by agreeing or disagreeing with the cigarette-harm belief statement.

While interest in cigarette replacement is low, a non-significant increase in being highly receptive to replacement has been observed since 2005. This may be attributed to increased general knowledge of the dangers of cigarettes and an increase in laws and regulations restricting smoking in public places; it could also be due in part to marketing by the tobacco industry for these types

of products. However, the hypothetical nature of these questions makes this point difficult to prove, and it has not been addressed by other studies.

The general knowledge and use of PREPs is very low among California smokers. Younger smokers have used snus and other PREPs at a higher rate than older smokers. In California, this is reflective of other non-cigarette tobacco products, such as cigars and hookah, which young adults are using at higher rates.⁴² Future studies should try to determine if this trend is solely a result of risk perception, a willingness to experiment with other products, or other factors.

Although knowledge and use of PREPs is low, it is possible that these products are not yet being aggressively marketed in California,^{3, 7} and it may be reasonable to assume that the marketing departments of major tobacco companies will increase awareness of these new products. In U.S. test markets for snus, interest and use of the product has increased greatly as a result of advertising campaigns.³ As these marketing campaigns reach a national level, we may see similar results throughout the United States.

Among all smokers, those defined as *receptive* to PREPs have no increased knowledge or use of most products than unreceptive smokers. However, among those who have heard of Ariva, receptive smokers are more likely to have used that product than unreceptive smokers. Comprised of ground tobacco pressed into a pill, Ariva is smaller and less conspicuous than many other PREPs. However, knowledge of Ariva is quite low, both on the California state level (8.6%) and the national level (HINTS 5.4%).⁶

Receptivity is not associated with knowledge and use of snus in this study. Unlike the other PREPs, snus is not a brand name but is a type of smokeless tobacco, the producers of which are continually increasing in number. Additionally, snus is the PREP most associated with the harm reduction debate,^{9-12, 14, 15, 20, 27, 28, 33, 43-45} and cigarette brands like Camel (RJ Reynolds) and Marlboro (Altria) have now entered the snus market. Results from this study show that the convenience angle may have more traction than the health argument for cigarette replacement candidates. Because the U.S. Food and Drug Administration (FDA) now monitor claims of harm reduction for tobacco products, it will be difficult to market snus with 'healthier' claims. Instead, they are likely to address convenience. In fact, Camel has already made that decision through new marketing slogans like "break free", "never miss a beat", "boldly go everywhere", and "enjoy camel on your own terms," it is apparent that Camel will be marketing snus as a 'use anywhere' tobacco product, a way to use tobacco where smoking is banned.

The CTS is the largest survey of randomly selected California adults designed specifically to collect tobacco use data. Because data on hypothetical cigarette replacement was previously collected (2005), changes in receptiveness within the same source population can begin to be evaluated. This study collects information on hypothetical PREP receptivity and actual PREP use, a combination of data not available from other datasets, allowing us to examine the association between potential and actual use of PREPs.

This study is limited by restricting the analyses to current smokers only. The PREP use behaviors of former smokers were not examined. Only households with landline home phones were eligible for selection and therefore, mobile phone users were excluded.

Results of this study may have implications on the tobacco harm reduction debate, most of which considers the *potential* for harm reduction in the United States and the *philosophy* of recommended PREP use.^{11, 12, 17, 19-21, 24, 26-29, 44, 46} Population studies of measureable harm reduction are lacking. PREP use may theoretically reduce health risks,^{17, 19-21, 24} easing the burden on the health care system,⁴⁶ and the heaviest smokers are the initial target population.^{17, 20, 21} To evaluate the association between receptivity to cigarette replacement and smoking consumption, a post-hoc analysis was performed using our data. Cigarettes-per-day was not associated with receptivity to cigarette replacement for health reasons. Although snus studies do not account for smoking level,^{22, 24, 47} the HINTS data shows that those smoking 20 or more cigarettes per day have more interest in PREPs than those smoking less than 20 cigarettes per day⁶ but no data relevant to replacement for health reasons is provided. Focus groups have shown that U.S. smokers that try PREPs do not like them and do not continue to use them.⁴⁸

Results from Sweden have shown that snus is associated with lower rates of smoking,^{10, 22, 24} and the literature reveals that snus is associated with fewer health consequences than smoking.⁹ This has led many tobacco researchers to recommend snus as a target product for harm reduction.^{11, 17, 19,}

⁴⁴ However, there are some researchers, even in Sweden, who do not agree that snus is an effective harm reduction product. Holm et al. believe that quitting smoking is the only truly safe option and that snus is simply a way for tobacco companies to maintain profits as the use of traditional cigarettes declines.²⁷ Additionally, Stenbeck et al.,²² found that in Sweden, snus use contributed to smoking cessation, thus reducing the health risks of many tobacco users, but also reported that young non-smoking men, who may otherwise be tobacco-free, were more likely than older men to initiate snus use. Results from our study indicate that the knowledge and use of snus and other smokeless PREPs may be insufficient to affect any measureable harm reduction in the United States.

While the philosophical debate on the merits of PREPs will continue, this study adds to the limited literature determining the potential capacity for harm reduction that exists in California, the largest state of the United States. Although the current study reveals differing patterns of use from the national HINTS data,⁶ there is a common finding that U.S. smokers are mostly unaware of smokeless PREPs and even fewer are using them. This result adds to the conclusions by Zhu et al.,³³ that the United States may not adopt snus with a commitment similar to other countries.

Although PREP use is low in the United States,^{6, 33, 48-50} results from the hypothetical cigarette replacement questions, especially the convenience scenario, suggest there may be a marginally increasing number of smokers receptive to cigarette replacement with a smokeless PREP. Thus, there may

be smokers in California who are open to cigarette replacement, but have not heard of specific products. However, this potential for increased smokeless PREP use should be viewed with caution because even those smokers who have heard of snus and other PREPs have scarcely used them. The notion that smokeless products will effectively reduce harm is undermined by our results, which indicate smokers are unlikely to switch to these products in large numbers in the near future. Further follow up studies are needed in the population to determine the long-term benefit of switching to these products.

