The Effects of Smoking Cigarette and Hookah to the Breath Carbon Monoxide Level

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ABSTRACT

Aim: The aim of this study is to compare the effect of smoking cigarette and hookah to the breath carbon monoxide level.

Methods: This descriptive cross-sectional research was performed in İstanbul hookah cafes and in Şişli Hamidiye Etfal Hospital Family Medicine policlinic, who applied for any complaint and accepted to include in the study, who were over the age of 18. After getting the information about sociodemographic factors and smoking features of individuals who use hookah and cigarette, the breath carbon monoxide levels were measured. Using the appropriate statistical methods $p<0.05$ was considered statistically significant.

Results: A total of 215 participants, 78.6% (n=169) of them were male, 61.9% (n=133) were single. 57.2% (n=123) of them was self-employment. The average carbon monoxide levels were 45.65±27.87 ppm in the group that uses both hookah and cigarettes; 45.35 ± 30.74 ppm in only hookah users and 16.22±11.97 ppm in only smokers group. There was a significant positive linear relationship between the amount of smoked cigarettes and hookah with the carbon monoxide level. The average carbon monoxide value was greater in the group who were using hookah and cigarette together.

Conclusion: The use of hookah increases the level of breath carbon monoxide more than cigarette. The breath carbon monoxide level increases linearly as the amount of cigarettes/hookah increase.

Keywords: carbon monoxide, hookah, smoke, tobacco

Nargile Ve Sigara Kullanımının Nefeste Karbon Monoksit Düzeyine Etkisi

ÖZ

Amaç: Bu çalışmanın amacı, nargile ve sigara içiminin nefeste karbon monoksid düzeyine etkisini karşılaştırmaktır.

Yöntem: Tanımlayıcı-kesitsel tipteki bu çalışma İstanbul ilindeki nargile kafelerde ve Şişli Hamidiye Etfal Eğitim ve Araştırma Hastanesi Aile Hekimliği Polikliniği'ne herhangi bir sebeple başvuran ve çalışmaya katılmayı kabul eden 18 yaş üzeri bireylerde yapıldı. Nargile ve sigara içen bireylerin sosyodemografik bilgileri, kullanım özelliklerine yönelik bilgiler alındıktan sonra nefeste karbon monoksid ölçümleri yapıldı. Uygun istatistiksel yöntemler kullanılarak $p<0,05$ anlamlı olarak kabul edildi.

Bulgular: Toplam 215 katılımcının %78,6'sı (n=169) erkek, %61,9'u (n=133) bekardı. %57,2'si (n=123) serbest meslekte çalışmaktaydı. Nargile ve sigarayı beraber kullanan grubun karbon monoksid ortalaması 45,65±27,87 ppm, sadece nargile içenlerin 45,35±30,74 ppm; sadece sigara içenlerin ise 16,22±11,97 ppm idi. İçilen sigara ve nargile miktarı ile karbonmonoksit miktarı arasında doğrusal pozitif anlamlı bir ilişki vardı. Sigara ve nargileyi birlikte kullananlarda karbon monoksid değerleri ortalaması daha fazlaydı.

Sonuç: Nargile kullanımı, nefeste karbon monoksid düzeyini sigaradan daha fazla arttırmaktadır. Nefeste karbon monoksid düzeyi içilen nargile/sigara miktarı arttıkça doğrusal olarak artmaktadır.

Anahtar kelimeler: karbon monoksid, nargile, sigara, tütün

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Introduction

In recent years, hookah has become one of the popular forms of tobacco use. Although they are perceived as more harmless than smoking, it is related with many of the similar chronic health effects (1). In addition to acute intoxications, carbon monoxide (CO) levels cause chronic polymyositis, pulmonary dysfunction, cardiovascular diseases.

During a smoking session that generally lasts 45 minutes to 1 hour, a hookah smoker typically inhales average 0.15 to 1 liters of smoke, and are exposed to a large number of toxic substances (2,3). Hookah smoke contains many toxic substances found in cigarette smoke; such as, nicotine, tar, carbon monoxide, polycyclic aromatic hydrocarbons, volatile aldehydes, phenols and heavy metals (4). This toxic substances cause many types of cancer.

This study aimed to compare the level of carbon monoxide in breath of a hookah and cigarette smoker.

