

Health Effects of Waterpipe Tobacco Use: Getting the Public Health Message Just Right

Mohammed Ali¹ and Mohammed Jawad²

¹Northwick Park Hospital, Harrow, UK. ²Department of Primary Care and Public Health, Imperial College London, London, UK.

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ABSTRACT: Many public health messages benchmark the harms of waterpipe tobacco against those of cigarettes, usually using numerical magnitudes of risk. This approach, although well intentioned, could be perceived as alarmist, damaging scientific credibility, and giving an unintended impression that one tobacco product is less harmful than the other. This commentary makes clear the harm waterpipe tobacco smoking poses to public health by describing its mechanism of use, consumption uptake, toxicologic profile, and documented health outcomes, as well as challenge existing thinking that toxicologic assessments are the most appropriate way to frame waterpipe tobacco health promotion messages. How can we describe the health effects of waterpipe tobacco without undermining its toxicity nor falling into the temptation of alarmist messaging? Several recommendations are provided.

KEYWORDS: Water pipe, shisha, hookah, tobacco, tobacco products, health promotion, health education, toxicology

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CORRESPONDING AUTHOR: Mohammed Jawad, Department of Primary Care and Public Health, Imperial College London, Hammersmith W6 8RP, London, UK. Email: mohammed.jawad06@imperial.ac.uk

Introduction

A waterpipe is an apparatus for smoking heated tobacco after its passage through water. The practice, commonly referred to as *narghile*, *shisha*, and *hookah* among other culturally specific names, was limited to Middle Eastern and South Asian (predominantly Indian and Pakistani) communities; however, a global spread in its use has been witnessed in the past 20 years.¹ Accompanying this spread is a ubiquitous but incorrect public perception that waterpipe tobacco is less harmful than cigarettes,^{2,3} justifying the need for counteractive health promotion messages. However, the lack of interventions specific to waterpipe tobacco smoking, as shown by a recent systematic review,⁴ is worrying. Public health groups appear to have overlooked the expectation to carefully translate waterpipe tobacco research into meaningful, effective, and pretested public health messages, and many have instead defaulted to exaggerative statements comparing waterpipe tobacco to 100 cigarettes or more.⁵ This stems from a popular statistic used by the World Health Organization in 2005⁶ comparing the volume of smoke produced by a 45-minute session of waterpipe tobacco use to 100 times the volume of smoke produced by a single cigarette. Alarmist messaging has been known to backfire if the emotional intensity of the message does not match the severity of the issue.⁷ However, with many toxicologic studies showing that a typical session of waterpipe tobacco smoke has about 25 cigarettes worth of tar, 11 cigarettes worth of carbon monoxide (CO), and 2 cigarettes worth of nicotine,⁸ how can we frame the harms of waterpipe tobacco smoking without doing injustice to its adverse toxicologic profile?

The tobacco product landscape is as varied, and perhaps as confusing, as it has ever been. There are multiple nicotine-containing products on the market – some are tobacco based, such

as waterpipe and smokeless tobacco products, whereas others do not contain tobacco but may contain chemicals found in tobacco smoke, such as electronic cigarettes⁹ and 'herbal' waterpipe products.¹⁰ To add more cloud to the smoke, nontobacco products may be marketed as tobacco products, and vice versa,¹¹ making it difficult for consumers and health care professionals to differentiate between them and thus make a judgement about harm.^{2,12} Cross-product marketing is seen mainly in electronic cigarette advertising, where products are named as waterpipe synonyms (eg, 'shisha sticks' or 'hookah pens'), despite having no resemblance to waterpipe tobacco.¹³ Are these deliberate tobacco industry attempts to bewilder policy-makers and stall legislative efforts to curb their consumption?