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CHAPTER 4

Determinants of Hookah Use Among High School Students

ABSTRACT

Objectives: To investigate hookah use in high school students, we examined risk perception and psychosocial risk factors of hookah use as well as patterns of initiation, use, and cessation.

Methods: Using a cross sectional survey of 689 high school students from three suburban schools in San Diego County, characteristics of hookah users are compared to non-users and factors associated with current hookah use were compared to former use.

Results: Hookah ever-use in the study population was 26.1%, previous month use was 10.9%, and current use was 10.3%. Subjects believed hookah to be more socially acceptable and safer than other tobacco products. Users were more likely than non-users to report a hookah lounge in their community. In comparison to former users, current users were more likely to have recently smoked a cigarette, to report a hookah lounge in their community, and to believe hookah is more socially acceptable than cigarettes.

Conclusions: Hookah use is becoming a commonly acceptable behavior among adolescents. Hookah lounges are associated with higher hookah use among high school students and should be a target of further regulation.

INTRODUCTION

According to the Youth Risk Behavior Survey (YRBS)¹ cigarette smoking (ever-use) by high school students decreased by 28.3% from 1997 to 2007 in the United States. This trend represents significant progress towards reducing nicotine initiation and addiction among adolescents and subsequent adult smoking since lifetime tobacco use frequently begins in adolescence.² However, the health benefits of this reduced tobacco use may not be appreciated if tobacco use is initiated through another tobacco product. Nicotine is highly addictive, regardless of the source, and tobacco is available in many forms. If adolescents are experimenting with different forms of tobacco, this may eventually undermine the long-term health gains from the reduction in cigarette smoking.

An older, international form of tobacco use, the hookah or waterpipe, has recently become more popular among young persons in the United States.^{3, 4} Similar to other tobacco products, hookah is related to a variety of preventable diseases, including cancers of the lung,^{5, 6} mouth,⁷ and bladder.^{8, 9} Hookah has also been associated with coronary heart disease¹⁰ and adverse pulmonary effects.¹¹⁻¹³ Additionally, hookah smoke has been shown to contain many of the same carcinogens as cigarette smoke.¹⁴

While cigarette smoking may be declining, hookah use is increasing in the United States and throughout the world,¹⁵⁻¹⁷ especially among adolescents and young adults.⁴ Many hookah users believe it to be safer and less addictive than cigarettes¹⁸⁻²² but because of the increased level of exposure during a

typical hookah session, hookah smoke may be even more dangerous than cigarettes.^{14, 23-25} Hookah smoking is done for a much longer time than single cigarettes, with many sessions lasting from 45 to 60 minutes or even longer,²⁰ as opposed to 5 – 10 minutes for a cigarette. Research shows that in some smokers a single puff from a hookah pipe contains a smoke volume comparable to an entire cigarette.^{20, 23} Hookah smoke also contains significant levels of heavy metals such as arsenic, nickel, cobalt, chromium, and lead.²⁵ The WHO calculates that a single hookah smoking session may be equivalent to 100 cigarettes¹⁶ (one cigarette per puff and 100 puffs per average session).

Many hookah smokers are occasional smokers, leading them into a false belief that they are in no danger of addiction or harmful effects.¹⁵ Hookah smoking is usually done indoors, often in ‘hookah lounges’ with many other hookah-smoking groups. All persons in the lounge are exposed to secondhand hookah tobacco smoke, which contains a considerable amount of fine particles known to cause respiratory damage.^{26, 27} The pleasant, fruity flavor of most hookah tobacco may render it less harsh to inexperienced users, leading to repeated use.²⁸ Compared to cigarettes, hookah is associated with “greater CO, similar nicotine, and dramatically more smoke exposure”.²³ During a hookah smoking session, many individuals share a single mouthpiece, increasing the spread of infectious diseases such as tuberculosis, hepatitis, and herpes.²⁹ Finally, smoking a hookah as an adolescent or young adult may increase the likelihood of smoking cigarettes either concurrently or later in life.³⁰

California labor code 6404.5 prohibits the use of tobacco in “enclosed places of employment”.³¹ However, an exemption for “Retail or wholesale tobacco shops” in California (and other states) has led to the increasing presence of ‘hookah lounges’, which are social establishments where groups of individuals may gather to socialize and smoke hookah. The comfortable lounge setting of these establishments is meant to encourage prolonged smoking and relaxation, thus increasing the patrons’ exposure to tobacco smoke over a longer period of time.³² The popularity of hookah bars is not specific to California as hookah lounges are being established throughout the United States, usually in proximity to colleges and universities.³²

While there are several studies of hookah among young adults, these studies are usually based on college and university populations.^{3, 21, 33-35} Other hookah studies recruit convenience samples from hookah lounges.³⁶⁻³⁸ Only two studies have evaluated hookah use among high school aged subjects^{39, 40} and neither of those studies examined hookah users and non-users specifically with respect to risk perception, patterns of use (including initiation and cessation) and other psychosocial risk factors. Since lifetime tobacco use is frequently established by the age of 18,² it is important to establish a more accurate picture of hookah use among those aged 18 years and younger. The current study aims to address this gap in awareness of hookah use at the high school level by examining risk perception and psychosocial risk factors among users and non-users of hookah, and to describe patterns of use and initiation among hookah users. Finally, this study

compares current hookah smokers to users who have quit in relation to various factors.

METHODS

Study Population

Data for this study were drawn from a survey of high school students in three suburban communities in San Diego County, 2010. The survey was administered to all grade-appropriate students in the classrooms of three participating high schools. The three schools were chosen from three different geographic communities in San Diego County. At one large high school, all seniors participated in the survey. At two smaller high schools, all juniors and seniors participated in the survey. To participate in this study, the student must have been present on the study day. The participation rate of eligible, present students was 99.7%, after two students were removed by their parents, for a total of 689 subjects.

