



REVIEW

Hookah, is it really harmless?



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Summary

The hookah is a snuff smoking device whose origin dates back to the fifteenth century, has been used extensively in the Middle East in recent decades has become popular in Western culture countries, particularly in Americas and Europe. It has been reported that like other forms smoking tobacco, their use can lead to addiction also is used for inhaling and other addictive substances. Has also been considered a risk factor for various isolated diseases, including chronic obstructive pulmonary disease (COPD), different types of cancer, hemodynamic alterations, vascular disease, infectious diseases, among others. In pregnant women has been reported that there use condition a diminution on fetal growth and different diseases in the newborn. It was also mentioned that hookah smoke contains several toxic substances that can affect both, the primary and the passive smoker, so we did this review to determine the complications associated with its use.

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Introduction

The hookah (also known as shisha, huqqa, argile, hookah, hubble, bubble, gozza, water pipe or boori) is a snuff smoking device created in the Indo-Pakistan subcontinent in the XV century [1] (Fig. 1). Its use represents a tradition that seeks to community interaction, although it was considered a pleasure for Rajas (Hindus rulers) [2]. In the XVI century its use spread to the Ottoman Empire, followed by Egypt and other regions of Mediterranean [1].

The hookah has been widely used in the Middle East, in recent decades, its use has gradually increased in young people lives in countries with Western culture, particularly in Americas and Europe [1,3], it is estimated that 100 million people around the world smoke hookah every day [4].

Recent publications show that unlike cigarette, the hookah is more socially accepted and for that reason fewer awareness campaigns with the objective to informs the public about the addictive and harmful to health exist [4,5], which is because the hookah use among young people, mainly women, has increased substantially in recent years. Furthermore it has been seen that users hookah tend to became cigarette smokers [5–8].

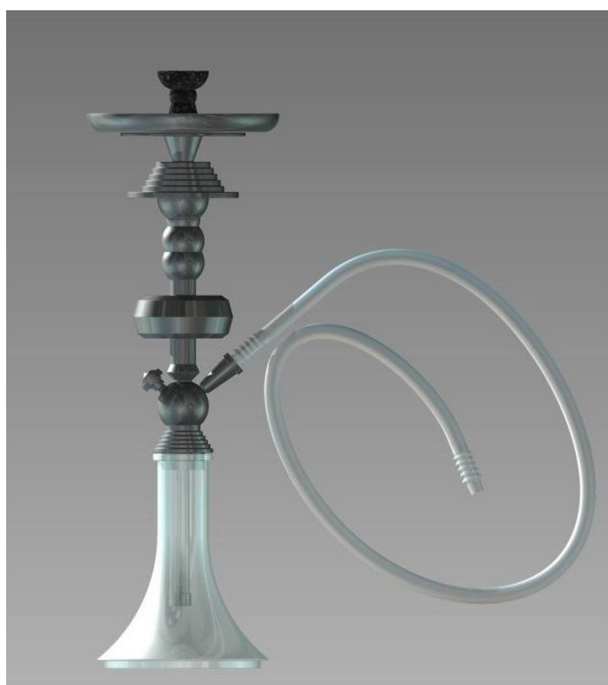


Figure 1 Graphical representation of the hookah.

The World Health Organization has reported that hookah smoke inhaled per puff is 0.15–1 lt and average hookah session lasts 20–80 min, this is equivalent of smoking 100 cigarettes or more [9]; currently there are sources available online that allow us to calculate this equivalence [10].

The aim of this review is to present the most important complications and associations of the use of hookah, from a critical and clinical perspective.

Addiction

Unlike the cigarette, the hookah has been less studied in relation to its addictive properties. Despite this, it is clear that individuals who use it are susceptible to suffer from addiction; this is due to the chemical properties of the smoke, duration and frequency of use, type of tobacco used and the volume of smoke inhaled.

Maziak published that hookah is an efficient tool that allows the user to dispose addictive and pathogenic substances contained in hookah smoke such as nicotine carbon monoxide [11], formaldehyde, acetaldehyde, acrolein among others [12,13]. Neergaard et al. published a meta-analysis which estimated that nicotine levels in the 24 h urine recollection in individuals who smoke hookah daily are 0.785 µg/ml (95% CI 0.578–0.991), the equivalent of 10 cigarettes (95% CI 7–13) [14] sufficient to develop an addiction [11].

Some teenagers start smoking hookah because it gives them a sense of belonging, maturity and autonomy, because this practice is usually performed as a group, today some groups use the hookah to use other addictive substances like marijuana or alcohol, when they replace the water or add this last one to the hookah container [15].

