ORIGINAL ARTICLE

Measuring Carbon Monoxide levels of Hookah Cafés in Karachi, Pakistan

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ABSTRACT

Objective: This study aimed to assess the levels of carbon monoxide (CO) in the air inside water-pipe cafés in Karachi, Pakistan.
Methodology: During June 2015, three water-pipe cafés in the city of Karachi, Pakistan were selected through convenience sampling. CO air samples were collected from the selected cafés using Carbon Monoxide USB Data logger. The graphs were automatically generated through the USB Data logger and the collected data was analyzed using Microsoft Excel.
Results: The results showed that the overall readings of CO levels were within/lower than threshold limit value (TLV) of 25 ppm. However, there was an increase of CO levels in indoor air of all included water-pipe café during peak hours when the cafés were open and had a regular customer flow compared to the CO levels overnight.
Conclusion: The findings of this study provide evidence that the air quality in water-pipe cafés is potentially hazardous to the health of its employees, which is critical to inform tobacco control policies and regulations for such venues. The study findings also indicate a clear need to extend research to not only focus on the indoor air quality of water-pipe cafés, but also the biological monitoring of employees in water-pipe cafés.

Key words: Water pipe smoking, second hand smoke, carbon monoxide, indoor air quality, hookah cafés

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INTRODUCTION

Tobacco-related research and tobacco control regulations generally remain limited to cigarettes, while other forms of tobacco uses are common worldwide[1]. Furthermore, some cities and states have specific exemptions that allow water-pipe smoking to remain in operation[2] which may be due to the ubiquitous but incorrect perception that water pipe smoking is less harmful compared to cigarette smoking because of the belief that dangerous tobacco components are filtered by the water[3,4].

In a water-pipe smoking session, the smoker inhales through the hose drawing smoke from the charcoal and tobacco combustion through the water as a result of which there is incomplete combustion of the tobacco. Both the charcoal briquette and the incomplete tobacco combustion contribute to the levels of carbon monoxide (CO) and particulate matter (PM) in the air[5,6]. Several toxicological studies have shown that a typical water-pipe tobacco smoke session has almost 25 cigarettes worth of tar, 11 cigarettes worth of CO and 2 cigarettes worth of nicotine[7].

Water-pipe tobacco smoke have shown to cause damaging effects on cell function in lung epithelial cells and vascular endothelial cells, which potentially leads to development of chronic obstructive pulmonary disease (COPD) and vascular disease[8]. Water-pipe smoke inhalers absorb a significant amount of toxic chemicals similar to those in cigarette smoke that are identified as a causal factor for lung disease, vascular damage, cancer, and dependence[8]. Therefore, the increase in water-pipe smoking popularity raises a public health concern.

Though, the dangers of water-pipe smoking have been documented, but data from water-pipe cafés is lacking[9,10]. Water-pipe smoke produces sweet smelling noxious fumes that the employees of a water-pipe café inhale along with the toxins from the charcoal that is used to heat the tobacco[2]. Assessing air quality through measurement of CO levels in closed room cafés may aid the understanding of the toxins and exposure of

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the employees. This study aimed to assess the level of carbon monoxide (CO) in the air inside water-pipe cafes in Karachi. The results can provide novel information regarding water-pipe smoke's effect on air quality which may help generate regulatory efforts to protect the café employees against water-pipe smoke. To the best of the authors' knowledge, this is the first study of its kind addressing carbon monoxide levels in water pipe cafes in Karachi, Pakistan.

METHODOLOGY

A cross sectional study was conducted in water-pipe cafés in Karachi, Pakistan during June 2015. Water-pipe cafés were identified through an internet search. Out of total 9 waterpipe cafes, 3 were selected through non-probability convenience sampling. All cafés were indoor, air-conditioned and had a dark interior structure. An initial visit to the selected venues was done to introduce the researcher and study objectives to the owners of the selected cafés and to seek their consent for the study. CO air samples were collected from the included cafés using Carbon Monoxide USB Data logger. The data logger measures and stores readings over a 0 to 1000 ppm measurement range and the data can be easily viewed by plugging it into a computer's USB port.