This study used passive assent for those under the age of 18. Adolescent assents were mailed to the parents/guardians of all targeted juniors and seniors two weeks before the study date, giving them opportunity to remove their child from the study. On the study date, subjects 18 years of age or older signed an adult consent before taking the survey. Procedures in this study were approved by the University of California, San Diego Human Research Protection Program.

Hookah Survey

The 44-question written survey included questions about tobacco use including cigarettes, smokeless tobacco, and hookah. All subjects were also asked questions about hookah lounges and relative harm perception of various tobacco products. Specific questions were asked of hookah ever-users to evaluate each user's hookah-use profile, including initiation/cessation factors and patterns of current hookah use. Demographic data were collected for all subjects.

Three aspects of hookah use are presented in this study. Ever-hookah use was determined by asking the subjects *'Have you ever smoked tobacco from a waterpipe or hookah (even one or two puffs)?'* (YES/NO). Hookah smoking in the previous month was determined from the group of hookah ever-users with the question *'Approximately how many times have you smoked tobacco from a hookah in the previous month?'* (once or more vs. none). Ever-use and use within the previous month are common measures used by other studies. Ever-use is also used to compare hookah users to non-users. To investigate factors potentially associated with hookah cessation, hookah users who have quit are compared to those who have not quit. Therefore, a definition of current and former hookah use was developed with the question *'If you no longer smoke hookah, please tell me why.'* (1, *I did not like it*; 2, *Health reasons, hookah is bad for me*; 3, *I started smoking cigarettes instead*; 4, *I started using a different tobacco product*; 5, *Other*; 6, *I*

still smoke hookah). Using response #6 to this question, we developed a definitive group of subjects who state that they are current hookah smokers.

Statistical Analyses

Responses for all relevant questions are given for the entire population and for hookah users (see tables 1, 2, 3 for specific survey items). Using chi-square analyses, hookah users were compared to non-users with regard to demographic factors, cigarette use, hookah lounge questions, and risk perception questions. Finally, current users were compared to users who have quit using age-adjusted logistic regression. An $\alpha=0.05$ level of significance was used in all chi-square and regression analyses. All statistics were done using SAS (version 9) statistical package.

RESULTS

For the total population, Table 4.1 shows demographic factors and responses to various questions intended for all subjects, including tobacco use. The average age of study subjects was 17.1 years and the majority of subjects were high school seniors and either Hispanic or non-Hispanic white. Risk perception and socially acceptability are only reported for those who have heard of hookah. A total of 37.7% of subjects ever smoked cigarettes while 26.1% ever smoked hookah. A comparable percent of students smoked hookah (10.9%) or cigarettes (11%) in the previous month, while only 1% used smokeless tobacco in the previous month. A large proportion of students

learned about hookah from friends (50.3%) or saw a hookah lounge (20.9%). Furthermore, hookah lounges were present in the neighborhoods of 26.3% of the students. Many students believe hookah is more socially acceptable (59.5%) and safer (46.3%) than cigarettes.

Subjects were asked to rank 4 tobacco products (chewing tobacco or dip, cigarettes, cigars, and hookah) in order of relative harmful health risks, assigning a score of “1” to the item they believed to be most harmful and a score of “4” to the least harmful. Figure 4.1 shows the average rank of each of the tobacco products with 95% confidence intervals. On average, high school students in this study believe cigarettes to be significantly more harmful than the other three tobacco products. They believed that cigars and smokeless tobacco were about the same (less harmful than cigarettes and more harmful than hookah), and they believed hookah to be the least harmful tobacco product.

Table 4.2 shows a comparison of hookah ever-users to non-users with regard to demographic factors, risk perception, and other factors. Although hookah users were significantly older than non-users, the average age of both groups was 17 and the narrow range of ages included in this study does not allow for a useful hookah-age association. Hookah users were similar to non-users with respect to gender and ethnicity. Ever-users were more likely than non-users to have smoked cigarettes, visited a hookah lounge, and know that there is a hookah lounge in the community of their home or school.

Additionally, hookah users were more likely to think that hookah is more socially acceptable and is safer or less addictive than cigarettes.

Table 4.1. Frequencies of Demographics and Item Responses for the Total Population (n=689), San Diego County High School Students, 2010.

Mean Age (sd)	17.1 (0.68)
	<u>Frequency</u>
Gender	
Male	350 (50.9%)
Female	337 (49.1%)
Grade	
Junior	187 (27.2%)
Senior	500 (72.8%)
Ethnicity	
Hispanic	230 (33.5%)
Non-Hispanic white	297 (43.2%)
African American	81 (11.8%)
Asian/Pacific Islander	59 (8.6%)
Other	20 (2.9%)
<i>Have you ever smoked a cigarette, even a single puff? (yes)</i>	260 (37.7%)
<i>Have you smoked any cigarettes during the last 30 days? (yes)</i>	76 (11.0%)
<i>Have you ever used chewing tobacco or dip? (yes)</i>	33 (4.8%)
<i>Have you used chewing tobacco or dip in the last 30 days? (yes)</i>	7 (1.0%)
<i>Have you ever heard of a tobacco-smoking device called a hookah or waterpipe? (yes)</i>	574 (83.3%)
<i>Please tell me how you first learned of hookah*[@]</i>	
Friend	289 (50.3%)
Saw a Hookah Lounge	120 (20.9%)
Brother or Sister	53 (9.2%)
Media (Movie, TV, Internet, etc.)	51 (8.9%)
Another Relative	49 (8.5%)
News	35 (6.1%)
Parent	29 (5.1%)
Other	12 (2.1%)
<i>Have you ever smoked tobacco from a waterpipe or hookah (even one or two puffs)? (yes)</i>	180 (26.1%)
<i>Have you smoked tobacco from a waterpipe or hookah in the last 6 months?</i>	125 (18.2%)
<i>Approximately how many times have you smoked tobacco from a hookah in the previous month? (>0)</i>	75 (10.9%)
Self-stated Current Hookah Smokers [†]	71 (10.3%)
<i>Have you ever been to a tobacco-smoking establishment known as a "hookah lounge", even if you did not smoke tobacco?</i>	107 (15.5%)
<i>Is there a 'hookah lounge' in the community where you live? (Yes)</i>	170 (24.7%)
<i>Is there a 'hookah lounge' in the community where you go to school? (Yes)</i>	82 (11.9%)
Presence of hookah lounge in community of residence OR school. (Yes)	181 (26.3%)
<i>Do you think hookah is more socially acceptable than cigarettes? (Yes)*</i>	340 (59.5%)
<i>Do you think hookah is safer or less addictive than cigarettes? (Yes)*</i>	263 (46.3%)

