

**NHS Leicester City/Leicester City Council  
Directorate of Public Health**

**Waterpipe smoking (Shisha): Potential effects and recommendations for further action.**

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**Author**

Mary Hall  
StR Public Health  
Public Health Directorate  
NHS Leicester City/Leicester City Council  
Email: Mary.Hall@lcchs.nhs.uk

**Sponsor**

Rod Moore  
Deputy Director Public Health  
Public Health Directorate  
NHS Leicester City/Leicester City Council  
Email: Rod.Moore@leicestercity.nhs.uk

**Context**

Against a background of apparent increase in the number and venues of waterpipe<sup>1</sup> smoking (WPS) and in the absence of any national or local policy, Leicester Tobacco Control Steering Group is seeking a view on potential, evidence based advice that should be provided to the general public on WPS.

**Plain English summary**

Waterpipe or shisha smoking is often considered a safe and harmless alternative to cigarette smoking. As a result more and more people are smoking shisha, particularly students and people in higher education.

Although there is insufficient high quality research studies to show definitively that WPS is harmful, or as harmful as cigarettes, increasing amounts of evidence are suggesting that the effects that WPS has on the body are similar to those of cigarette smoke.

At the moment there is no national policy to raise awareness about WPS and many people do not understand that it may have a harmful effect on their own and other people's health around them.

This report recommends that more information is provided for people on WPS and that health care staff take more care in asking their patients about WPS.

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<sup>1</sup> Multiple terms are used to describe waterpipe smoking: shisha, narghile, hookah, argile. This report uses the term waterpipe smoking (WPS) throughout meaning all of these terms.

## Background Information

WPS appears to be increasing globally ([Akl et al 2011](#)) and, particularly in the Western world, the increase is being seen in the young and educated population (eg see Chan & Murin, 2011, Jackson & Aveyard, 2008), i.e. those who do not traditionally smoke cigarettes; there is evidence to suggest that they do so in the belief that WPS is a harmless alternative (Cobb et al 2010).

A WHO paper in 2005 has been generally criticised for its lack of evidence base (Chaouachi 2009) particularly its assertion that one WPS session is equivalent to 200 cigarettes. However there remains a dearth of research or evidence about any potential harmful effects of WPS, and those that have been carried out tend to be of low quality (eg see [Akl et al 2010a](#)) and are not consistent in instrument use or measurement techniques, so are not validated ([Akl et al 2010b](#)). Equally, types of tobacco, charcoal and waterpipe used vary globally so it is difficult to draw any conclusions from research carried out in different parts of the world.

In the light of this lack of evidence, this paper attempts to draw some general conclusions from the evidence that is available and makes recommendations based on the 'likelihood' of harm to the shisha smoker and those around. This paper is not therefore based upon a systematic review of the literature where all published and unpublished literature is examined thoroughly and systematically for both quality of study and evidence produced, rather an review of key identified research papers providing an overview of evidence available.

## Methodology

English language searches from 2000 onwards were carried out on medline, NHS evidence, NICE and Cochrane databases using the search terms shisha, waterpipe, nargile, narghile or hookah. The 2005 WHO Waterpipe recommendations paper was read as a starting point. Initially the search strategy looked only for systematic reviews, or meta-analyses, however there were very few of these identified so other papers were included that seemed to link to potential harmful effects. For example papers that researched lung function, carbon monoxide or nicotine addiction. References were followed up where they seemed appropriate (as above). Many papers have been critiqued by other researchers and these critiques were read for background information.

A summary of papers is included in Appendix 1.

## Quality of research

The few systematic reviews (underlined references) carried out make reference to the very low quality of research available, noting that studies were very small, carried out on the same subjects, did not use controls, or were not consistent in equipment use of measurement (for example), i.e. all had very low scores when scored against GRADE criteria. The inconsistency in measurement and equipment used (including type of tobacco) and low numbers studied remains a constant criticism of many research papers ([Akl et al 2010b](#)) highlighting the difficulty in drawing any firm conclusions from results. Many papers quote a few key researchers who have in turn been criticised for their poor methodology (Chaouachi 2012) again making it difficult to draw any evidence based conclusions from findings.

Despite all of this, there did appear to be some consistency in findings and some general agreement on results, and this general agreement has formed the basis of this papers' recommendations. Whilst acknowledging that 'general agreements' are not a strong evidence base, it is felt, given the potential risk to the population of shisha smoking, this is enough until more robust, validated research is carried out.