The sampling device was left with café managers. It was left for 30 hours at venue #1, for almost 7 hours at venue #2 and for 70 hours at venue #3 to measure the CO levels in the respective cafés. Different duration for recording CO levels in different cafes was to compare the variation in data among the cafés. The graphs were automatically generated through the USB Data logger and the collected data was analyzed using Microsoft Excel. All the graphs were compared for peak levels at various intervals. Ethical approval for this study was obtained from Dow University of Health Sciences (IRB-564/DUHS/-15/51).

RESULTS

All venues were poorly ventilated and had closed windows and doors that only opened occasionally. Almost 60% of the café employees were less than 25 years old whereas the others were 25 years old or above. The average sampling duration of CO inside the cafés was around 36 hours. The date from the USB data logger was graphed which was then analyzed. Figure 1 depicts the readings of CO levels in indoor air of water-pipe café venue #1. The levels showed that CO levels increased up to 15 ppm from 4 PM to 1:30 AM and then again started to peak, going up to 20 ppm around 1 PM the following day.

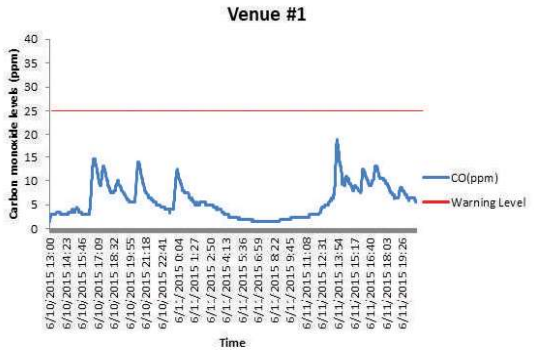

Figure 1: Carbon Monoxide levels at Venue #1

Figure 2 illustrates CO monitoring samples from venue #2, which were taken for 7 hours from 1 PM to 8 PM. The CO levels were observed to increase above 5 ppm from 4 PM onwards, reaching the highest level of 21 ppm between peak hours (6 PM – 7 PM).

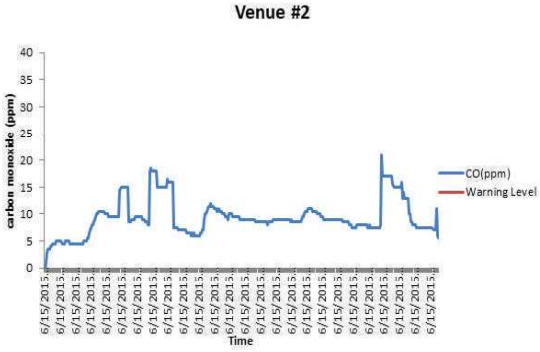

Figure 2: Carbon Monoxide levels at Venue #2

Figure 3 shows CO levels at venue #3 which were measured for three days. Each day CO level started to increase at around 12 PM and remained increased till 12 AM. They reached the highest peak at almost 20 ppm at day 3 around 12 PM.

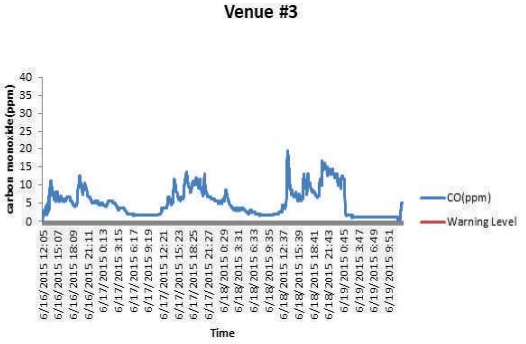

Figure 3: Carbon Monoxide levels at Venue #3

Overall, readings of the CO monitoring samples from all included venues peaked at an average of 20 ppm which was within threshold limit value (TLV) of 25 ppm and MAK maximum workplace value of 30 ppm.

