

## The latest on Hookahs:

### What You Don't Know Can Kill You

*By Kamlesh Asotra, Ph.D.*

*Reprinted courtesy of the Tobacco-Related Disease Research Program: Tobacco-Related Disease Research Program Newsletter: Burning Issues:*

*Tobacco's Hottest Topics  
Volume 7, Number 3, August 2005*

<http://www.trdrp.org/Newsletters.asp>

**“Harmful hookahs lure a young crowd”**—announces the headline of a recent Contra Costa Times article. According to the article, public health professionals in California are very concerned about hookah smoking among our youth.<sup>1</sup> Researchers across the globe have echoed similar concerns. A growing number of college students and others in the United States who have tried or now regularly participate in hookah smoking claim that they do not smoke cigarettes or use tobacco. Most of these individuals believe that hookah smoke is neither addictive nor as harmful as cigarette or cigar smoke. This sense of false security may be perpetuated by the myth that the hookah smoke, after bubbling through water, becomes devoid of the harmful elements that are present in cigarette smoke.

Among more than 1 billion smokers worldwide, 100 million people in Africa, Asia, and the Middle East use water pipe or hookah to smoke tobacco. Water pipe is variously known in different regions as hookah (Indian subcontinent and Africa), shisha, borry, goza (Egypt, Saudi Arabia), narghile, argihle (Jordan, Lebanon, Syria, and Israel), shui yan dai (China), or hubble-bubble. It's believed to have originated in India in the 16th century and found its way to Persia (Iran), Turkey, and the Eastern Mediterranean. In the last 25 years, hookah smoking has become increasingly popular in Arab societies, Europe, and the United States due mainly to the cultural and social practices of new immigrants from countries where hookah smoking is an accepted tradition. Recently, hookah bars have mushroomed across California and in several other states with sizable Arab-American populations. More than 300 hookah bars are operating in the United States, with at least 50 in California. Many are located near colleges, universities, and shopping malls and are frequented by college students and locals. The bars offer an “exotic ambience” where customers can smoke a variety of fruit flavors and aromas in smoking sessions that last 45 to 60 minutes, for the cost of about \$15.

Is hookah smoke really so innocuous? This article describes hookah smoke chemistry and highlights facts related to hookah smoking and diseases that deserve attention and further scientific research.

## Hookah tobacco combustion—“cool” burning

Hookah or water pipe is made of a clay bowl, body, water reservoir, and a stem or hose for inhalation of tobacco smoke. Hookah tobacco—mu’essel or maassel (assal means honey in Arabic)—is a moist, pastelike mixture of about 30% crude, cut tobacco, fermented with approximately 70% honey, molasses, and pulp of different fruits to create the fruity flavor and aroma of the smoke when subjected to slow combustion with burning charcoal. The combustion processes that produce cigarette smoke and hookah smoke are very different. Mainstream cigarette smoke is produced at 900°C. Hookah smoke is produced at nearly half that temperature at 450°C. Hookah smoke bubbles through water at the base reservoir.

During a smoking session, more glowing charcoal is added to the partially consumed hookah tobacco once the original charcoal in the bowl is used up. As the hookah smoking session progresses, the reservoir water becomes increasingly brown in color on account of “tar,” dissolved chemicals, and other particulates in the hookah tobacco aerosol. The chemical waste-laden water is discarded and the hookah reservoir is then replenished with fresh water for the next smoking session.

## What is in hookah smoke?

During the last 40 years of research, nearly 4,800 chemical compounds have been identified in cigarette smoke, including 69 carcinogens. In contrast, only five studies have been published in English on the chemical composition of hookah smoke, and those focused on only a relatively small number of chemical compounds. Combustion chemistries involved in the production of mainstream cigarette smoke and mainstream hookah smoke differ due to widely different combustion temperatures and the dry or humid characteristics of tobacco. In both cases, plant-derived organic matter undergoes pyrolysis or volatilization, producing addictive nicotine as well as a number of the same toxicants from combustion. These include carbon monoxide (CO), “tar,” and myriad carcinogenic polycyclic aromatic hydrocarbons (PAH). Also, hookah smoke contains significantly higher quantities of toxic heavy metals like arsenic, nickel, cobalt, chromium, lead, and cadmium, as compared with cigarette smoke. These facts about hookah smoke are a “screaming warning” that hookah smoking is harmful. In a carefully designed recent study, researchers Shihadeh and Saleh used a smoking machine that replicated the puffing mechanics derived from precise measurements of 52 hookah smokers in Lebanon. Shihadeh and Saleh carried out stringently controlled quantitative chemical analyses of hookah smoke. They found that hookah smoke produced nearly two orders of magnitude greater amount of “tar” from a single smoking session than that produced from a single cigarette. Simply put, hookah smoke produces nearly 100 times more “tar” than cigarette smoke, for each gram of the respective tobaccos. **Table A** shows that hookah smoke contains several-fold greater quantities of harmful chemicals thus far studied than found in cigarette smoke.

**Table A**  
**Chemicals found in hookah smoke *versus* cigarette smoke.**  
*Adapted from Shibadeh and Saleh<sup>11</sup>*

Chemical	Yield from 1 gm hookah tobacco	Yield from cigarette smoke, 1 gm tobacco	Multiple of average cigarette smoke value
“Tar,” mg	802	Range: 1–27 Average: 11.2	100-fold
Nicotine, mg	2.96	Range: 0.1–2 Average: 0.77	4-fold
Carbon monoxide CO, mg	143	Range: 1–22 Average: 12.6	11-fold
PAH			
Phenanthrene, µg (co-carcinogen)	0.748	0.2 – 0.4	2.5-fold
Fluranthracene, µg (co-carcinogen)	0.221	0.009 – 0.099	4-fold
Chrysene, µg (tumor initiator)	0.112	0.004 – 0.041	5-fold

In light of these recent chemical data on selected constituents of hookah smoke as compared with those of mainstream cigarette smoke, hookah smoke of various fruity flavors, tastes, and aromas may be even more harmful than disease-causing cigarette tobacco smoke.