Table 4.1 Continued

	Frequency
If YES (hookah is safer), please tell me why. (Fill in blank)**@	
No nicotine, less nicotine, not as addictive	87 (33.1%)
Safer, less chemicals, cleaner	66 (25.1%)
Cigarettes easier to get, more convenient, use more often	33 (12.5%)
It just seems like it, I was told that, I don't know	25 (9.5%)
Water filters smoke, smoke is more filtered	16 (6.1%)
The tobacco/smoke is flavored	12 (4.6%)
Hookah is more socially acceptable	8 (3.0%)
Inhaling steam, water vapor, smoking air	7 (2.7%)
Other	20 (7.6%)

* Out of 574 subjects who have heard of hookah

† Responded 'I still smoke hookah' when asked 'If you no longer smoke hookah, please tell me why.'

@ Multiple responses allowed by each subject

** Out of 263 subjects who believed hookah is safer or less addictive than cigarettes

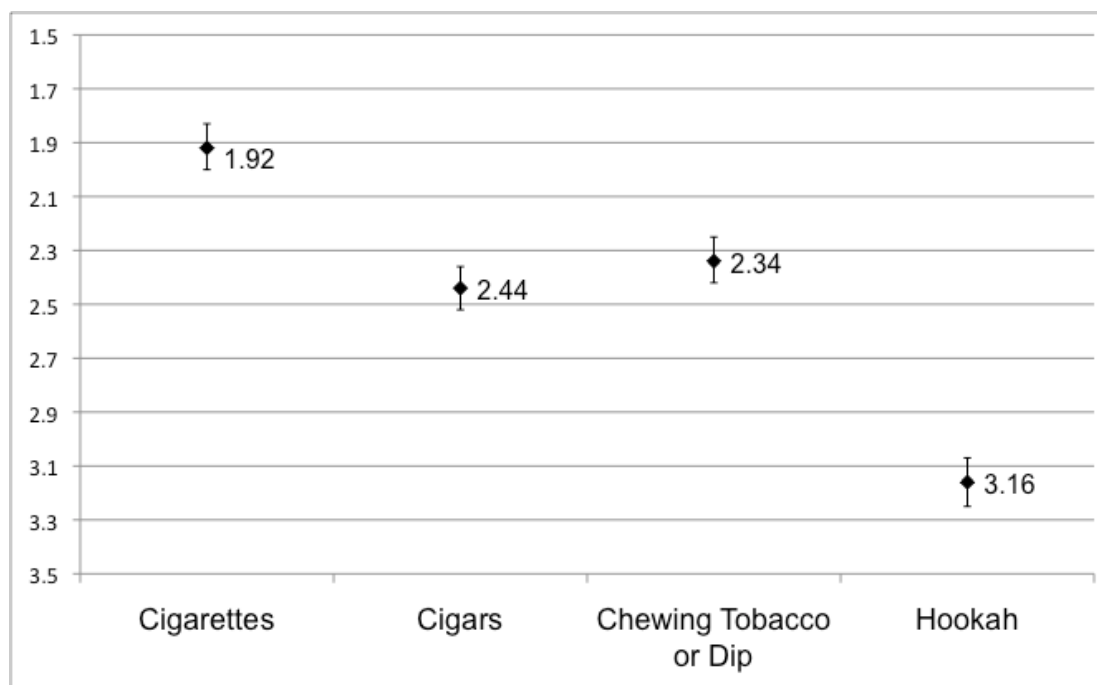


Figure 4.1. Average Rank and 95% Confidence Limits of the Perceived Relative Health Risks for Various Tobacco Products by San Diego County High School Students, 2010 (n=574) (1 = Most Harmful; 4 = Least Harmful)

Hookah users were asked a series of questions in order to develop a profile of initiation, patterns of use, and cessation (Table 4.3). The average age of initial hookah smoking was 15.8 years and hookah smokers shared a hookah pipe with an average of 5.2 people and had smoking sessions that

averaged 47.5 minutes. The majority of hookah smokers reported that they have only smoked hookah a few times in their life or fewer and a large majority reported that they share the same mouthpiece with others at least some of the time.

Table 4.2. Comparison of Hookah Ever-Users to Non-Users with Respect to Various Factors in San Diego County High School Students (n=688) 2010.

	Hookah Ever- Users (n=180)	Hookah Non- Users (n=508)	P- Value
Age (s.d.)	17.06 (17.00 – 17.12)	17.31 (17.22 – 17.39)	<0.001
Gender			
Male	91 (50.1)	259 (51.2)	0.88
Female	89 (49.4)	247 (48.8)	
Grade			
Juniors	23 (12.8)	164 (32.4)	<0.001
Seniors	157 (87.2)	342 (67.6)	
Ethnicity			
Hispanic	63 (35.0)	167 (33.0)	0.13
Non-Hispanic white	83 (46.1)	213 (42.1)	
African American	14 (7.8)	67 (13.2)	
Asian/Pacific Islander	12 (6.7)	47 (9.3)	
Other	8 (4.4)	12 (2.4)	
Smoked Cigarette - Ever	136 (75.6)	123 (24.2)	<0.001
Smoked Cigarette last 30 Days	55 (30.6)	21 (4.1)	<0.001
Ever Been to a Hookah Lounge	77 (42.8)	30 (5.9)	<0.001
<i>Is there a 'hookah lounge' in the community where you live? (Yes)</i>	96 (53.3)	74 (14.6)	<0.001
<i>Is there a 'hookah lounge' in the community where you go to school? (Yes)</i>	51 (28.5)	31 (6.1)	<0.001
Presence of hookah lounge in community of residence OR school. (Yes)	99 (55.3)	82 (16.1)	<0.001
<i>Do you think hookah is more socially acceptable than cigarettes? (Yes)*</i>	156 (87.6)	183 (46.7)	<0.001
<i>Do you think hookah is safer or less addictive than cigarettes? (Yes)*</i>	140 (78.2)	123 (31.6)	<0.001

* Out of 574 subjects who have heard of hookah

Table 4.3. Means and Frequencies for Responses to Questions Asked of Hookah Ever-Users (n=180), San Diego County High School Students, 2010.