In the absence of long-term epidemiologic studies, the new wave of tobacco and nontobacco nicotine-containing products in Western markets has resigned academics and health care professionals to centre the debate of harm based on toxicological assessments of smoke produced.¹⁴ Although these allow for interesting chemical-by-chemical comparisons, there is little consensus as to where some products, such as waterpipe tobacco and electronic cigarettes, fall on the spectrum of harm. However, unlike electronic cigarette researchers, waterpipe tobacco researchers are unified in their position that waterpipe tobacco is harmful,¹⁵ although the quantification of that harm lacks consensus.

This commentary attempts to make a clear and cohesive outline of the harm waterpipe tobacco smoking poses to public health by describing its mechanism of use and consumption uptake in different settings globally, as well as challenge existing thinking that toxicologic assessments are the most appropriate way to frame counteractive waterpipe tobacco health



promotion messages. How can we describe the health effects of waterpipe tobacco without undermining its toxicity nor falling into the temptation of alarmist messaging? It will end by suggesting ways forward for research and health promotion to ensure that we can take closer steps to get the waterpipe tobacco public health message just right.

Mechanism of the Waterpipe Apparatus

The first step in understanding the health effects of waterpipe tobacco is to be clear on its functionality. The waterpipe apparatus is typically made up of the head, body, bowl, and hose (Figure 1).¹⁶ The main type of tobacco smoked is a sweetened type with different varieties of flavoured glycerol and other additives to replicate fruits, drinks, and even candies/sweets. This is commonly referred to as *mo'assel*, the Arabic for 'honeyed', and is thought to contain 30% tobacco¹⁷ and have high moisture content.¹⁸ *Mo'assel* tobacco is placed in the head of the waterpipe apparatus and covered in aluminium foil perforated with pinholes. The head is pressed onto the waterpipe apparatus with a tight seal which in turn is attached to the body and bowl, the latter of which is partially filled with water. A flexible hose is attached to the body and is usually made up of leather or plastic. Pieces of coal are placed on top of the foil-covered head to heat the underlying tobacco. During a puff, the user inhales through the hose which draws air into the head. The heated air mixes with the *mo'assel* tobacco and the smoke generated passes through the body, cooling and condensing as it does so, before it reaches the bowl. The smoke then passes through the hose and is carried to the user. It is important to note that waterpipe users are victim of a 'double whammy' – the inhalation of both tobacco smoke and charcoal smoke – which should be borne in mind when considering its health effects.

Why Should We Be Interested in the Health Effects of Waterpipe Tobacco?

Epidemiology of use

A potentially harmful consumer product that is used infrequently or used only by a minority population is unlikely to elicit much public health concern. However, waterpipe tobacco smoking is no longer restricted to its endemic Middle Eastern or South Asian regions. Two recent studies conducted in London (United Kingdom)¹⁹ and Florida (United States)²⁰ have documented a higher prevalence of current waterpipe tobacco use, whether measured as 'past 30 day' or as 'daily or occasional' use, among high school and university students compared with cigarette use. In another survey involving more than 100 000 students from 152 universities in the United States, waterpipe tobacco was second only to cigarettes with more than 8% of students reporting current (past 30-day) waterpipe tobacco use.²¹ In Middle Eastern settings, there are alarming reports: almost 40% of adolescents in Lebanon are current (past 30-day) waterpipe tobacco users, and in other countries such as Egypt, Morocco, Qatar, and the United Arab

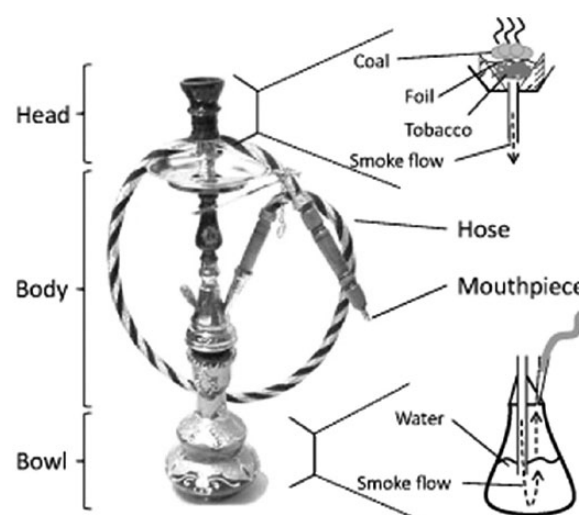


Figure 1. Waterpipe with schematic representation.