Smith-Simone showed that much of hookah smokers (HS) have the false belief that the use of it does not generate addiction, analyzing 100 HS from which 96% believe they have the ability to leave it when they decide but only 32% have tried [16]. Also, there is the mistaken belief that the use of the hookah is free of adverse health effects or have fewer adverse effects than cigarettes, this may contribute to the onset of smoking and lack of interest on leave; for this reason the clinical approach for the addiction of this group of patients should include an integral approach that considers the misperceptions of this practice [17–20].

Hookah and the lungs

It has been shown that there is a significant difference between HS and no hookah smokers ($p < 0.001$), in relation to the free radical levels in neutrophils fiend peripheral blood samples, being elevated in HS, this conditions a

damage to the lung parenchyma and cause airway inflammation [21,22].

Raad et al. through a meta-analysis, that analyze several studies that evaluated lung function in cigarette smokers, and HS and non-smokers, found that among cigarette smokers and HS there is not a significant difference in spirometric tests, unlike what was found between the HS and non-smokers, which found that there is a significant difference, where there was a decreased from 4.04% in FEV₁, 1.38% in FVC and the relationship FEV₁/FVC decreased in 3.08%, this suggests that hookah use is a risk factor for obstructive pattern [23]; This fact agrees with the other authors mentioned, which highlights Chaouachi who reported that the chronic use of hookah, with a frequency of one or more hookah sessions per day, can lead to COPD [13,21,24,25].

In a cross-sectional study, conducted by Mutairi et al. they reported that the frequency of chronic bronchitis is higher in HS (11.75%) than cigarette smokers (9.5%) [26]. This is consistent with work by Mohammad et al. which showed that chronic bronchitis is most prevalent in HS than in cigarette smokers ($p < 0.001$) [27].

Hookah and cancer

The hookah smoke can reach a temperature of 450 °C (842 °F) [21], and contains genotoxic and clastogenic components such as tar and polycyclic aromatic hydrocarbons, which contribute to the carcinogenesis process [21,28–30].

In a study conducted in Pakistan by Sajid et al. in which was measured the level of carcinoembryonic antigen (CEA) in 36 non-smokers male and 59 HS who had smoked at least eight years. They were divided into groups according to how long have been smoking, it concluded that there is an elevation of 5.11 (± 3.08 ng/ml) of the CEA in those who smoke 2–6 h per day, this ratio significantly relates to the group of non-smokers ($p < 0.0001$). This is of great relevance due the fact that the elevation of CEA is a marker of malignancy as well as chronic inflammation; it has been observed that CEA is elevated in pancreatic, uterus, breast and lung cancer [2].

Gupta et al. in a study conducted in India, conducted a survey of smokers and non-smokers with a history of lung cancer, found that the risk factor for the development of lung cancer in the HS is 1.94 (95% CI 0.85–4.44); also showed that the risk factor for lung cancer development increases with duration of use of hookah, being in the group who have smoked less than 24 years of 0.51 (95% CI 0.06–4.39), in the group of 35–44 years is 2.70 (95% CI 0.86–8.48) and in those who had smoked more than 45 years is 4.44 (95% CI 1.20–16.44) [31].

In another study, comparing 251 cases of lung cancer patients versus 500 controls, it was observed that 120 had a history of hookah smoking and in those patients the calculated risk was 5.83 (95% CI 3.95–8.60) for the development of lung cancer, $p < 0.0001$ [29]. Other authors have linked the use of hookah with bronchogenic carcinoma [21,32].

Khlifi et al. in a comparative study found that tissues from head and neck tumors (especially oral cancer), unlike

that found in healthy tissue, there is an increase in the amount of some heavy metals like arsenic, cadmium, chromium and nickel reported although the difference was not statistically significant ($p < 0.05$), the authors attribute the increased heavy metals in the diseased tissues to the substances found in smoke and the cigar and hookah [33]. Other authors have mentioned that chronic irritation and exposure to carcinogens caused by hookah smoke, also contributes to the development of mouth cancer, squamous cell type and keratoacanthoma [13,21,22], this information is consistent with the postulation of Rastam et al. [34].

With the intent of calculating the relationship between esophageal squamous cell carcinoma and the different habits in the subjects who suffer from this disease, Nasrollahzadeh et al. conducted a comparative study which found that the risk of the HS to develop esophageal cancer is 1.85 (95%CI 0.95–3.58) [35]. Is important to recognize that the authors mention the need for more studies, because they like others authors believe, that the hookah contributes to the development of esophageal cancer, this due to the different carcinogenic substances contained in the hookah smoke [35–37].

Hosseini et al. conducted a study in which 137 patients with the histopathological diagnosis of prostate cancer where compared with 137 healthy controls, of whom it was noted that only 8 patients and 2 controls had a history of being HS, prostate cancer risk factor of 7.0 (95%CI 0.9–56.9) was calculated, although the difference between the two groups was not statistically significant ($p < 0.069$) [38]. It is necessary to perform more studies to evaluate the correlation between different types of cancer and smoking hookah.