### **Who says hookah smoking isn’t addictive?**

Hookah smoking is an efficient nicotine delivery system. After a 45- minute hookah smoking session, the concentrations of nicotine and its longer-lived metabolic product, cotinine, become significantly elevated in saliva, plasma, and urine. Comparison of

urinary levels of cotinine between hookah smokers and cigarette smokers suggests that in a single hookah smoking session using 20 grams of hookah tobacco, the hookah smoker is exposed to several-fold greater quantities of the addictive stimulant nicotine for up to 45 to 60 minutes. That is equivalent to chain-smoking 15 cigarettes. A cross sectional study on hookah smokers from 112 restaurants and cafes in Aleppo, Syria, reported that 96% of weekly hookah smokers and 50% of daily hookah smokers did not smoke cigarettes. This survey found that 91% of weekly hookah smokers and 51% of daily hookah smokers did not have the will to quit, which highlights the addictive nature of hookah smoking among myriad factors.

### **Carbon monoxide in hookah smoke: Effects on lungs, heart, and brain**

Hookah smokers are exposed to three-fold greater amounts of CO—an odorless gas—than are cigarette smokers. Based on their chemical analysis, Shihadeh and Saleh provide strong evidence that the CO:nicotine ratio in hookah smoke is 50:1, and that for cigarette smoke is 16:1. One of the reasons for the greater CO concentrations in Hookah smoke is the charcoal that is added to enhance the burning of the moist tobacco concoction. Hemoglobin, the iron-containing protein in blood that transports oxygen from lungs to all parts of the body in vertebrates, has extremely high affinity for CO, and forms carboxyhemoglobin (COHb), which can no longer serve as either the oxygen acceptor or as the oxygen carrier. Hookah smokers have significantly higher levels of COHb in their blood than heavy cigarette smokers who smoke 15 to 40 cigarettes.

Because the duration of a single puff of hookah smoke is double that of a cigarette, and the suction pressure for inhalation of hookah smoke is four times that for a cigarette, the hookah smoke reaches deeper into lung tissue. Consequently, hookah smoking may cause greater ventilatory incapacitation, especially in older individuals, than cigarette smoking causes. Since smoking rates among 18- to 24-year-olds are the highest of any age group in California, the recent trend of hookah smoking among youth, unless checked, may exacerbate the future incidence of chronic obstructive pulmonary disease. Blood pressure (systolic, diastolic, and mean), expired CO, and heart rate all increase upon hookah smoking. Heart and brain have extremely critical requirements for a minimal threshold of oxygen. Episodes of sudden and short periods of oxygen deprivation can result in heart attack or brain stroke. Chronic exposure to nicotine also has a direct effect on the heart, causing atrial flutter. This exposure leaves hookah smokers vulnerable to this debilitating condition.

### **How hookah smoke may affect fertility, virility and babies**

It is becoming increasingly clear that, like tobacco smoking, mainstream hookah smoke and second-hand hookah smoke cause deleterious effects on reproductive systems in men and women and produce genotoxic, mutagenic, and teratogenic effects on babies of smoking parents. These effects include infertility in females and sterility of males, and low birth weight and birth defects in babies born to smoking

mothers. A recent study of 100 Egyptian infertile women determined that the couples' infertility was due to sterility of husbands who were hookah smokers. High concentration of CO is a major component of second-hand smoke from hookah. The contribution from burning charcoal in hookah may also have significant and deleterious effects on young babies that may be exposed to mild CO levels. Even at very low levels, such as 25 to 50 parts per million parts of air, CO can produce permanent damage to the inner ear in young babies and irreversible loss of hearing.

### **TRDRP research on hookah smoking**

TRDRP is at the forefront of recognizing and supporting innovative and novel ideas in a proactive manner. Keeping with its mandate, TRDRP funds innovative and high-quality biomedical, policy, and prevention research in California. This research aims to mitigate the suffering and economic burden due to myriad diseases caused by tobacco products.

This year, as over the past 15 years, TRDRP has once again distinguished itself among all federal and public funding agencies in leading the charge against tobacco by awarding the first ever research grant on hookah smoke. TRDRP has made a three-year new investigator grant award to Nada Kassem, Dr.P.H., M.S., R.N., C.H.E.S., to study "Water Pipe Use, ETS Exposure and Home Policies among Arab Americans." Dr. Kassem is currently a faculty research investigator at the Center for Behavioral Epidemiology and Community Health, Graduate School of Public Health, San Diego State University. This is the first tobacco related research grant awarded to Dr. Kassem.

TRDRP invites research grant applications from California scientists on all aspects of hookah smoke for various funding mechanisms.

*Dedicated to the fond memory of Surender S. Katoch, B.Sc., M.Sc.,M.Phil., Ph.D.—a dear friend and scientific collaborator—who dedicated his life to mitigating cardiovascular disease, and suddenly died on May 14, 2005 due to a massive heart attack. Dr. Katoch was Professor and Chairman, Department of Bio-Sciences, Himachal Pradesh University, Shimla, India. Surender will be sorely missed by family members and numerous friends all over the world.*