Emirates, waterpipe tobacco prevalence was significantly higher than cigarette prevalence.^{22,23} Generally, it has been reported that younger age groups have a particularly high prevalence of waterpipe tobacco use. The relationship between age and waterpipe tobacco use is appropriately demonstrated from data collected in the United States which show the past 30 day and ever use peak between the ages of 19 and 20 years.²¹ Older people are now less likely to smoke waterpipe tobacco compared with younger age groups, in contrast to the pattern seen in the 1990s.²⁴ A study from the Middle East enquired about smoking behaviours among adults from 10 countries in the region (and Pakistan) and concluded that waterpipe tobacco smoking prevalence (defined as ever smoking on a daily basis) was significantly less common than cigarette smoking in individuals aged >40 years compared with those aged <40 years.²⁵

In addition to younger age groups, waterpipe tobacco has a salient association with higher socioeconomic positions. For example, an online survey of adults in the United Kingdom showed that those from higher socioeconomic positions were twice as likely to be waterpipe tobacco smokers than those from lower positions,²⁶ whereas in Syria, waterpipe tobacco prevalence is 5 times higher in those with higher socioeconomic status than those with lower status.²⁷

Other than geographical location, age, or socioeconomic status, evidence suggests that the strongest correlate of waterpipe tobacco use is concurrent cigarette use. Globally, studies have shown that cigarette smoking is a leading predictor of waterpipe smoking^{28–30}; however, data are lacking as to the extent to which waterpipe tobacco can be considered a precursor to future cigarette use.

Attitudes and beliefs

Social norms. Framing public health messages for waterpipe tobacco smoking should consider normative perceptions. Social

Norms Theory suggests that norms are misperceived as individuals follow 'imaginary peers' and feel under pressure to imitate erroneously perceived group patterns.³¹ Social norms affect waterpipe tobacco smoking in a similar fashion to cigarettes,³² working via peer influence through modelling or imitation of friends' behaviour, or through selective reinforcement by peers or parents of certain behaviours.³³ For example, parental and peer waterpipe tobacco use is consistently and strongly associated with individual waterpipe tobacco use in a number of settings, including several Middle Eastern countries,³⁴ Sweden,³⁵ and the United States.³⁶ In a qualitative study across 4 countries in the Middle East, 1 participant was quoted as saying, 'Now my father is enjoying smoking waterpipe with me; every night, he prepares his waterpipe and asks me: don't you want to prepare your own?' (Woman, smoker, 18-25 years – Lebanon).³⁷ This study concluded by suggesting that socio-cultural norms towards waterpipe tobacco far outweighed its health considerations. Social media may have a role to play, given that from a random sample of 5000 waterpipe-related tweets in 2014, 87% normalised waterpipe use by making it seem common, normal to use, and portraying it positively.³⁸

Descriptive norms. Descriptive norms, also known as perceived prevalence, are the belief about how most of the people act in a social group.³⁹ The higher the perceived prevalence, the more likely that the individual will believe that behaviour is normative. In one study of more than 1000 adolescents in Lebanon, more than 65% perceived the prevalence of waterpipe tobacco use to be higher than it was (ie, had high pluralistic ignorance).⁴⁰ In a similar study among more than 400 college freshmen at 1 US university, just under half had high pluralistic ignorance, and pluralistic ignorance was associated with waterpipe tobacco use but not with cigarette or cigar use.⁴¹ However, high pluralistic ignorance may be limited to younger age groups and minority ethnic groups (where waterpipe tobacco prevalence is higher), as explained by a qualitative research study among community workers in Canada.⁴²