## **Potential harmful effects**

### **Lung Function**

In a number of studies lung function was measured after WPS, with the argument being made that a reduced lung function (as measured by forced expiratory volume, FEV1, or forced vital capacity, FVC) is a significant and valid surrogate measure of restrictive airway diseases such as COPD.

WPS had a 43% reduced FEV1 as compared to non-smokers, ranging from 58% to 29% reduced FEV1. There was no significant difference between FVC and FEV1/FVC. WPS had a 27% higher FVC than cigarette smokers (ie a better FVC) ranging from 9% to 44% higher. There was no significant difference between cigarette and WPS FEV1 and FEV1/FVC ([Raad et al 2010](#)). Comparison between WPS and smokers who 'deeply' inhale cigarettes rather than inspiring in a normal breath inspiration, showed similar effects on lung functions, with all lung function tests being significantly lowered for WPS ([Boskabady et al,2012](#)), indicating the similarity on lung function between WPS and those who inhale cigarettes deeply, and the difference between WPS and non-smokers.

[Akl et al 2010](#) assessed one study looking at effects of second hand smoke on wheezing and nasal congestion in children which found a significant association with WPS and/or cigarette smoking on respiratory illness. However the study was judged to be of very low quality.

Both number and volume of puffs were significantly less in cigarette smokers than shisha smokers ([Cobb et al, 2011](#); [Eissenberg et al 2009](#)), highlighting the potential greater increased inhalation of smoke in shisha smokers. A later study agreed that more smoke is inhaled in WPS, but that this smoke is generally 'more dilute' than cigarette smoke, making direct comparisons such as 'one shisha session equals 200 cigarettes' problematic; it also noted the fewer shisha sessions that occur compared to cigarettes smoked ([Boskabady, 2012](#))

A meta-analysis found a significant association ([Akl et al 2010](#)) between WPS and lung cancer, with those who smoke shisha being twice as likely to have lung cancer as those who don't, ranging from 10% to five times more likely to have lung cancer; studies were all of a low quality.

Levels of carcinoembryonic antigen (CEA), a marker of chronic inflammation, were lower in light versus non-smokers, the same in medium versus non-smokers smokers and significantly higher in heavy smokers versus non-smokers (those who smoked two to four sessions per day for a total of six or under hours), possibly highlighting the effect of heavy WPS on future inflammatory processes in the lungs and the lack of potential effect in medium and light WPS smokers ([Sajid et al 2008](#)).

## **Carbon Monoxide**

Studies have explored two different aspects of WPS and carbon monoxide: exhaled or external carbon monoxide levels, referred to as CO and internal, absorbed carbon monoxide that haemoglobin is bound to in the place of oxygen, referred to as COHb (Carboxyhaemoglobin). CO is linked to second hand smoke risk whereas COHb is linked to individual smoker risk.

Carbon monoxide in cigarette smoke is known to increase the chance of cardiovascular disease, with second hand smoke causing lung cancer in adults and greatly increasing the risk of respiratory illness in children, and sudden infant death.

Isolated cases of carbon monoxide poisoning associated with WPS have been reported but are not on a large scale and are mainly due to poor ventilation (Chaouachi, 2012).

COHb levels were raised in shisha smokers (Hakim et al 2011) and were higher in shisha smokers than cigarette smokers when the two were compared (Cobb et al 2011, Eissenberg & Shihadeh 2009). The comparison groups were compared over time with one cigarette (usually smoked within 10 minutes) compared to one WPS cessation (approximately 45 minutes). All studies reported a time effect on COHb, i.e. that the longer the smoking session, the higher the COHb, to a maximum peak level usually after 45 minutes in a 45 minute WPS session and 5 minutes smoking a cigarette.

One study compared smoking flavoured tobacco (the usual preparation for shisha) with a flavour matched tobacco free product (Blank et al 2011): there was no significant difference between the two preparations in COHb or expired CO levels, with significant increases noted for both indicating the lack of 'benefit' on these measures that non-tobacco products have.

Expired carbon monoxide levels were all significantly higher in WPS than cigarette smoking with a significant time effect noted; shisha smoking tends to go on for longer, so expired CO is around for longer and therefore at higher levels.

## **Nicotine**

Nicotine in cigarette smoking causes the chemical release of adrenaline, increasing heart rate, BP and restricting the blood flow to the heart muscle causing rapid shallow breathing. It also causes the release of dopamine (responsible for feelings of pleasure and wellbeing) and insulin. When nicotine levels drop, the smoker has the urge to light up again.