Methods

This descriptive cross-sectional research was conducted with individuals who were 18 years old and older who applied to the Şişli Hamidiye Etfal Hospital Family Medicine policlinic for any reason and agreed to participate in the study and also in various hookah cafes in the city Istanbul. In addition to the sociodemographic information, hookah smokers and the cigarette smokers were asked questions related to consumption of water pipe /cigarette (duration, frequency, etc.). After that measurements of CO level in breath carried out with individuals smoking hookah right after 30th minute of the session and for cigarette smokers 15th minute right after finishing any smoking session in the day. The cigarette group consisted of subjects who consume 20 cigarettes per day. The measurements of CO level in breath was taken with recently calibrated 'piCOSmokerlyzer' (Bedfont Scientifict Ltd.). CO grouping was done in the form of 1-7 ppm nonsmoker, 8-15 ppm low dependent group, 16-50 ppm strong dependent group, 51 and higher ppm dangerously strong dependent group.

The study was approved by the the Şişli Hamidiye Etfal Training And Research Hospital's Research Ethics Committee (25.02.2014; Decision Number: 294/599).

Mean, standard deviation, median, minimum maximum, ratio and frequency values were used in the descriptive statistics of the data. In the analysis of quantitative data, chi-square test was used, while in the analysis of qualitative data independent sample t test, ANOVA test and Mann-Whitney U test were used; $p < 0.05$ was considered as statistically significant.

Results

A total of 215 people were included in our study. The sociodemographic characteristics of the participants are given in Table 1. Men (86.9%, n=113) were more likely to use hookahs than women and the singles were using more hookahs than the married ones ($p<0.001$, $p<0.001$). The CO levels of all participants were 33.92±27.36 ppm (min=3, max=100) on average; mean values were 38.25 ± 28.17 ppm in males and 18.00 ± 16.34 ppm in females which the difference was statistically significant ($p<0.001$). There was no significant relationship between the average CO levels of the cigarettes, the hookah group and the hookah+cigarette group ($p=0.092$, $p=0.092$, $p=0.713$) in relation to gender, education status and alcohol drinking status. However, there was a significant relationship between average CO amount and marital status of the three groups ($p=0.004$). Primary school graduates were more likely to smoke cigarettes (82.5%, n=37) ($p=0.025$); high school and college graduates were using hookah more (68.8%, n=117) ($p<0.001$). The distribution by sociodemographic characteristics and the average of CO measurements are given in Tables 1 and 2.

Among the participants high school and college graduates consumed <5 hookah (47.9%, n=56) and primary school graduates more than 15 hookah (%69.2, n=9) per month ($p=0.039$) . 86% (n=185) of the participants lived with the family and there was no significant relationship between the average amount of CO of the three groups ($p=0.998$). Mothers of participants were mostly primary school graduates

Table 1. Sociodemographic characteristics of the groups participating in the study

Sociodemographic characteristics	Cigarette Smokers		Hookah Smokers		Hookah and Cigarette Smokers		Total	
	n	%	n	%	n	%		
The average age year ± sd (min-max)	36,88±10,73 (18-63)		27,40±8,63 (18-60)		28,05±11,17 (18-63)		31,33±11,15 (18-63)	
Sex								
Female	29	34,1	7	0,3	10	16,1	46	21,4
Male	56	65,9	61	89,7	52	83,9	169	78,6
Marital Status								
Single	32	37,6	59	86,8	42	67,7	133	61,9
Married	53	62,4	9	13,2	20	32,3	82	38,1
Educational Background								
Primary School	32	37,6	8	11,8	5	8,1	45	20,9
High School-Collage	53	62,4	60	88,2	57	91,9	170	79,1
Profession								
Student	3	3,5	21	30,9	17	27,4	41	19,1
Self Employed	47	55,3	43	63,2	33	53,2	123	57,2
Others	35	41,2	4	5,9	12	19,4	51	23,7
Alcohol								
Drinker	35	41,2	40	58,2	35	56,5	110	81,2
Nondrinker	50	58,8	28	41,2	27	43,5	105	18,8
Total	85	100	68	100	62	100	215	100

(46.5%, n=100) and fathers were mostly high school graduates (31.6%, n=68). Average smoking was 15.38 ± 17.56 (min=0.25, max=160) packets / year and 47.6% (n=70) were moderately dependent accoring to Fagerström score. Participants who have cigarette smoker mothers, Fagerström's score were higher (p=0.002), there was no significant difference in having a cigarette smoker father (p=0.494).