Injunctive norms. Approval or disapproval of waterpipe tobacco smoking is known as injunctive norms, and this area has mixed findings. Given waterpipe tobacco smoking is commonly performed as a social activity with friends or family, and a key feature of its use is sharing between users, it is seen as socially acceptable.^{43,44} In examples from Lebanon and Jordan, authors found that the encouragement from friends and family influenced waterpipe tobacco,^{45,46} whereas having friends who disapproved of waterpipe tobacco was associated with less use.⁴⁷ This pattern has also been reported among youth in India,⁴⁸ and in cross-sectional studies of Arab Americans in the United States and adolescents in Lebanon, friend and family influence was associated with waterpipe tobacco initiation for both male and female users.^{40,49} Among adolescents in Lebanon, nearly 30% of waterpipe users had their water pipe paid for by their parents.⁴⁰

Despite this, disapproval of waterpipe tobacco use has been documented in the literature. In a cross-sectional study among 547 university students in Jordan, about 30% of waterpipe users claimed that their parents would discipline them if they found

out about their waterpipe use; interestingly, this figure was higher for men (35.0%) compared with women (20.0%).⁴⁶

Perceived risk. Risk perception is an important determinant of smoking behaviour and behavioural intention.⁵⁰ Qualitative research from the United States, United Kingdom, and Syria broadly suggest a reduced harm perception compared with cigarettes.⁵¹⁻⁵³ The perceived lack of nicotine and addictive potential of waterpipe tobacco^{2,3} suggest that users have a strong sense of perceived control over their waterpipe tobacco use. In one study among university students in North Carolina, those who believed waterpipe tobacco to be less harmful than cigarettes had more than 2.5 times the odds of being a past 30-day waterpipe user compared with those who believed waterpipe tobacco to be as harmful as cigarettes.⁵⁴

One common theme seen in risk perception studies is the benchmarking of waterpipe tobacco against cigarettes; whether this is a cause or result of waterpipe tobacco users' approach to assessing waterpipe harm is unclear. However, a review of more than 1000 waterpipe-related news articles showed that nearly half benchmarked the harms of waterpipe against cigarettes, and a fifth made scientifically incorrect claims comparing one 45-minute session of waterpipe (however defined) with at least 100 cigarettes, without reference to the toxicant comparator,⁵ suggesting a strong media influence in promoting this benchmarking approach.

What Is the Evidence for the Health Effects of Waterpipe Tobacco?

Toxicology

The emergence of waterpipe tobacco smoking around the world has prompted research into the toxic content and biological activity of waterpipe tobacco smoke. Studies date back to 2003¹⁸ and typically involve connecting a waterpipe apparatus to a smoking machine which captures all the smoke for chemical and biological mapping. Smoking machines are usually programmed to produce a set puffing regimen; however, unlike cigarettes, numerous factors can affect the smoke produced from a water pipe, including the type of coal, the quality of the tobacco, the volume of water used, the design of the water pipe itself, the number/duration/volume of the puffs, and the length of the waterpipe sessions, including the number of users sharing a water pipe.¹⁸ Therefore, studies have tended to use a protocol which specifies the amount of tobacco and charcoal used as well as the preparation method and the puffing regimen. The most commonly used is the 'Beirut method', which was derived from actual smoking patterns and waterpipe preparations used in several Beirut cafes.⁵⁵ This method ensures that confounding variables are standardised across studies.