DISCUSSION

Indoor airborne concentrations of CO were noticeably elevated in the sampled water-pipe cafés from Karachi city; supporting previous evidence that water-pipe affects indoor air quality by producing a significant quantity of CO[11]. The results showed an increase of CO levels during the hours when the cafés were open for business and had a regular customer flow. Whereas from 12 midnight to 12 noon, readings from all venues showed a decrease level of CO in the air. Thus, indicating that CO levels increase during hours of high number of active water-pipes and customers[12], as majority of water-pipe users in Karachi prefer smoking it at the café[13]. In addition to CO, particulate matter (PM2.5), particle-bound polycyclic aromatic hydrocarbons (p-PAHs) and air nicotine are also seen to be increased in indoor air of water-pipe venues[11] however, these indicators of air quality were not measured in the present study.

The charcoal used to heat the water-pipe tobacco was likely the major source of CO measured in the present study as the venues did not have an alternate source of combustion byproducts such as cooking and open fires. However, cigarette smoking can be considered as a confounder for the level of CO found in the cafés which calls for additional research to assess this correlation.

According to the National Ambient Air Quality Standards set by United States Environmental Protection Agency (EPA), the overall average CO concentration at venue #1 and venue #3 were within the EPA 8-hours CO level of 9 ppm[14]. Whereas, the average CO level at venue #2 exceeded 9 ppm, however as the measurement was taken over a period of 7 hours, the EPA 8-hours CO air quality standard cannot be identified. Similarly, the measured CO levels from all venues were within the EPA 1-hour CO level of 35 ppm[14].

Thus, the results showed that the CO levels in the included venues were below the warning level and appeared to be safe for employees working in that environment. This contraindicates with finding from previous studies in which CO was seen to be remarkably increased in indoor air of cafés[15,16]. A possible explanation of our findings can be that the concentration of CO in air depends on multiple factors, including the number of smokers in the room, the rate at which they smoke, the volume into which the smoke is distributed, the rate at which the air in the space exchanges with uncontaminated air and the rate at which the smoke is removed from the air. Significant correlations have also been observed between mean CO and the number of water-pipe smokers, number of water-pipes and water-pipe smoking density[17].

Additionally, evidence suggests that CO levels are higher in patrons of water-pipe cafés, for both current and non-cigarette smokers, compared to cafés where water-pipes are not available as people who did not use any cigarette in the past month but visited a water-pipe café demonstrated to have significantly higher CO values (mean=28.5ppm)[18]. As a smoker can inhale 10 times the number of "puffs" in a single hookah session and each "puff" can have 10 times the volume of CO of that in a conventional cigarette, it leads to an increased CO level in hookah smokers[19]. In spite of this, it remains an under researched topic and an overlooked hazard among Pakistani health planners[20]. It is crucial to test CO levels of employees of water-pipe cafés to further investigate the effects of second hand smoking of water-pipe on a person's health.

Limitations in the present study should be kept under consideration when generalizing the results to other water-pipe venues and cities. Study limitations include the small sample size and the failure to assess the air exchange rates or ventilation within the venues, which made it difficult to explain the variability in CO levels within and between venues. Additionally, all concentrations reported in the paper may not necessarily signify actual personal exposures as they are based on area sampling only. Also, as the sampling device was left with the café managers, this could have introduced measurement bias during data collection. Thus, further studies should be conducted on larger sample size including personal air sampling and direct ventilation assessment to more accurately assess exposures.

CONCLUSION

The findings of this study showed that the overall readings of CO levels were within/lower than threshold limit value (TLV) of 25 ppm. However, the aforementioned limitations of this study indicate a clear need to extend research to not only focus on the indoor air quality of water-pipe cafés, but also the biological monitoring of employees in water-pipe cafés.

Author's contributions: RB designed the study proposal, did the data collection and analysis with MP's support. MP did the study write-up and developed the manuscript with the help of RB.

