Introduction

Today, hookah use is a growing problem throughout the world, especially in the countries of the Eastern Mediterranean, including the Arab countries, Turkey, and Iran (1-3). While most recent studies, policies, and efforts have focused on cigarette smoking, hookah use is increasing, particularly in developing regions (Asia, India, and the Eastern Mediterranean), and has received little attention (4, 5). There has been a significant increase in hookah use according to the results of a study conducted in one of the Arab countries, indicating that 25% of male students and 5% of female students used hookah (5).

In recent years, the popularity of hookah has increased among young people in the Middle East, the United States, Canada, France, Russia, the United Kingdom, and Australia (6). The most important factors influencing the increase in hookah smoking are social acceptance, lack of awareness about its health effects, and lack of consistency in prevention programs.

Many people believe that hookah smoke is somewhat purified and less dangerous due to passing through water and this misconception has increased the use of hookah in friendly gatherings (7, 8); however, in most cases, hookah use is one of the preventable causes of diseases and deaths due to heart diseases and cancer. Studies have shown that a single hookah smoking session could be associated with endothelial dysfunction, even in young people without cardiovascular disorders or other risk factors.

The results of a study showed that there are several toxic substances in hookah smoke, including nicotine (9-11), carbon monoxide (9, 12), carcinogenic polycyclic Relationship between Exposure to Hookah Smoke and Lung Capacity of Hookah Cafe Employees

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Abstract

Background: The aim of the present study was to investigate the effect of exposure to hookah smoke on the respiratory capacity of employees working in hookah cafes in Bandar Abbas.

Methods: A total of 75 employees of hookah cafes and 64 people in the control group were the target population. Participants without a history of smoking, diabetes, and hypertension were included in the study. First, the height and weight of subjects were measured and then a respiratory test was performed by an occupational medicine specialist. At the same time, a checklist was completed, which contained demographic characteristics, history of working in hookah cafes, pulmonary diseases, hypertension, smoking, exercising, and a second job.

Results: The mean age of the case and control groups was found to be 31.41 and 30.73 years, respectively. The mean values of the indices in the case and the control groups were as follows: forced expiratory volume (FEV1): 84.4% and 89.9%, forced vital capacity (FVC): 91.5% and 91.1%, forced expiratory flow 25-75 (FEF25-75): 78.7% and 75.9%, and peak expiratory flow (PEF): 87.2% and 95.2%, respectively. A significant relationship was found between exposure to hookah smoke and the lung capacity of employees working in hookah cafes (P < 0.001).

Conclusion: Based on the findings of the study and in order to reduce passive exposure to hookah smoke and its negative consequences, officials should review and apply strict rules on hookah use and monitor and control the air quality inside hookah cafes.

Keywords: Waterpipe, Hookah, Smoke, Employee, Lung capacity

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Introduction

Today, hookah use is a growing problem throughout the world, especially in the countries of the Eastern Mediterranean, including the Arab countries, Turkey, and Iran (1-3). While most recent studies, policies, and efforts have focused on cigarette smoking, hookah use is increasing, particularly in developing regions (Asia, India, and the Eastern Mediterranean), and has received little attention (4, 5). There has been a significant increase in hookah use according to the results of a study conducted in one of the Arab countries, indicating that 25% of male students and 5% of female students used hookah (5).

In recent years, the popularity of hookah has increased among young people in the Middle East, the United States, Canada, France, Russia, the United Kingdom, and Australia (6). The most important factors influencing the
The checklist contained information on age, gender, completed by interviewing case and control participants. A checklist was prepared and whom 64 were included in the study after screening group who were age-matched with the case group, of hookah cafes were selected as the study population. An environmental health statistics, there are 68 active hookah cafes in Bandar Abbas, among which 50% (34 units) were selected as the target population. Two to three employees working in hookah cafes. According to one study, long-term exposure to hookah smoke leads to increased plasma and salivary levels of toxic metals, namely cadmium, copper, and zinc, which can contribute to cancer development. In a meta-analysis, the odds ratio for the association between hookah smoking and heart disease was reported to be 1.67 (95% CI = 1.25, 2.24), confirming the hypothesis that hookah is indeed harmful to the cardiovascular system.

Another study (data collected from 152 academic institutions; n = 100891 students) showed a moderate association between hookah use and mental health variables, such as depression, anxiety, and addictive disorders among students. These findings provide evidence that hookah not only impairs the "physical" health of the smoker, but also endangers his/her mental state.