In a recent toxicologic review of waterpipe tobacco smoke,¹⁶ the few studies that did not use the Beirut method had small variations in charcoal, puff number/duration/interval, and tobacco amount. From the data analysed in the review, tar content ranged from 242 to 2359 mg per smoking session, nicotine

levels ranged from 1.04 to 7.75 mg per session (however, if herbal tobacco is used, then the nicotine amount becomes negligible⁵⁶), and the amount of CO ranged from 57.2 to 367 mg per session.¹⁶ CO levels are directly proportional to the amount of charcoal used, and when electric heating and less coal were used, this reduced CO levels to 5.7 mg/session. This review also concluded that these substances are significantly higher than the amount generated in 1 cigarette.¹⁶ A meta-analysis of waterpipe and cigarette toxicant exposure suggested that these values roughly correspond to a session (however defined) of waterpipe tobacco being equivalent to 25 cigarettes worth of tar, 11 cigarettes worth of CO, and 2 cigarettes worth of nicotine.⁸

Other products commonly found in waterpipe tobacco smoke include carbonylic compounds, tobacco-specific nitrosamines, primary aromatic amines, furanic compounds, polycyclic aromatic hydrocarbons, heavy metals, and volatile organic compounds, among others.¹⁶ Most yields were higher for a waterpipe tobacco smoking session than for a single cigarette session; however, the ranges were usually much wider compared with ranges for cigarette smoke yields.

One argument against the use of smoke machines is that these do not correlate well with the human absorption and exposure of toxic chemicals. One particular study addressed this by directly comparing machine-derived toxicants from waterpipe tobacco smoke with blood concentrations.⁵⁷ It was found that CO and nicotine yields from the smoke produced were highly correlated with plasma concentrations in the analysed blood. Therefore, although concurrent validity has yet to be established, it may be assumed that smoke toxicant yields generated in the various studies can track human exposure.

Several studies have also directly compared waterpipe tobacco products with tobacco-free ('herbal') waterpipe products. Although nicotine was found to be absent from 'herbal' products, all other potentially harmful substances, including aldehydes, CO, and tar, were present in similar or greater amounts to waterpipe tobacco products.^{10,56} This therefore suggests that tobacco-free 'herbal' waterpipe products are likely to induce a similar effect on human health as tobacco waterpipe products.

Biologically, some studies showed that waterpipe tobacco smoke causes damaging effects on cell function in lung epithelial cells and vascular endothelial cells, both being key factors in the development of chronic obstructive pulmonary disease (COPD) and vascular disease. The pathogenesis involved impaired cellular growth and repair, inflammation, oxidative stress, and impaired vasodilation.^{58,59} It has also been reported that smoke generated from tobacco-free 'herbal' waterpipe products may still have deleterious effects on the body as it causes reduced cellular proliferation and cell cycle arrest.⁶⁰ Therefore, the harm reduction potential of tobacco-free 'herbal' waterpipe products is strongly disputed.

Overall, these studies have shown that waterpipe tobacco smoking results in significant exposure to CO, polycyclic aromatic hydrocarbons, nicotine, and tar, as well as other substances with yields being generally greater than in cigarettes. This pattern is reflected in biomarker levels in the blood samples of waterpipe tobacco smokers. It is therefore evident that waterpipe tobacco users inhale and absorb a significant load of toxic chemicals similar to those found in cigarette smoke that are known to cause lung disease, vascular damage, cancer, and dependence. Yet it remains difficult, and perhaps impossible and unhelpful, to numerically quantify waterpipe tobacco to cigarettes, given the variation in tobacco quality, puffing behaviour, and the presence of sharing.

Health effects

Cardiovascular effects. Both the acute and chronic cardiovascular health effects of waterpipe tobacco smokers have been documented. For short-term cardiovascular effects, studies have generally measured heart rate and blood pressure before and after smoking sessions with a period of abstinence before the study. For example, in Israel, after 1 session of waterpipe tobacco smoking, the systolic and diastolic blood pressure levels of 45 men and women (average age: 32 years) significantly increased after smoking (systolic: 119.5 vs 132.0 mm Hg, diastolic: 74.8 vs 83.0 mm Hg, $P < .001$). Heart rates increased from 80.4 to 95.6 beats/min ($P < .001$).⁶¹ Another study focused on heart rate variability as its end outcome – a predictor of coronary artery disease and mortality. It showed that there was a transient decrease in variability after smoking both tobacco and tobacco-free 'herbal' waterpipe products.⁶²