Mean peak nicotine levels were found to be similar between cigarette and shisha smokers, though with different peak times (Cobb et al 2011) or higher in shisha smokers (Eissenberg et al 2009) again with different peak times – shisha smokers peaking after more time. Despite the difference in findings, both studies did find increased nicotine levels. The study using a flavoured tobacco free product found significant increase in nicotine levels in those that used flavoured tobacco but none in those who used the tobacco free product (Blank et al 2011).

## **Low Birth Weight**

Three studies assessed by [Akl et al \(2010\)](#) found an association between WPS and low birth weight, with a pooled OR of 2.12, meaning those that smoke shisha are twice as likely to give birth to a baby of low birth weight than those who don't, with a range of being 8% to 300% more likely to give birth to a low birth weight child. Again these were small, low quality studies.

## **Other potential outcomes**

Other studies assessed by [Akl et al \(2010\)](#) found no association between WPS and bladder cancer, oesophageal cancer, oral dysplasia, Hepatitis C or infertility.

## **Summary**

Despite the lack of clear, consistent and valid evidence most studies reviewed agree that:

- a) WPS increases expired CO levels and COHb levels, and in some cases has been found to be similar to those of cigarette smoking levels. There is therefore a risk of second hand smoke effects on those around shisha smokers and a potential cardiovascular effect on shisha smokers themselves.
- b) There is a time effect on CO and COHb levels, meaning that the longer a session carries on the higher the CO and COHb levels (rising to a peak level), which some studies have found to be higher in WPS than cigarette smoking and others have found to be the same; none found them to be less. Increased CO and COHb levels may increase risk of lung cancer, cardiovascular disease and COPD.
- c) There is an effect of WPS on lung function, with WPS having a reduction in some of their lung function tests, potentially highlighting future respiratory problems. There is disagreement on the size of effect and how WPS lung function tests compare to those of cigarette smokers.
- d) Nicotine levels are raised in shisha smokers who use tobacco products but not in those who use non-tobacco products. However CO and COHb levels are similarly raised in both. Raised nicotine levels may increase the need to smoke again.
- e) Puff rates and volume of smoke inhaled increases with time; amounts of both were found to be higher in WPS.

## **Conclusion**

There is general agreement that WPS is not a harmless alternative to cigarette smoking. Despite the lack of agreement on scale of effect, the idea that WPS does have harmful health effects is generally supported. Based on this agreement, there would appear to be a need to take further action in order to reduce population risk.

## Recommendations

1. There is general awareness/perception raising about WPS. Specifically that:
  - a. WPS causes raised carbon monoxide in the atmosphere (CO) and in blood levels (COHb) that are known to be harmful in cigarette smoking and can cause cardiovascular disease, respiratory problems and have an effect on those who are in the same environment.
  - b. Flavoured WPS products contain tobacco which causes raised CO, COHb and nicotine levels.
  - c. Labelling on WPS products does not have the same regulations as cigarette packets and therefore does not contain health warnings even though there may be health effects.
  - d. Smoking through water, using flavoured tobacco or the lower temperatures of WPS does not mean that WPS is harmless.
  - e. WPS is included in young people's smoking awareness sessions.
  - f. The WHO analogy of one shisha session being the same as 200 cigarettes is not used due to lack of or conflicting evidence and its potential to discredit all health advice on WPS.
2. Questions about an individual's WPS status are incorporated into general health checks, including information about how often a person smokes WPS and how long each session lasts.
3. Taking lung function measures as part of a health check (such as FEV1) may highlight potential effects of WPS on users.
4. Pregnant women do not smoke WPS and standard advice about smoking in pregnancy is followed.
5. Children and pregnant women do not stay in the same environment as a WPS session.
6. Despite the lack of evidence based interventions of WPS (Ward 2011), it would be reasonable to provide current WPS with access to smoking cessation services if requested and assessed.
7. There is an investigation into labelling of WPS products within Leicester in order to understand this further (eg are packages being labelled as a harmless alternative to tobacco, or 'tar free').
8. There is further investigation into the prevalence of shisha smoking within Leicester.