<u>Question</u>	<u>Average (sd)</u>	<u>Range or Percent</u>
<i>How old were you when you first smoked tobacco from a hookah?</i>	15.8 (1.34) years	8 – 18 years
<i>When you have smoked a waterpipe in the past, on average, how many people were smoking from the same waterpipe?</i>	5.2 (3.25) people	1 – 32 people
<i>Approximately how many times have you smoked tobacco from a hookah in the previous month?</i>		
All Hookah Users	1.1 (2.69) times	0 – 26 times
Hookah Use in previous month	2.7 (3.61) times	1 – 26 times
<i>When you smoke waterpipe tobacco, how long does the smoking session usually last? (minutes)</i>	47.5 (37.54) minutes	10 – 205 minutes
<i>On average, how often do you smoke tobacco from a waterpipe or hookah?</i>		
I have only smoked once in my life		21.1%
I have only smoked a few times in my life		45.7%
I smoke less than once a month		15.4%
I smoke at least once a month but not every week		13.1%
I smoke at least once a week but not everyday		4.0%
Everyday or almost everyday		0.6%
<i>Think about when you have used a hookah in the past. Do you share the same mouthpiece with others?</i>		
Never		14.9%
Some of the time		23.4%
Most of the time		19.4%
All the time		42.3%
<i>How confident are you that you can quit hookah smoking anytime you want?</i>		
Very confident		93.1%
Confident		5.1%
Somewhat confident		0.6%
Not very confident		0.6%
Not at all confident		0.6%
<i>Do you intend to quit smoking hookah?</i>		
In the next month		5.2%
In the next 6 months		0.6%
Sometime in the more distant future		20.1%
No, I do not plan to quit		29.3%
I have already quit smoking hookah		44.8%

Table 4.3 Continued

<u>Question</u>	<u>Percent</u>
<i>Where do you usually smoke hookah?*</i>	
At home	9.14%
At a friend's house	81.1%
At a hookah lounge	25.7%
Other	5.14%
<i>When you smoke hookah, where do you most often get the tobacco?*</i>	
I buy it myself at a hookah lounge	16.0%
I buy it myself from another store	10.3%
I get it from a family member	4.0%
I get it from a friend	72.0%
I get it from the Internet	0.6%
Other	7.4%
<i>How were you first introduced to hookah?*</i>	
From a friend	84.0%
From a brother or sister	12.0%
From a parent	1.1%
From another relative	8.0%
Other	2.9%
<i>If you no longer smoke hookah, please tell me why.*</i>	
I did not like it	21.6%
Health reasons, hookah is bad for me	12.9%
I started smoking cigarettes instead	4.1%
I started using a different tobacco product	1.8%
Not exposed to it	17.0%
Other	7.6%
I still smoke hookah	42.1%

* Multiple responses allowed

Using the last question from Table 4.3, current hookah smokers were defined as those who stated “I still smoke hookah” and to assess age-adjusted odds ratios for correlates of use using logistic regression analyses, they were compared to hookah users who have quit (all other responses). Compared to those who have quit, current hookah smokers were more likely to have smoked a cigarette in the past 30 days (OR 3.06; 95%CI 1.54 – 6.11), to know of a hookah lounge in the community in which they live (OR 2.07; 95%CI 1.09 – 3.91), to share a mouthpiece with other hookah smokers (OR 7.33; 95%CI 2.10 – 25.65), and to believe hookah is more socially acceptable than

cigarettes (OR 4.59; 95%CI 1.27 – 16.57). Current hookah users were not significantly different than ever-users who have quit with regard to other variables from the survey.

DISCUSSION

Hookah use among this study population is the highest ever reported for high school students for all ethnic groups. Previous month hookah use is comparable to cigarette smoking, which is an indicator of the wide spread use among high school students. Weglicki found a higher hookah ever-use rate (38%) among only Arab American adolescents,⁴⁰ and non-Arab American use was 21.3% in that study. The use of hookah reported in the current study is also higher than that of some adult studies. The American College Health Association National College Health Assessment collects data from college students at more than 30 colleges and universities in the United States.⁴¹ Ever-use of hookah among these college students was 17.8%, which is 31.8% lower than the prevalence rate among high school students reported in the current study. Although another study²¹ of university students reported greater ever-use of hookah (40.5%), hookah use in the previous month was similar (9.5%) to that reported in this study. Unlike our study, self-reported current hookah use was not asked in other studies.

While ever-use of cigarettes is higher than hookah (37.7% vs. 26.1%), use of the two products in the previous month is the same (11.0% vs. 10.9%). Thus, 29.2% of cigarette experimenters and 41.7% of hookah experimenters

have used each product more recently. The fact that recent use of these two products is the same represents a noteworthy milestone as the vast majority of tobacco interventions and media campaigns have historically focused on cigarettes.

It has been reported that subjects believe hookah to be safer than cigarettes because the water in the pipe filters out harmful substances.^{4, 29, 42} In reality, this has been rarely investigated. While many studies ask '*if*' hookah is less harmful than cigarettes,^{3, 21, 36-38, 43} very few ask '*why*'.¹⁸ Results from this study indicate that the 'water-filter' myth is not the predominate explanation for hookah risk perception among high school students as only 6.1% of subjects who believed hookah to be safer than cigarettes gave this response. A third of subjects believed hookah to have less nicotine, no nicotine, or to be generally 'less addictive' than cigarettes. The fact that hookah delivers similar nicotine levels as cigarettes²³ should be emphasized in future interventions. The belief that cigarettes have more health risks than hookah is common.^{18, 21, 22, 38} However, subjects also ranked hookah as being safer than both cigars and smokeless tobacco. This finding, especially among high school students, has not been previously reported. An intervention on the specific dangers of hookah will be needed if this finding is confirmed by other studies.