In a large prospective study that included more than 20 000 participants in Bangladesh, men with a history of heavy waterpipe tobacco smoking had nearly twice the risk of dying from ischaemic heart disease compared with nonsmokers. However, most waterpipe tobacco smokers (99%) in this study were also cigarette or 'beedi' (an alternative and common form of tobacco use) smokers, so it was not possible to adjust for this.⁶³ In a cross-sectional study from Iran of more than 50 000 participants, waterpipe tobacco users had nearly 4 times the odds of self-reported ischaemic heart disease or heart failure compared with nonusers (adjusted odds ratio [AOR]: 3.8, 95% confidence interval [CI]: 1.5–9.2).⁶⁴ In a third cross-sectional study from Lebanon, 1210 patients from 4 hospitals were evaluated for angiographically defined coronary artery disease. Patients with a long history of waterpipe tobacco smoking had 3 times the odds of severe stenosis compared with nonsmokers after adjusting for demographics and other vascular disease risk factors, such as cigarette smoking and diabetes.⁶⁵

Respiratory effects. In one study of 47 volunteers in Israel with an average age of 25 years, CO levels in haemoglobin increased after a waterpipe tobacco smoking session ($P < .00001$), with 6 volunteers having a rise of 25% and 2 with a 40% increase.⁶⁶ Another study looking at pulmonary function, respiratory rate

and oxygen consumption before and after waterpipe tobacco smoking sessions showed that oxygen consumption decreased from 1.9 to 1.7 L/min, baseline respiratory rate increased from 17.7 to 19.7 breath/min, forced expiratory volume (FEV: 25-75) over the middle half of the forced vital capacity (FVC) decreased from 5.5 to 5.3 L, and perceived exertion (measured by Borg Scale) at mid and peak exercise increased.⁶⁷ Therefore, acute waterpipe tobacco smoking does appear to cause impairment of lung function, decrease exercise capacity, and reduce oxygen consumption at both the molecular and physiological levels.

Carbon monoxide and pulmonary function changes have also been reported in long-term waterpipe tobacco smokers. In one cross-sectional study in Pakistan, blood CO concentration was significantly higher in waterpipe tobacco smokers (10.5%) compared with cigarette smokers (6.2%) and nonsmokers (0.9%) ($P < .01$). Oxyhaemoglobin levels were significantly lower in waterpipe tobacco smokers compared with cigarette smokers and nonsmokers.⁶⁸ In another study of Saudi men and women, pulmonary function (forced expiratory volume at 1 second [FEV₁], FVC, and FEV₁/FVC) was impaired in long-term waterpipe tobacco smokers compared with nonsmokers.⁶⁹

Although these long-term studies provide data linking waterpipe tobacco smoking to reduced pulmonary function, they do not show a direct link to respiratory disease. However, a few studies have shown an association between waterpipe tobacco smoking and COPD. In one case-control study, 274 cases of chronic bronchitis (using the standard definition of chronic cough with sputum production for 3 consecutive months for 2 years) and 559 controls without the condition aged ≥ 40 years were enrolled. The results indicated that the odds of having bronchitis were 5.7 times higher in waterpipe tobacco smokers of >20 waterpipe tobacco-years compared with nonsmokers; however, this was not adjusted for cigarette smoking.⁷⁰ Another study, using the GOLD spirometry-based definition of COPD (FEV₁/FVC $< 70\%$ on spirometry), found an association between COPD and waterpipe smoking adjusted for possible confounders such as age and cigarette smoking (AOR: 2.5, 95% CI: 1.8-3.5).⁷¹

Cancer. The association between various types of cancer and cigarette smoking has been clearly demonstrated in many previous studies; however, the link with waterpipe tobacco smoking has not been extensively researched. In one laboratory study, exposure of human alveolar cells to waterpipe tobacco smoke resulted in reduced cell proliferation, cell cycle arrest, and increased doubling time as well as greater chromosomal abnormalities,⁷² all of which are cellular events which may translate into a higher risk of developing cancer.