Table 2. Distribution of ppm of breath CO according to sociodemographic characteristics

Sociodemographic Characteristics	Cigarette Smokers	Hookah Smokers	Hookah and Cigarette Smokers	p
Sex				
Female	11,10±5,60	24,43±27,05	33,50±17,24	0,092
Male	18,88±13,49	47,75±30,41	47,980±26,71	
Marital Status				
Single	15,84±7,79	44,71±30,79	47,60±27,30	0,004
Married	16,45±13,97	49,56±31,89	41,55±22,70	
Education				
Primary School	13,41±6,04	57,25±34,35	46,40±15,21	0,092
High School-Collage	17,92±14,21	43,76±30,19	45,58±26,69	
Alcohol				
Drinker	15,82±14,11	45,75±31,19	39,37±22,15	0,713
Nondrinker	16,80±8,16	45,08±30,82	50,49±27,75	

Table 3. According to the Fagerström nicotine dependency score, the distribution of the breath CO measurement averages

	The breath CO measurement averages (ppm)		
Fagerström nicotine addiction score	**Cigarette Smokers**	**Hookah and Cigarette Smokers**	**p**
Low	10,92±4,41	36,50±24,35	0,179
Medium	16,39±15,87	51,03±26,05	
High	18,06±7,785	43,79±25,670	
Total	16,22±11,971	45,65±25,872	

Table 4. Comparison of average breath CO ratio cigarette smoking / hookah smoking status

Smoking / Hookah Smoking Situation	**Average Breath CO Level (ppm) (min-max)**	**p**
Only Cigarette Smokers	16,22±11,97 (3-100)	<0,001
Only Hookah Smokers	45,35±30,74 (5-100)	
Cigarette+Hookah Smokers	45,65±27,87 (4-100)	
Total	33,92±27,36 (3-100)	

According to the Fagerström nicotine dependency score, there was no significant difference between the groups in terms of breath CO (p=0.179) (Table 3). The highest smoking ratio (85.4%, n=35) was in the age group 41-64 (p=0.009). Hookah was generally ≤5 per month (27.4%, n=59). According to CO grouping, most of the "non-smokers" (80%, n=4) ≤5 pieces/ month; while dangerously strong dependent group (67.7%, n=21) consumed ≥15 pieces / month of hookah. There was a linear positive correlation between the number of cigarettes smoked by the smokers during the day and the amount of CO (p=0.001). The amount of CO increased as the number of cigarettes increased. Similarly there was also a significant positive correlation between the amount of hookah and CO (p<0.001). The amount of CO increased as the amount of hookah increased. In both groups, the amount of CO was significantly higher in hookah smokers that smoke 5 or more times per month, than smokers that smoke less than 5 per month (p=0.004). Mean CO values of 147 cigarette smokers was higher; (p<0.001) than those using hookah. In 130 participants there was no relationship between smoking cigarettes with hookah and CO values (p=0.954). When the averages of CO values of all participants were compared; the smoking group is different from the other two groups and there was no difference between the hookah and both hookah-cigarette group (p<0.001) (Table 4).

Discussion

Considering the data of hookah users, it is seen that the majority of the users are male. In different studies, proportion of men using hookah ranges from 57% to 68% (3,5-8). Likewise studies that was made in Turkey shows that male hookah smokers ratio is higher than women, in fact the ratio in the study of Subaşı et al. is 79.9% (9-11). In Alzyoudve et al.'s study, 64% of those using hookah are women. There are studies showing that there are no differences according to sex (12-14). In our study, hookah smokers ratio of men is also higher than women (78.6%, n=169, p<0.001). When it is assessed in terms of quantity; men are seen to use more, much like the frequency of smoking hookah. In Aljarrah et al.'s study, men who consumed hookah every day were found to be statistically more than women and it was determined that most women who participated in the study smoked hookah in every six months (6). In our study while most of the women consumed ≤5 hookahs per month, men usually consumed more than 15 hookahs per month. The reason for that can be considered as smoking cigarettes is more common in males in Turkey. Moreover, we can say that hookah cafes are arranged in a way that men might prefer, which may cause women to prefer less because of the cultural reasons.

Although the frequency of hookah use is generally reported as 5 or less per month, it seems to be different according to the countries (3,6,9,12). Poyrazoğlu et al. study found that hookah is commonly used (≤1 /week)

by students (81.0%, n=173) (15). In our study, the frequency of using hookah in general was found to be ≤5 per month. The differences between the studies may be due to the different cultural and sociodemographic characteristics of the cities in which the research is conducted, as well as different expressions of frequencies used in different studies. Also it is expected that hookahs smoked ≤5 times in a month due to the number of hookah cafes being very high in metropolites such as Istanbul. Also people prefer to use it as a tobacco product for a long time and chatting situations in weekends or holidays, or in situations when there is no shortage of time.