Smoking hookah generates high levels of particulate matter in hookah cafes, inactively exposing customers and employees to hazardous levels of pollutants. Exposure to poor air quality poses health risks, especially in people with lung and cardiovascular disease. It could cause risks to the health of workers who are exposed to second-hand hookah/tobacco smoke in a daily manner and for long periods of time. Preliminary evidence suggests an intermediate relationship between hookah use and respiratory, cardiovascular, cancer, and even eczema. Therefore, considering the importance of hookah smoking, especially in the southern regions of the country, this study aimed to investigate the effect of exposure to hookah smoke on the respiratory capacity of employees working in hookah cafes in Bandar Abbas.

**Materials and Methods**

In this case-control study, the study participants were employees working in hookah cafes. According to the environmental health statistics, there are 68 active hookah cafes in Bandar Abbas, among which 50% (34 units) were selected as the target population. Two to three employees from each hookah cafe were selected and included in the study. After initial screening and taking into account the exclusion criteria (no underlying respiratory disease, hypertension, diabetes, and smoking), 75 subjects in these hookah cafes were selected as the study population. An equal number of subjects were registered as the control group who were age-matched with the case group, of whom 64 were included in the study after screening for exclusion criteria. A checklist was prepared and completed by interviewing case and control participants. The checklist contained information on age, gender, history of working in a hookah cafe, smoking, diabetes, family history of diabetes, number of hours worked, exercise, second job, hypertension, and so on.

After completing the checklist, a respiratory capacity test was performed on the study participants. In order to perform the test, the participants rested for 15 minutes and then, they sat on a completely comfortable and flat chair. They were asked to relax their belt so that they would not feel any pressure. The test was performed by an occupational medicine specialist. Before each test, measurement equipment was re-calibrated. For the subjects, a nasal clip and a disposable mouthpiece were used and the subjects were asked to close their lips tightly around the mouthpiece. In accordance with the standards of lung function testing of the American Chest Association and the European Respiratory Association, the following steps were performed for breathing:

1. First, a few normal breaths (inhale and exhale) were taken.
2. Second, a deep, full, and fast inhale was performed so that all the spaces of the lungs were filled with air.
3. Finally, exhaling was performed as quickly as possible with the maximum intensity and strength so that the lungs became completely empty. The exhalation lasted at least 6 seconds.

The test was performed three times and the highest capacity was recorded on a spirometry tape and then interpreted and analyzed by an occupational medicine specialist. Pulmonary function parameters included Forced vital capacity (FVC), Forced expiratory volume (FEV), FEV1, forced expiratory flow 25-75 (FEF25%-75%) and peak expiratory flow (PEF), which are described below.

FVC is the amount of air that a person can push out of lungs after taking a deep breath. FEV is the amount of air that a person can exhale through pressure on the lungs. FEV1 is a part of the forced expiratory volume that leaves the lungs in the first second. FEV 25-75% is the forced expiratory flow between 25% and 75% of vital capacity. PEF is the peak of expiratory flow, i.e., the maximum expiratory flow when a person exhales with maximum pressure.

To describe the data, mean and standard deviation were used for quantitative variables, and frequency and percentage were used to present qualitative variables. Additionally, t-test, Chi-square, and Fisher’s exact test were used to analyze the data.

**Results**

In this study, a total of 75 subjects were registered in the case group and 75 subjects in the control group. The demographic information of the participants is presented in Table 1.

Based on the results, no statistically significant difference was observed between the case and control groups for the
variables of gender, drug use, age, and work experience ($P > 0.05$). However, there was a statistically significant difference in terms of physical activity and smoking between the case and control groups ($P < 0.05$). In order to better explain the similarity of the demographic characteristics of the case and control groups, a part of this information is shown in Figure 1.

In this study, the dependent variables of systolic blood pressure (SBP), diastolic blood pressure (DBP), FEV1, FVC, PEF, and FEF25-75% were compared between the case and control groups through independent samples t test. The results are presented in Table 2.

According to Table 2, there was a statistically significant difference in FEV1, PEF, and FEV1/FVC ratios between the case and control groups. In order to better explain the studied indices in terms of respiratory capacity, the values of these indices were presented in Figure 2.