There were no differences in hookah use by gender. Previous studies^{3, 35, 39, 40} found a strong gender association with males using hookah at higher rates. Only one other study²¹ reported no association between gender and

hookah use. The lack of a gender association may reflect hookah's increasing popularity among females in relation to males and other tobacco products. While not yet proven in the United States, international studies have shown that, for women, hookah is more socially acceptable than any other tobacco product.⁴⁴⁻⁴⁶ Also, a study in Syria found that hookah smoking by women was tolerated by family members more than hookah smoking by men.⁴⁷ While other studies have found hookah use to be more prevalent among whites,^{3, 21} the current study found no association between hookah use and ethnicity. The lack of a hookah-ethnicity association may be indicative of a high degree of ethnic integration among this study population. Not surprisingly, hookah users were more likely than non-users to have smoked a cigarette (both ever and in the last 30 days), as reported in other studies.^{3, 21, 40} Also, hookah users were more likely to think hookah is more socially acceptable than cigarettes and to believe that hookah is safer or less addictive than cigarettes. While these findings are supported in studies of college students,^{3, 21} we found no reports of such findings for high school aged subjects. In fact, the only other study of this age group found that most subjects (77%) believed hookah to be as harmful or more harmful than cigarettes.⁴⁰ However, that study was a comparison of Arab American adolescents to non-Arab American adolescents and did not compare hookah users to non-users.

Hookah users were significantly more likely than non-users to know of a hookah lounge in their community (both school and residence). While some hookah users probably know of the hookah lounge *because* they have

smoked hookah, 22.3% of hookah users reported that they first learned of hookah by seeing a hookah lounge. The presence of hookah lounges has most likely increased the use of hookah in this study population and the legality of hookah lounges and 'cigar bars' in California should therefore be addressed. Cigarettes are banned throughout California in all indoor places of employment. By completely banning one product for health reasons and allowing others, the message inadvertently being sent is that hookah and cigars are safer to use. The belief that legality endorses safety may be reasonable, especially among adolescents.³² This message is being sent, not just to Californians, but also to many Americans throughout the United States.³² Because the role of hookah lounges has not been previously reported, future studies of hookah use should incorporate this element.

In our study, hookah use among minors (under 18 years of age) was 23.3% (n=116). Also, 67 (13.5%) minors reported that they had been to a hookah lounge. These statistics represent illegal tobacco use and illegal visitation to hookah lounges by under-age adolescents. While most minors who have simply used tobacco are probably getting it from older friends, the fact that so many minors have been to hookah lounges should be addressed. While the existence of hookah lounges is of concern itself, the enforcement of laws restricting access to minors should be immediately addressed.

The average age of initiation (15.8 years) found in the current study is much younger than in previous reports,^{37, 38} although the current population is also much younger than in those studies. In comparison to older hookah

smokers from other studies, the high school aged users in this study use hookah less frequently and for shorter duration.^{37, 38} Additionally, the current population overwhelmingly lists 'friends' as both the source of hookah initiation and the current source of hookah tobacco.

Only 15% of hookah users reported that they *never* share a mouthpiece with other smokers. With 85% of users sharing a mouthpiece with an average of 5.2 people at each smoking session, the potential for the spread of infectious disease is substantial in this study population. Any hookah educational intervention aimed at adolescents and young adults should include information regarding the spread of infectious disease.

Almost half (42.1%) of hookah ever-users in the current population report that they still smoke hookah and the likelihood of nicotine addiction developing in these individuals is therefore considerable. Factors associated with continued hookah use (versus hookah cessation) are not surprising. We could not find other studies that assess hookah cessation and comparisons to our data were not possible. In the current study, the presence of hookah lounges in the community is once again associated with continued hookah use. This provides further support for the need to reassess the legality of these establishments.

To our knowledge, this is the first survey of high school students comparing hookah users to non-users on demographics, risk perception, and other risk behavior factors as well as examining patterns of initiation, use, and cessation in a population of hookah users. Two other studies^{39, 40} have

collected hookah prevalence rates for high school students but neither of those studies addressed the determinants of hookah use with similar detail of the current study. This study addresses exposure to hookah lounges and cessation factors (current vs. former users), factors previously unavailable for this age group. The participating high schools were very diverse with respect to ethnicity and geography and the participation rate for this study was 99.7%.

The cross sectional nature of the study prevents the assessment of temporality or causal inference. The study population was comprised of students from three high schools in San Diego County. Although these high schools are diverse, findings from this study may not be generalizable to other high school students. Also, the questionnaire was designed specifically for this study and has not been validated for hookah use, although most questions were taken from large well-known tobacco surveys and altered specifically for hookah.

Tobacco control efforts have traditionally focused on cigarettes and the results are encouraging. However, hookah use is undoubtedly on the rise in adolescents and young adults. This study suggests that hookah is taking hold in some high school aged students at a rate higher than previously suspected. The presence of hookah lounges and other factors have lead to the false belief of 'safer use' for too long. It is highly likely that some hookah smokers were first introduced to the behavior because of the presence of hookah lounges and it is even more likely that some hookah smokers have continued the behavior because of this hookah lounge presence. Therefore, the

existence of hookah lounges is most likely contributing directly to tobacco use and subsequent nicotine addiction. As a result, these establishments will contribute to the health care burden associated with lifetime tobacco use. We have identified several factors that must be incorporated into an intervention on hookah use aimed at high school aged students. We must reassess our tobacco control priorities in this age group and begin to seriously address the growing hookah epidemic.

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CHAPTER 5
DISCUSSION

The discussion of this dissertation will begin with a summary of the individual findings. Then, a comprehensive discussion of implications will be presented. After limitations and strengths are reviewed, specific recommendations for tobacco control and research will be offered.