Lung cancer has been most extensively researched in waterpipe tobacco smokers, however limited it may be. In a case-control study from Lebanon of lung cancer correlates, the risk of having lung cancer was 6 times higher in former waterpipe tobacco smokers compared with nonsmokers; however, when stratified for gender, the risk was only significant

in men ($P = .009$). Furthermore, there was no excess risk when adjusting for confounders such as cigarette smoking and occupational exposure to toxins.⁷³ In a similar study from India comparing 120 waterpipe tobacco smokers with non-smokers, the risk of developing lung cancer was again 6-fold; however, this was not adjusted for cigarette smoking.⁷⁴ Similar to other waterpipe tobacco research, not many studies have examined health effects over time, so evidence is lacking. However, a cohort study from China which started in 1976 found that of the 842 lung cancer deaths, 21.4% were attributable to tobacco alone; however, smoking a bamboo water pipe appeared to confer less risk than cigarette use, given their equivalent tobacco consumption.⁷⁵

Other researched associations between waterpipe tobacco smoking and cancer include oesophageal and gastric cancers. One case-control study showed twice the risk of oesophageal cancer in waterpipe tobacco smokers which increased with greater duration or cumulative time spent in smoking.⁷⁶ However, in another study, exclusive waterpipe tobacco smoking again showed no increased risk of cancer having adjusted for cigarette smoking and other confounders.⁷⁷ In terms of gastric cancer, a large 10-year prospective cohort study supported the association with waterpipe tobacco smoking even after adjusting for cigarette smoking.⁷⁸ In this study, waterpipe tobacco smoking was associated with 3.4 (95% CI: 1.6-7.1) times the risk of developing gastric cancer compared with nonsmokers.

Obstetric and perinatal. One retrospective study found 2.4 times greater odds of low birthweight among exclusive waterpipe tobacco smokers after adjusting for important confounders such as gestational age, parity, and obstetric complications. However, it could not adjust for other important confounders such as alcohol intake or other substances.⁷⁹ In another study which did control for other substance intake, there was a non-significant association between low birthweight and waterpipe tobacco smoking.⁸⁰ In a recently published meta-analysis, the pooled AOR estimate for the association between waterpipe tobacco smoking and low birthweight was 2.4 (95% CI: 1.3-4.3).⁸¹

Oral disease. In one study, poor periodontal health was measured by plaque index and the gingival index. There was an overall significant association between exclusive waterpipe tobacco smoking and plaque/gingival index compared with nonsmokers.⁸² Another study assessed the association between waterpipe tobacco smoking and oral lesions suspicious of cancers. In this cross-sectional design, it was found that referral rates for suspicious oral lesions were greater for waterpipe tobacco smokers even after adjusting for potential confounders; however, it did not follow up patients, and therefore, more comprehensive studies are needed.⁸³

Infectious disease. No demonstrable evidence has been gathered to suggest that sharing waterpipe hoses increases the risk of transmitting infectious diseases from person to person. However,

bacterial isolates from the waterpipe apparatus have been identified from studies in Iran^{84,85}; in some cases, up to 82% of waterpipe apparatuses and accessories return with positive bacterial cultures.⁸⁴ With more waterpipe tobacco cafes opening worldwide, a greater number of people will come near each other and will continue to share hoses; thus, more research into this is certainly warranted.