Cardiovascular effect of the hookah

Nicotine is a potent alkaloid, which pass thru the alveoli to the bloodstream and then crosses the blood brain barrier which stimulates nicotinic receptors in the central nervous system, it causes the release of catecholamines and consequent hemodynamic changes are generated including tachycardia, vasoconstriction, increased mean arterial pressure and turbulent blood flow [39]; this facts also can be awarded to endothelial dysfunction caused by nicotine, because this inhibits endothelial relaxation dependent of nitric oxide, observed in laboratory animals [40].

Blank et al. through a comparative double blind study conducted in 37 HS, showed that cardiovascular effects are mediated primarily by nicotine in tobacco, it showed that in the group of smokers the smoke with nicotine increased heart rate 8.6 beats per minute (± 1.4) unlike the group of smokers that smoke tobacco without nicotine [41]. Similar data were reported by Shaikh et al., which analyzed the vital signs of 202 volunteers aged 17 years following a hookah session of 45 min, which found an increase in systolic blood pressure 15.7 mmHg (± 0.950), diastolic 2.02 mmHg (± 0.684), heart rate 6.34 (± 0.643), $p < 0.001$ [39]; This data are consistent with the published in other study [42].

In 2011 it was shown that following a 30-min session of smoking hookah, the concentration of carboxyhemoglobin (COHb) increased 1.47% ($\pm 0.56\%$) to 7.4% ($\pm 5.52\%$),

$p < 0.001$; also observed a decrease in serum eosinophil numbers of 3.03% (± 2.25) to 2.86% (± 2.09), $p < 0.018$ [43].

It has been attributed to the hookah secondary polycythemia, which reported the first case in Haifa, Israel, a young hookah smoker male patient with no other relevant antecedent or evidence of hematologic disease, in laboratory studies identified 22.7 g/dL hemoglobin (reference range 13.5–17.5 g/dL), a hematocrit of 69.1% (reference range 40–52%) and COHb levels of 27.2% (reference range <1.5% in non-smoking and 1.5–5% in smokers) [44].

The plasma fibrinogen has been considered an independent cardiovascular risk factor, because it is a determining factor in platelet aggregation. In 2004 it was published a comparative analysis of cigarette smokers, HS and non-smokers, in which 450 male patients where attended; Analyzing those under 55 years old, the HS showed that 84.5% had a fibrinogen serum value greater than 217 mg/dL, whereas in patients older than 55 years who have smoked hookah for over 10 years, 95% of patients achieved a value greater than 217 mg/dL in serum fibrinogen, in non-smokers 66.7% had a serum value lower ($p < 0.01$) [45].

Wu et al. followed a cohort of 20,033 individuals for 7.6 years in Bangladesh, where the use of hookah was associated with a relative risk of ischemic heart disease of 1.45 (95%CI 0.86–2.43), cerebrovascular disease with a risk of 0.91 (95%CI 0.56–1.46) and coronary artery disease with a risk of 1.20 (95%CI 0.87–1.67), we believe that the weakness of this study is the short follow-up time of the study population [46].

Hookah and infectious diseases

Microbiological risk is that the hookah is used by several people at the same time, the moist of the tobacco creates conditions for the development and growth of various microorganisms, some individuals do not change the water in the hookah for each smoking session and its structure make difficult washing of all its parts, for these reasons the HS may be exposed to different microorganisms that may be harmful to health [29,47].

Mycobacterium tuberculosis is one of the pathogens transmissible through hookah, because they have been documented cases of patients with pulmonary tuberculosis where hookah and the mouthpiece were responsible for transmission vehicles, some reports have been associated with the use of marijuana, as demonstrated Munckhof et al., when they report an outbreak of pulmonary tuberculosis in Queensland, Australia [22,48].

El-Barrawy et al. conducted a cross-sectional study in Egypt in order to relate the presence of *Helicobacter pylori* (HP) and smoking, the study include 210 male patients with an age range of 20–40 years, of whom 14 where community HS that had a risk of infection HP of 4.1 (95%CI 1.01–17.24) unlike the 3 non-community HS whom the risk of HP infection was 1.1 (95%CI 0.04–18.11) [49].

Habibi et al. reported that a risk factor for transmission of hepatitis C virus in the hookah smoking community practice, because sharing the mouthpiece between individuals with gingivitis or any other type of lesion in the oral cavity makes them likely to transmit or be infected

[50]. Other viruses that can be transmitted are: Epstein–Barr virus, herpes simplex virus and respiratory virus [15].

Fungal infections have also been reported to be hookah transmitted diseases, for example a 46-year-old resident of Kfar Saba, Israel, with the diagnosis of acute myeloid leukemia, who presented with invasive pulmonary aspergillosis, it was determined that the pathogen that infect the immunocompromised patient was in the marijuana smoked in the hookah, there are also reports where found *Aspergillus sp.* in marijuana and tobacco used in this practice [51].