Summary of Findings

Results from this dissertation indicate that use of some alternative tobacco products is increasing while use of other products is not decreasing similarly to cigarettes.¹ Smokeless tobacco, cigars, and hookah each represent a different set of trends and risk factors. Most notable, is the rapid increase of hookah use, especially among young adults. Information concerning harm reduction indicates that current smokers in California are not willing to replace their cigarettes potentially reduced-exposure products (PREPs) in a manner similar to other countries.

Smokeless Tobacco

Data from the 2008 California Tobacco Survey (CTS) and the separate high school study agree that smokeless tobacco use, especially in adolescents and young adults, is declining and does not represent a significant proportion of tobacco use. In 2008, only 2.0% of all adult males in California were current users of smokeless tobacco, and use of smokeless tobacco has significantly decreased in California males aged 18 – 24 since 1990. National surveys also show that smokeless tobacco use is on the decline.² Among high school

students in this dissertation, just 4.8% had ever used smokeless tobacco and 1.0% had used smokeless tobacco in the past 30 days. The CTS data suggest that smokeless tobacco users tend to be male, non-Hispanic white, and current cigarette smokers, in accord with national surveys.³

The declining use of smokeless tobacco observed in this dissertation reflects a trend consistent with the last 100 years. According to the National Cancer Institute (NCI), smokeless tobacco use represented approximately 40% of all tobacco use at the turn of the last century.⁴ Since then, smokeless tobacco has seen a steady decline in use.⁴ However, the low prevalence of smokeless tobacco use among adolescents and young adults observed in the CTS and the high school survey may be deceiving as these groups appear to be compensating with other tobacco products. Because the newer PREPs, such as snus, are smokeless products, the study of smokeless tobacco will shift from traditional products to include a more diverse catalog of newer products.

Cigars

While the use of cigars has not increased appreciably in recent years, the prevalence of current and ever-use remains at or near a 30-year high.⁵ In 2008, 7.8% of California adult males were current cigar smokers, representing the highest prevalence of current use in the 18-year history of the CTS. According to the Adult Tobacco Survey, the median current use of cigars among 19 participating states (California not included) from 2004 to 2007 was

6.4%.⁶ Thus, the use of cigars in California appears to be higher than in other parts of the United States. Although cigar use may not be increasing, it is also not decreasing in a manner similar to cigarette consumption. According to the CTS, current cigar smokers tend to be male, non-Hispanic white, young, and educated, a finding supported by other surveys.^{3, 7}

While cigar use receives less attention in public health research than other tobacco products, many users believe cigar smoking is safer than cigarettes.⁸⁻¹¹ If current trends continue, cigar use will most likely represent a larger proportion of tobacco use in the future.

Hookah

Use of hookah appears to be on the rise throughout the United States, especially in young people.¹²⁻¹⁶ From 2005 to 2008 ever-use of hookah among California Adults rose by 41.8% among males and 47.4% among females. Among young adults aged 18 – 24, hookah use is as common as any other non-cigarette tobacco product. Among high school students surveyed for this dissertation, ever-use of hookah was 26.1% and use within the previous month was 10.9%, a rate similar to cigarette use (11.0%). This is the first report of hookah use among high school students in California and trends cannot yet be evaluated. However, the fact that recent hookah use is equal to recent cigarette use represents a significant point of interest. The profile of adult hookah users in California is similar to cigar users in that they are young, male, educated, non-Hispanic white, and former or current

cigarette smokers, which coincides with other studies.^{17, 18} Previous studies have found gender differences for hookah use^{12, 15, 19, 20} so the results from the high school survey may be an anomaly. However, if the gender-gap is decreasing for hookah use, then hookah may becoming more socially acceptable among females, as reported by other international studies.²¹⁻²⁴

Comprehensive Implications

Cigarette use is declining in California.²⁵ Results from this dissertation indicate that the use of most other tobacco products is not declining and is increasing among select groups. While smokeless tobacco use is low, cigar use remains high among adult men and some data from this dissertation indicate that it may be increasing. Especially concerning is the use of hookah reported among young people. In the CTS, hookah use was as common as any other non-cigarette tobacco product, and among high school students, recent hookah use was as common as recent cigarette use. These findings suggest that hookah may become the most popular tobacco product among young people, even surpassing cigarettes, in the near future. The most important aspect of hookah use among young people is risk perception. As a social behavior, hookah use most likely occurs on weekends and at irregular intervals among young people, although this has not been studied sufficiently. This intermittent use of the product may lead such users into a belief that they are not candidates for addiction. To date, there are no studies on the addictiveness of hookah with regard to weekly patterns of use. The belief that

hookah is less harmful than cigarettes is common. However, among high school students in this study, the novel finding that they also believe hookah to be significantly less harmful than cigars and smokeless tobacco is concerning. Identifying the foundation of this belief is highly important, as it may be an important causal factor related to increasing hookah use.

Interest and use of smokeless PREPs was extremely low among California adult smokers. However, results from initial test markets of snus in Indiana indicate that interest in this product increased significantly in response to an aggressive marketing campaign by Camel.²⁶ This traditional cigarette maker has subsequently expanded their marketing of snus to a national level, and the PREP use data from the CTS reported in this dissertation was collected before this national marketing campaign began. Therefore, it is reasonable to expect a heightened level of awareness and use of snus in forthcoming surveys. While not statistically significant, there was a general trend for increased interest in cigarette replacement in both of the hypothetical scenarios. If this tendency for increased receptivity is accurate, the audience for a national snus marketing campaign may be growing, and the use of snus will likely increase in the near future. While this would represent a success for Camel and other snus makers, it would also offer an opportunity for tobacco researchers to study the effects of snus use in the United States. Until the use of snus reaches a sufficient prevalence, it will be difficult to study snus risk factors on the population level and it will be impractical to make definitive recommendations regarding harm reduction.