Recommendations and Conclusions

This commentary has shown that despite the immaturity of waterpipe tobacco research, there is enough cause for public health action. We have presented evidence that waterpipe tobacco is no longer restricted to endemic Middle Eastern or South Asian regions, nor the diaspora of these communities in Western settings. An epidemiologic shift in use from elderly to youth waterpipe tobacco smoking has occurred, and social norms towards waterpipe tobacco use may include high family influence, pluralistic ignorance, and social acceptability. This, coupled with low perceived risk, requires an appropriate health promotion response. However, the health promotion literature lacks an evidence base for waterpipe tobacco. About half of waterpipe-related online news articles benchmark waterpipe tobacco against cigarettes, and a significant number attempt to quantify this risk, which may result in alarmist messaging.⁵ Given the evidence presented on toxicology and the adverse health effects of waterpipe tobacco, how can we proceed to getting the public health message just right? Suggestions include the following:

- *To avoid numerically comparing a session of water pipe with an equivalent number of cigarettes.* As well intentioned as these messages are, they could damage scientific credibility and give an unintended impression that one tobacco product is less harmful than the other. The World Health Organization recognises that interpretation of numerical risk data can be confusing for users and recommends that tobacco labelling should refrain from containing quantitative descriptions of tar, nicotine, and CO emission yields.⁸⁶
- *To benchmark waterpipe tobacco to cigarettes qualitatively, such as using the phrase 'as harmful as' or 'at least as bad as'.* This delivers a more balanced approach to recognise the harms of waterpipe tobacco while acknowledging that further studies are needed before the full health burden of waterpipe tobacco can be established.
- *To directly address social norms towards waterpipe tobacco.* Although combating low perceived risk is the most logical (and perhaps most common) method of addressing social norms, considerations should be given to descriptive and injunctive norms that also shape behavioural intent to use waterpipe tobacco. This includes challenging peer and family influence and using social media to combat the overwhelming positive normative perception currently present there.

- *To play on health outcomes that are specific to waterpipe tobacco and not to cigarettes, such as the potential for CO poisoning⁸⁷ and the risk of infection transmission when sharing the water pipe with others.⁸⁵* This delivers a new angle to tobacco health promotion messaging that may be less resistant to a fading effect.

One remaining question is the extent to which we require further health-related (toxicological or epidemiological) studies on waterpipe tobacco to further public health action. On one hand, further research may catalyse waterpipe tobacco health policy changes by renewing pressure on local or national policymakers. This is particularly important in low-income and middle-income countries, where policy advocacy is generally weak.⁸⁸ On the other hand, one can argue that given how much we already know about the health effects of cigarettes, we should extrapolate these findings to waterpipe tobacco and minimise the typical generational delay between research findings and policy change. This will save time, money, and potentially many lives.

Those considering future research on the health effects related to waterpipe tobacco smoking should consider a number of pertinent points. First, estimating the dose of waterpipe tobacco exposure is difficult, and epidemiological measures should consider the use of 'water pipe-pack years' in a similar fashion to cigarette research (the derivation of this measure has been explained elsewhere⁸⁹) to standardise comparisons across studies. Second, the type of waterpipe tobacco consumed should be established. This commentary describes the most common waterpipe tobacco type consumed, *mo'assel*; however, other types (*jurak*, *ajami*, and *tombak*) may be more dominant in certain settings, particularly in non-Western settings.⁹⁰ Often, waterpipe tobacco type is omitted in epidemiological studies assessing the health effects of waterpipe tobacco,⁹¹ which is of concern given each type may have a different composition (or 'concentration') of tobacco.⁹² Third, the need to adjust for cigarette smoking or other tobacco use, or perhaps better, the need to power the study so that analysis among waterpipe-only users can be achieved, and cannot be underestimated. Many waterpipe studies surprisingly fail to adjust for potential confounders, the main reason for which is a low sample size and subsequent low-powered analysis.

In an era of multiple tobacco or tobacco-mimicking products on our shelves, getting the waterpipe tobacco public health message just right can be challenging. However, the literature outlined in this commentary may help researchers and health promotion groups take closer steps towards well-framed and impactful messaging. The need for the evaluation of waterpipe tobacco health messages, both quantitatively and qualitatively, is paramount, and we should be mindful of possible impact of our work on existing messaging for other tobacco products.

Author Contributions

MA and MJ conceptualised the manuscript. MA conducted a review of the literature and wrote the first draft. Both authors reviewed and approved the final draft.

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