**Discussion**

As shown in Figure 1, a large number of people who work in hookah houses are women. The presence and activity in the cafe and the use of hookah can have more adverse effects on the health of women compared with men. The harmful effects of hookah during pregnancy, especially in the first trimester of pregnancy, have long been reported in various studies (23). These effects included intrauterine fetal growth reduction, preterm delivery, placental abruption, abnormalities, perinatal complications, low birth weight, increased risk of genetic disorders, and respiratory failure at birth (23, 24). In the study of Eftekhar et al, it was reported that hookah use during pregnancy is a risk factor for intrauterine fetal growth reduction (OR = 3.5, 95% CI = 1.1-12.6) (25). In recent years, the increase in the number of hookah cafes, the tendency to use hookah, and the creation of suitable conditions for women to use hookah have led to a greater tendency of women to hookah smoking. This shows the need for more information and awareness in this field (26). The results of the present study (Table 2) showed that exposure to hookah smoke reduced pulmonary function indices including FEV1, FEV1/FVC, and PEF, and in this regard, there was a significant difference between case and control groups ($P < 0.05$). According to previous studies, the air quality of hookah houses is significantly low, and high amounts of particulate matter (PM2.5) and carbon monoxide have been detected in these places. Studies on hookah cafe employees have shown that non-smokers have measurable carcinogenic and inflammatory biomarkers (27). In a study by Meo et al on hookah smokers, a significant reduction in lung function

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**Table 1. Demographic Characteristics of the Participants**

| Variable          | Category | Case No. (%) | Control No. (%) | Total No. (%) | P Value* |
|-------------------|----------|--------------|-----------------|---------------|----------|
| Gender            | Male     | 33 (44.0)    | 40 (53.1)       | 73 (48.7)     | 0.253    |
|                   | Female   | 42 (56.0)    | 35 (46.7)       | 77 (51.3)     |          |
| Drug use          | No       | 71 (94.7)    | 69 (92.0)       | 140 (93.3)    | 0.513    |
|                   | Yes      | 4 (5.3)      | 6 (8.0)         | 10 (6.7)      |          |
| Physical activity | No       | 60 (80.0)    | 40 (53.1)       | 100 (66.7)    | 0.001    |
|                   | Yes      | 15 (20.0)    | 35 (46.7)       | 50 (33.3)     |          |
| Smoking           | No       | 64 (85.3)    | 75 (100.0)      | 139 (92.7)    | 0.001    |
|                   | Yes      | 11 (14.7)    | 0 (0.0)         | 11 (7.3)      |          |
| Age (yr) (mean ± SD) |        | 31.67 ± 8.02 | 30.83 ± 4.43    | 31.25 ± 6.47  | 0.429    |
| Work experience (yr) (mean ± SD) | | 3.81 ± 2.48  | 4.44 ± 2.14    | 4.12 ± 2.33   | 0.095    |

*Comparison between case and control groups.
Table 2. Comparison of the Case and Control Groups in Terms of Hypertension and Spirometric Indices

| Variable     | Case (n = 75) Mean ± SD | Control (n = 64) Mean ± SD | P Value |
|--------------|-------------------------|---------------------------|---------|
| SBP (cmHg)   | 11.24 ± 1.40            | 11.03 ± 0.96              | 0.279   |
| DBP (cmHg)   | 7.36 ± 0.69             | 7.28 ± 0.63               | 0.457   |
| FEV1         | 84.41 ± 9.38            | 89.93 ± 7.56              | <0.001  |
| FVC          | 91.48 ± 10.67           | 91.19 ± 7.99              | 0.849   |
| FF25-75      | 78.73 ± 17.01           | 75.91 ± 12.01             | 0.242   |
| PEF          | 87.21 ± 14.24           | 95.21 ± 10.61             | <0.001  |
| FEV1/FVC ratio | 0.926 ± 0.07          | 0.988 ± 0.04              | <0.001  |