Limitations and Strengths

The CTS represents a California population and the high school study was conducted at three high schools in San Diego County. Care must be taken in generalizing to other populations. The CTS and the high school study are both cross sectional studies and causal inference cannot be established. Although individual change cannot be estimated, population parameters are subject to comparison between time intervals in the CTS. Limitations of the CTS are similar to other large surveys that use random-digit-dialing. Only those households with landline home phone numbers were eligible for random selection. Those households relying solely on cell phones were not accessible as part of the target population and therefore not eligible for this study, and such households may be different than households with landlines. In comparison to respondents that do not have a cell phone in addition to their landline, those that also had cell phones in addition to landlines in the CTS were more likely to be young and educated and less likely to be Hispanic compared to other ethnicities. Alternative tobacco use was not affected by having a cell phone in addition to a landline after controlling for age, education, and ethnicity. Because the CTS is an extensive survey covering many aspects of cigarette and tobacco use, the number of questions on alternative tobacco use, harm reduction, and PREP use was limited in scope. Similar to other large telephone-based surveys, response rates for the CTS have recently declined. While the response rate for the 2008 CTS was low

(24.4%), comparisons of previous CTS smoking data with the Current Population Survey Tobacco Use Supplement (CPS-TUS), a survey with a significantly higher response rate (>75%), have shown that the declining response rates of the CTS most likely do not result in inaccurate smoking estimates.²⁷ However, it is unknown how the low response rate affects smoking and alternative tobacco estimates in the current survey. The questionnaire for the high school study was designed specifically for this dissertation and has not been validated. However, many questions were taken from larger established surveys, and altered specifically for hookah.

The CTS is the largest representative sample of randomly selected California adults designed for the purpose of collecting tobacco use data. The statistical weighting helps generalize results to the entire population of California adults. Because hookah use was collected in the previous (2005) CTS, a three-year difference in hookah use prevalence from similar source populations can be estimated. Most other studies of hookah use have employed convenience sampling^{7, 17, 18, 28} (in hookah lounges) or smaller-scale prevalence sampling^{12, 13, 15, 16} (colleges and universities). Additionally, the CTS collects information on hypothetical PREP susceptibility and actual PREP use, a combination rarely available, allowing for the examination of the association between potential and actual use of PERP products.

The high school portion of this dissertation is the first survey of high school students comparing hookah users to non-users with respect to demographic, risk perception, and other risk behavior factors. It is also the

first study of high school age youth to define patterns of initiation, use, and cessation in a population of hookah users. This is the first hookah study in which subjects were asked about exposure to hookah lounges in the communities where they live or attend school. Additionally, this is the first study to analyze factors associated with current hookah smoking in comparison to those who have quit. The participating high schools were diverse with respect to ethnic, geographic, and socioeconomic factors and the participation rate for this study was 99.7%.

Recommendations for the Future of Tobacco Control

Further research into the increasing use of hookah, especially among adolescents and young adults, is needed. More definitive prevalence rates and risk factors should be established for different populations throughout the United States. There are various factors of hookah use that should be studied among young people, including patterns of weekly use, patterns of hookah lounge visitation, total tobacco consumption, the specific contents of hookah lounge tobacco, and the increasing use of hookah among women. In this dissertation, recent hookah use was equal to recent cigarette use among high school aged subjects. If this finding is confirmed by other studies, then a reassessment of tobacco control resources is suggested. In addition to continued cigarette education, adolescents and young adults should be targeted for an educational intervention on the unique dangers of hookah use.

'Cigar bars' and 'hookah lounges' should be banned in California and other states in accordance with most indoor smoking bans. Permitting special exemptions to such bans supports the supposition that hookah and cigars may be a safer and more acceptable form of tobacco use. Hookah lounges and cigar bars operate in California and most other states because they are classified as a retail tobacco shop, deriving a majority of their business from tobacco sales.²⁹ In other states and cities, loopholes exist because hookah has not yet been clearly defined as a tobacco product.³⁰ Achieving this recommendation will require dedicated dissemination of the data contained in this dissertation as well as new studies with various methodologies examining relevant aspects of hookah use. Although Chapters 2, 3, and 4 have been submitted to research journals for publication, direct dissemination of the findings to the population will also be required. The three participating high schools will each receive detailed, school-specific reports of hookah use in this study population. It will also be recommended to the high school administrators that these findings are presented to students, teachers, and parents at meetings of relevant school associations. Additional levels of support can be recruited through dissemination to governing bodies including school boards, city counsels, and the San Diego Board of Supervisors. To achieve a change in law (illegalization of hookah lounges), local representatives to the California State Assembly and California State Senate are targets for eventual dissemination.

Cigar use is not decreasing similarly to cigarette smoking and may be increasing among some groups. Large national and state tobacco surveys should include data collection for cigar use and its correlates. Also, the public health community should standardize a definition for current use of cigars to facilitate the comparison of rates across studies. The following is a suggested definition for current cigar use.

A current cigar smoker is one who states that he or she now smokes cigars 'some days' or 'every day' when asked "Do you now smoke cigars some days, every day, or not at all?"

This suggested definition of current cigar use removes the component of total lifetime cigars smoked that some surveys include. Removing the total-cigars-smoked component allows for newer (younger) cigar smokers to be included in the definition. It also eliminates the potential for recall bias, as some people may not remember how many cigars they have smoked in their lifetime. Additional research is needed on the patterns of hookah use before a standard definition of current use can be suggested.

In lieu of hypothetically arguing the merits of harm reduction,³¹⁻⁴³ a variety of studies should be employed from the perspective of different disciplines. The use of PREPs should eventually be measured in a prospective study, following subjects for tobacco-related health outcomes. Until the benefits of PREPs can clearly and statistically be shown to outweigh the potential risks, harm reduction products should not be recommended as a safer alternative to cigarettes.

As cigarette laws become more comprehensive and cigarette use continues to decrease, tobacco companies will most likely modify their marketing and production strategies to include products that have not yet received the negative international notoriety of cigarettes. If the tobacco research community and related policy makers fail to anticipate the direction of this change, then we can expect the use of hookah, cigars, and various new smokeless products to increase over the coming years. While continuing to target cigarette reduction, we must broaden our goals to encompass the growing use of alternative tobacco products.

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