Hookah and pregnancy

The harmful effects of hookah during pregnancy have been known for a long time. Nuwayhid et al. reported a reduction of 100 g (relative to the average adjusted) in infants born of women who smoke one or more hookah sessions a day during the first trimester of pregnancy [52]. This fact is consistent with that reported by Aghamolaei et al., who showed that the use of hookah during pregnancy is a risk factor for intrauterine fetal growth reduction with a risk of 3.5 (95%CI 1.1–12.6) [53], manifested with low weight, low Apgar score and respiratory failure at birth, this is due to maternal exposure to carbon monoxide during pregnancy [21].

Additionally, it have been linked the use of hookah with premature labor, placental disruption [52], malformations and perinatal complications [54]. Also has been associated an increased risk of genetic disorders in the children of HS mothers [55].

Hookah and passive smoking

The harmful effects of hookah are not limited to primary smokers also have adverse health effects to the passive smokers, because the smoke components are distributed in the room where they are smoking and these are inhaled by the no smokers [56,57].

Daher et al. showed that hookah smoke unlike cigarette smoke emit 4 times more poly-aromatic hydrocarbons (1193 ± 226 ng/hookah vs. 305 ± 49 ng/cigarette), 4 times more aldehydes ($12,000 \pm 1610$ μ g/hookah vs. 2954 ± 416 μ g/cigarette), 5 times more of ultrafine particles ($3.99 \pm 0.60 \times 10^{12}$ particles/hookah, vs. $0.638 \pm 0.188 \times 10^{12}$ particles/cigarette) and 35 times more CO than a cigar (2269 ± 108 mg/hookah vs. 65.5 ± 5.5 mg/cigarette) [28]. Has also been noted that hookah smoke contains various toxic substances among which is arsenic, cobalt, chromium and lead [58].

In a study conducted in Beirut to 625 children with an average age of 10–15 years, of whom 438 live with a smoker, it was estimated that the risk factor for the development of respiratory diseases in children living along with a HS is 2.3 (95%CI 1.1–5.1) [59].

Regarding passive smokers is a lack in published information, we are considering that should be perform more studies on this population. Other authors, propose that the available information indicates that must be taken more

energetic action to raise awareness and to prohibit their use of hookah in public places [60–63].

Conclusion

The hookah has been falsely regarded as harmless, compared to other ways to smoke snuff. We can conclude from this review that there is sufficient evidence to consider the hookah as a harmful health element, as it has been associated with different pathologies (Table 1) reason for which the physician must always question directly the existence of that habit, as well as active smoking and

passive smoking hookah. There is sufficient evidence for the physician recommends the abandonment of the hookah and recommend avoidance of exposure to smoke hookah.

However, there are few clinical studies in Western populations on smoking-related diseases, so this theme gives guideline to develop more extensive clinical trials for the progression of associated diseases, as well as extensive revisions on the subject.

Conflict of interest statement

The authors declare they have no conflict of interest. The role of each author in this review was in the study design, in the collection, analysis and interpretation of data, the writing of the manuscript by Ruben Blachman-Braun and Ivette Buendía-Roldán; Ivette Buendía-Roldán in the decision to submit the manuscript for publication in this Journal.

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Table 1 Summary of diseases and associations that have been attributed to the use of the hookah.

	Diseases and associations with use of hookah
Psychiatric	Addiction [11,14,16]
Pulmonary	Obstructive spirometric pattern [23] COPD (chronic bronchitis) [26,27]
Cancer	Elevation of carcinoembryonic antigen [2] Lung cancer [29,31] Bronchogenic carcinoma [21,32] Oral cancer [13,21,22] Esophageal cancer [35] Prostate cancer [38]
Cardiovascular	Hemodynamic changes (tachycardia, vasoconstriction, increased mean arterial pressure and non-lineal blood flow) [39,41,42] Elevation of carboxyhemoglobin [43] Secondary polycythemia [44] Elevation of plasma fibrinogen [45] Association with ischemic heart disease [46] Association with cerebrovascular disease [46] Association with coronary heart disease [46]
Infectious diseases	<i>Mycobacterium tuberculosis</i> [22,48] <i>Helicobacter pylori</i> [49] Hepatitis C virus [50] Epstein–Barr [15] Herpes simplex [15] Respiratory virus [15] <i>Aspergillus sp.</i> [51]
Pregnancy	Decreased fetal intrauterine growth [52,53] Respiratory failure at birth [21] Premature labor [52] Placental abruption [52] Genetic disorders and malformations [54,55]
Passive smokers	Exposure to toxic substances and heavy metals [28,58] Risk factor for the development of respiratory diseases [59]

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