Figure 2. Comparison of the Case and Control Groups in Terms of Respiratory Capacity Indices

parameters was observed compared to the control group, including FEV1, FEV1/FVC ratio, FEF-25%, FEF-50%, FEF-75%, and FEF-75-85%. This is an important part of the respiratory function assessment and is used to classify the nature, severity, and progression of respiratory diseases (28). Other studies in this regard also confirm the findings of the present study (28-30). Short-term effects on lung function, changes in oxidative and inflammatory markers in the lung, lung cancer, respiratory disease, increased heart disease, and blood pressure are among the most important health effects of hookah use (31). As shown in Table 2, there was no significant difference between the case and control groups regarding SBP and DBP (P > 0.05). This may be due to the shorter contact time, the type of tobacco used, or the short follow-up time of the study. In a double-blind comparative study, Blank et al showed that cardiovascular effects are primarily caused by nicotine in tobacco. In the group of smokers, nicotine-containing smoke increased heart rate (unlike in cigarette smokers who smoked nicotine-free tobacco). Other similar findings were reported by Shaikh et al who examined the vital signs of 202 volunteers after 45 minutes of hookah use and observed an increase in systolic and diastolic blood pressure, and heart rate (32,33).

Conclusion
What is certain is that prolonged presence in a space filled with hookah smoke has adverse effects on lung capacity. In the end, it can be concluded that authorities should pave the way for more comprehensive studies, policy-making, review and enforcement of stricter laws, as well as monitoring of air quality inside hookah supply centers and the use of hookah to reduce inactive exposure and its negative consequences for health. The negative effects of using hookah or exposure to hookah on health should not be underestimated. Performing similar studies can increase the level of public awareness and knowledge of different groups in society and help educate them about the harmful effects of hookah.

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Authors' Contributions
Conceptualization: VA, HE. Methodology: VA, HE, Leila Rezaei. Investigation: ZH, HRG, SD. Writing—Original Draft Preparation: VA, HE, AG. Writing—Review and Editing: VA, HE, AG.

Conflict of Interests
The authors declare no competing interests.

Ethical Statement
The project has been confirmed by ethical committee of Hormozgan University of Medical Sciences

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Informed Consent
The participants in the study filled the informed consent form before performing the experiments.

References
1. Bahtouee M, Maleki N, Nekouee F. The prevalence of chronic obstructive pulmonary disease in hookah smokers. Chron Respir Dis. 2018;15(2):165-72. doi: 10.1177/1479972317709652.
2. Toghyani A, Sadeghi S. Association of demographic variables and smoking habits with the severity of lung function in adult smokers. J Res Med Sci. 2022;27:18. doi: 10.4103/jrms.jrms_854_21.
3. Dehvari M, Babaei A. Analysis of heavy metals and PAHs in the waste resulting from hookah consumption: Ahvaz city, Iran. Environ Sci Pollut Res Int. 2022;29(22):33130-7. doi: 10.1007/s11356-021-17910-8.
4. Waziry R, Jawad M, Ballout RA, Al Akeil M, Alk EA. The effects of waterpipe tobacco smoking on health outcomes: an updated systematic review and meta-analysis. Int J Epidemiol. 2017;46(1):32-43. doi: 10.1093/ije/dyw021.
5. Dadipoor S, Heyrani A, Mirzaei-Alavijeh M, Aghamolaei T, Ghaffari M, Ghanbarnejad A. Using intervention mapping for hookah smoking cessation: a quasi-experimental evaluation. Addict Sci Clin Pract. 2022;17(1):18. doi: 10.1186/s13722-022-00287-5.
6. Albert SL, Rogers E, Hall Z, Zuardo G, Bragg MA. Comparing the prevalence of alcohol, combustible and electronic cigarettes, hookah, and marijuana, in music videos across 6 genres of popular music from 2014-2020. Subst Use Misuse. 2022;57(6):967-74. doi: 10.1080/10826084.2022.2058703.
7. Zhou S, Behroz L, Weitzman M, Pan G, Vilcassim R, Mirowsky JE, et al. Secondhand hookah smoke: an occupational hazard for hookah bar employees. Tob Control. 2017;26(1):40-5. doi: 10.1136/tobaccocontrol-2015-052505.

8. Hammal F, Wild TC, Finegan BA. Knowledge about the waterpipe (hookah), a qualitative assessment among community workers in a major urban center in Canada. J Community Health. 2016;41(4):689-96. doi: 10.1007/s10900-015-0143-9.

9. 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. 2003;43(5):655-61. doi: 10.1016/j.fct.2004.12.013.

10. Qasim H, Alarabi AB, Alzoubi KH, Karim ZA, Alshbool FZ, Khasawneh FT. The effects of hookah/waterpipe smoking on general health and the cardiovascular system. Inhal Toxicol. 2006;18(4):255-94. doi: 10.1080/08958370500444163.