References

1. Torrey CM, Moon KA, Williams DAL, green Tim, Cohen JE, Acien AN, et al. Water pipe cafes in Baltimore, Maryland: Carbon monoxide, particulate matter, and nicotine exposure. J Expo Sci Environ Epidemiol. 2015; 25(4):405-410.
2. Noonan D. Exemptions for hookah bars in clean indoor air legislation: a public health concern. Public Health Nurs. 2010;27(1):49–53.
3. Akl EA, Ward KD, Bteddini D, khaliel R, Alexander AC, Lotfi T, et al. The allure of the waterpipe: a narrative review of factors affecting the epidemic rise in waterpipe smoking among young persons globally. Tob Control. 2015;24(1):i13–i21.
4. Akl EA, Jawad M, Lam WY, Co CN, Obeid R, Irani J. Motives, beliefs and attitudes towards waterpipe tobacco smoking: a systematic review. Harm Reduct J. 2013;10: 12. doi: 10.1186/1477-7517-10-12.
5. Cobb CO, Shihadeh A, Weaver MF, Eissenberg T. Waterpipe tobacco smoking and cigarette smoking: a direct comparison of toxicant exposure and subjective effects. Nicotine Tob Res. 2011;13(2):78–87.
6. Shihadeh A, Saleh R. Polycyclic aromatic hydrocarbons, carbon monoxide, “tar”, and nicotine in the mainstream smoke aerosol of the narghile water pipe. Food Chem Toxicol. 2005;43(5):655–661
7. Primack BA, Carroll MV, Weiss PM, Shihadeh AL, Shensa A, Farley ST, et al. Systematic review and meta-analysis of inhaled toxicants from waterpipe and cigarette smoking. Public Health Rep. 2016;131(1):76–85.
8. Ali M, Jawad M. Health Effects of Waterpipe Tobacco Use: Getting the Public Health Message Just Right. Tob Use Insights. 2017;10:1179173X17696055. doi: 10. 1177/1179173X17696055.
9. M, J, Vogl, L. Waterpipe cafés are hazardous to your health: Determination of a waterpipe specific calibration factor. 2018;221(1):48-53. doi: 10.1016/j.ijheh. 2017. 10.002
10. Zhou S, Behrooz L, Weitzman M, Pan G, Vilcassim R, Mirowsky J, et al. Secondhand hookah smoke: an occupational hazard for hookah bar employees. Tob Control. 2017;26(1):40-45. doi: 10.1136/tobaccocontrol-2015-052505.
11. Moon KA, Magid H, Torrey C, Rule AM, Ferguson J, Susan J, et.al. Secondhand Smoke in Waterpipe Tobacco Venues in Istanbul, Moscow, and Cairo. Environl Res. 2015; 142:568–574. doi: 10.1016/j.envres.2015.08.012.
12. Gurung G, Bradley J, Delgado Saborit JM. Effects of shisha smoking on carbon monoxide and PM2.5 concentrations in the indoor and outdoor microenvironment of shisha premises. Sci Total Environ.2016;548-549:340-346. Doi:10.1016/j.scitotenv.2015.12.093.
13. Khan N, Siddiqui MU, Padhiar AA, Hashmi SA, Fatima S, Muzaffar S. Prevalence, knowledge, attitude and practice of shisha smoking among medical and dental students of Karachi, Pakistan. J Dow Univ Health Sci. 2008;2(1):3-10.
14. United States Environmental Protection Agency. National Ambient Air Quality Standards (NAAQS) Table, EPA, 2016. Available at: (Accessed on: 18th January 2019).
15. M,R,S,A. Concentrations of carbon monoxide in indoor and outdoor air of Ghalyun cafes. (ARP).2015; 6(4):550-555.
16. Fromme H, Dietrich S, Heitmann D, Dressel H, Diemer J, Schulz T, et.al. Air contamination during a waterpipe (narghile) smoking session. Food Chem Toxicol.2009; 47:1636-1641.
17. Moon KA, Magid H, Torrey C, Rule AM, Ferguson J, Susan J, et.al. Secondhand Smoke in Waterpipe Tobacco Venues in Istanbul, Moscow, and Cairo. Environ Res. 2015;142:568–574.
18. Barnett T, Curbow B, Soule E, Tomar S, Thombs D. Carbon monoxide levels among patrons of hookah cafes. Am J Prevent Med. 2011;40(3):324-8.
19. Ashurst J, Urquhart M, Cook M. Carbon monoxide poisoning secondary to hookah smoking. J Am Osteopath Assoc. 2012;112(10):686-688.
20. Khan N, Iftikhar S, Siddiqui MU, Padhiar AA, Haq SA. Effect of Age and Gender on the Knowledge, Attitude and Practice of Shisha Smoking among Medical and Dental Students of Karachi, Pakistan. J Dow Univ Health Sc. 2010;4(3):107-112