## Abbreviations

BP	Blood Pressure
CEA	Carcinoembryonic antigen
COPD	Chronic Obstructive Pulmonary Disease
CO	Carbon monoxide (in environment/expired air)
COHb	Carboxyhaemoglobin. Levels of Carbon Monoxide in blood
OR	Odds Ratio
CI	Confidence Interval
FEV1	Forced expiratory volume in 1 second
FVC	Forced volume vital capacity: the volume of air forcibly blown out after full inspiration
HR	Heart Rate
PEFR	peak expiratory flow rate
SMD	Standardised mean difference
WPS	Water pipe smokers/smoking

## References

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## Appendix 1: Summary of papers

**Akl et al (2010)a:** Systematic review and meta analyses of 24 studies based on Cochrane Guidelines looking at lung cancer (6 studies), low birth weight (3 studies), periodontal disease (5 studies), respiratory illness (1 study), bladder cancer, oesophageal cancer, oral dysplasia, Hepatitis C and Infertility.

Main findings: shisha smokers were twice as likely to have lung cancer than non smokers, ranging from 10% to five times more likely (OR=2.12; 95% CI 1.1,5.1); were twice as likely to have low birth weight babies ranging from 8% to four times more likely (pooled OR =2.12; 95%CI 1.08,4.18) and from three to five times more likely to have periodontal disease. They highlighted the poor quality of evidence, for example, small numbers of study participants, lack of controls, use of same participant populations for different studies and lack of validated outcome measures.

**Blank et al (2011):** double blind, placebo-control study comparing a tobacco free to tobacco product in WPS examining nicotine levels, COHb and expired CO. Small study (n=37) of occasional shisha smokers (2-5 sessions per month).

Main findings: WPS significantly increased mean plasma nicotine concentration ( $3.6 \pm 0.7$  ng/ml) and heart rate ( $8.6 \pm 1.4$  bpm) in those smoking tobacco products only while significant increases in expired CO and COHb levels were reported in all participants.

**Cobb et al (2011):** compared toxicant exposure and subjective effects between WPS and cigarette smokers. 54 participants smoked either a waterpipe (mean time 43.3mins) or cigarette (mean time 6.1min).

Main findings: peak nicotine levels were similar in each group but rose according to time, with cigarette smokers peaking at 5 minutes and WPS at 45 minutes. Mean expired-air CO: Cigarette  $7.4 \pm 0.5$  ppm at 50mins,  $7.1 \pm 0.5$  ppm at 60 mins and waterpipe:  $32.9 \pm 2.7$  ppm at 50mins and  $31.1 \pm 2.6$  ppm at 60mins. Mean peak COHb was less in cigarette smokers ( $1.2 \pm 0.1\%$ ) than shisha smokers ( $4.5 \pm 0.3\%$ ), and puff number and volume was significantly less in cigarette smokers.

**Eissenberg E and Shihadeh A (2009)** Small study (n=31) comparing toxicant exposure between cigarette and WPS in existing cigarette and shisha smokers (one participant population). Compared smoking one cigarette with a 45 minute WPS session.

Main findings: There was a significant time effect on CO levels in both groups. COHb levels in cigarette smokers peaked at 1.2% and WPS 3.9%, mean plasma nicotine levels peaked at 6.8ng/ml (cigarette, 15 minutes) and 8.5ng/ml (WPS, 45 minutes).

**Hakim et al (2011)** Small study (n=45) comparing pre and post levels of different cardiopulmonary measures after one 30 minute session of WPS in existing shisha smokers. Eight of the participants were also cigarette smokers. Significant changes were noted in COHb levels (from median 1.4 to 7.4). There were no significant changes in PEFR, FEF and eosinophil %.

**Raad et al (2011)** Systematic review and meta-analysis of six cross sectional studies comparing effects of water pipe smoking on lung function. There was no standardisation across studies of puff rate, type of charcoal, tobacco used or measurement.

Main findings: WPS had 43% reduced FEV1 as compared to none smokers, ranging from 58% to 29% reduced FEV1. There was no significant difference between FVC and FEV1/FVC. WPS had a 27% higher FVC than cigarette smokers ranging from 9% to 44% higher. There was no significant difference between cigarette and WPS FEV1 and FEV1/FVC.

**Sajid et al (2008):** Small study comparing CEA levels in shisha smokers to non-smokers of shisha or cigarettes. Small study (n=59) with unmatched, non-randomly selected controls (n=36) and large age range (20 – 80 years). Study found that only heavy shisha smokers had a significant increase in CEA has compared to non-smokers. Heavy smokers were defined as those who smoked for up to six hours per day.