11. Al Rashidi M, Shihadeh A, Saliba NA. Volatile aldehydes in the mainstream smoke of the narghile waterpipe. Food Chem Toxicol. 2008;46(11):3546-9. doi: 10.1016/j.fct.2008.09.007.

12. Jacob P 3rd, Abu Raddaha AH, Dempsey D, Havel C, Peng M, Yu L, et al. Nicotine, carbon monoxide, and carcinogenic exposure after a single use of a water pipe. Cancer Epidemiol Biomarkers Prev. 2011;20(11):2345-3. doi: 10.1158/1055-9965.epi-11-0545.

13. Schubert J, Hahn J, Dettbarn G, Seidel A, Luch A, Schulz T. Mainstream smoke of the waterpipe: does this environmental matrix reveal as significant source of toxic compounds? Toxicol Lett. 2011;205(3):279-84. doi: 10.1016/j.toxlet.2011.06.017.

14. Sepedtjian E, Abdul Halim R, Salman R, Jaroudi E, Shihadeh A, Saliba NA. Phenolic compounds in particles of mainstream waterpipe smoke. Nicotine Tob Res. 2013;15(6):1107-12. doi: 10.1093/nttr/nts255.

15. Schubert J, Bewersdorff J, Luch A, Schultz TG. Waterpipe smoke: a considerable source of human exposure against furanic compounds. Anal Chim Acta. 2012;709:105-12. doi: 10.1016/j.aca.2011.10.012.

16. Blachman-Braun R, Del Mazo-Rodriguez RL, López-Sámano G, Euendia-Roldán I. Hookah, is it really harmless? Respir Med. 2014;108(5):661-7. doi: 10.1016/j.rmed.2014.01.013.

17. Tamim H, Yunis KA, Chemaitelly H, Alameh M, Nassar AH. Effect of narghile and cigarette smoking on newborn birthweight. BJOG. 2008;115(1):91-7. doi: 10.1111/j.1471-0528.2007.01568.x.

18. Meo SA, AlShehri KA, Al-Harbi BB, Barayyan OR, Bawazir AS, Alazani OA, et al. Effect of shisha (waterpipe) smoking on lung functions and fractional exhaled nitric oxide (FeNO) among Saudi young adult shisha smokers. Int J Environ Res Public Health. 2014;11(9):9638-48. doi: 10.3390/ijerph110909638.

19. Ansari H, Ansari-Moghaddam A, Mohammad M. Prevalence of substance abuse and associated factors in hookah users. J Mazandaran Univ Med Sci. 2016;26(136):73-84. [Persian].

20. Shearston J, Lee L, Eazor J, Meherally S, Park SH, Vilcassim MR, et al. Effects of exposure to direct and secondhand hookah and e-cigarette aerosols on ambient air quality and cardiopulmonary health in adults and children: protocol for a panel study. BMJ Open. 2019;9(6):e029490. doi: 10.1136/bmjopen-2019-029490.

21. Raad D, Gaddam S, Schunemann H, Irani J, Abou Jaoude P, Honeine R, et al. Effects of water-pipe smoking on lung function: a systematic review and meta-analysis. Chest. 2011;139(4):764-74. doi: 10.1378/chest.10-0991.

22. Hakim F, Hellou E, Goldbart A, Katz R, Bentur Y, Bentur L. The acute effects of water-pipe smoking on the cardiorespiratory system. Chest. 2011;139(4):775-81. doi: 10.1378/chest.10-1833.

23. Jonoidi Jafari A, Rastegar A, Nazarzadeh M. Evaluation of the cardiorespiratory system. Chest. 2011;139(4):764-74. doi: 10.1378/chest.10-0991.

24. Qasim H, Alarabi AB, Alzoubi KH, Karim ZA, Alshbool FZ, Khasawneh FT. The effects of hookah/waterpipe smoking on general health and the cardiovascular system. Inhal Toxicol. 2006;18(4):255-94. doi: 10.1080/08958370500444163.

25. Blank MD, Cobb CO, Kilgalen B, Austin J, Weaver MF, Shihadeh A, Eisenberg T. Acute effects of waterpipe tobacco smoking: a double-blind, placebo-control study. Drug and Alcohol Dependence. 2011 Jul 1;116(1-3):102-9. doi: 10.1016/j.drugalcdep.2010.11.026.