According to the Global Adult Tobacco Survey, the use of hookah in young people (4.3% in the 15-24 age group) is more common than in other age groups (4). In the study of Soule EK et al. hookah smokers were mostly male, young adults and alcohol users (1). The alcohol use in our study group was relatively low and there was no relationship with the breath CO. However, it should not be forgotten that this situation may change according to cultural circumstances. In studies conducted in young adults and adolescents, cigarette smokers, users of other tobacco products, alcohol and drug users found to be more likely to use hookah (17). In many studies, the average age was found to be 18-29 (3,6,8,9,14,19, 20). In our study, the average age of those who use hookah is 27.71±9.89 and is compatible with the literature. Today, hookah cafes are arranged more for young people. The tendency towards growth in tobacco and tobacco products is considered to be a symbol of desire for growth in adolescence, due to it is percieved as a sense of belonging to a group, symbol for freedom and imitating someone, and the consumption of younger age groups is increasing. This is remarkable and we, as physicians, should inform young people about protection, quitting and supporting them.

According to the Global Adult Tobacco Survey, the use of hookah is more common in educated people (5.1% in high school graduates; 3.9% in college graduates). In our study, when the consumption rate of monthly hookah was evaluated according to education level, high school-university graduates were smoking less than 5 hookah (47.9%, n=56) per month and most of primary school graduates were smoking 15 or more (69.2%, n=9) (p=0.039). In the study of Sriha Belluith A et al. 68.7% of participants were found to be nicotine addicts and in our study it is found to be 68.4% (n=147) (21). The primary school graduates in our study were mostly cigarette smokers (82.5%, n=37, p=0.025); high school and college graduates generally used hookah (68.8%, n=117, p<0.001). It is possible to explain this fact that since hookah cafes are nearby of universities, university students are able to access these places more easily, the effect of peer groups, socialization and wanting to be together with friends can be considered to be more influential. For this reason, with raising consciousness of the youth of university, banning or putting a certain limit to open hookah cafes near the campuses will be appropriate.

The study of Temel O et al. found the mean expiratory air CO level in cigarette smokers was 18±9.6 ppm. While there is no significant relationship between expiration air CO and sex, age, occupation groups; there was a significant positive correlation between cigarette consumption and CO in expiratory air and Fagerström nicotine addiction test results. In this study, CO measurements made after how many minutes of smoking cannot be found (20). In our study, smokers that consume one pack of cigarettes per day were included in the cigarette group, and measurements had taken after average of 4.29±2.74 cigarettes. There was no correlation between CO between groups of smokers according to Fagerström levels (p=0.193). In our study, the average value of the CO in the group of the cigarette smokers was found 16.22±11.97 ppm (min=3 ppm, max=100 ppm); 11.10±5.60 ppm for females and 18.88±13.48 ppm for males, which was not statistically significant in a similar manner to other studies (22).

Studies have shown that hookah causes a 30 ppm increase in the level of CO in breath and it is thought that hookah causes more CO increase compared to cigarettes because of the coal placed on the tobacco. This level is five times higher than expected from a cigarette (23). In other studies performed, 9-30 fold increase in CO in hookah smoke compared to cigarette

was detected. The amount of breath CO was shown to increase by 2.7 ppm after a cigarette and by 23.9 ppm after a hookah session (2,17,24,25). In the study of Jacob P et al. an average of 33.5 ppm of CO was found in only hookah smokers (26). In the study of Yalcin FK et al. amount of CO in breath raised about 6 times in the group of only hookah smokers; while the number found to be by 2.7 times in both hookah and cigarette smokers group after the use of hookah (27). In the study of Primack BA et al. in the meta-analysis of 17 studies; in a single hookah session 192.0 (77.5 to 307.0) mg; and in one cigarette 17.7 (15.6, to 19.9) mg of CO were detected (4). Comparing smoking a single cigarette and a session of 45-60 minute hookah smoking, it is reported that hookah causes higher exposure to nicotine and CO (17). It was determined that all the toxic substances originating from tobacco were found to be most in users that smoke both cigarettes and hookahs; five toxic substances (carbon monoxide, phenanthrene, pyrene, acrylamide and benzene) of only hookah smokers were found to be higher than only cigarette smokers (28). In another experiment conducted in experimental environment, the mainstream CO amount in hookah session was 254 mg. and 3 ppm for cigarette (29). In the study of Akhter S et al. the measurements taken at the 30th and 90th minutes were 9.4±4.6 ppm ($p<0.005$) from 3.5±0.6 ppm for cigarettes; while those of hookah smokers increased from 27.7±4.9 ppm to 57.9±27.4 ppm ($p<0.005$) (8). It has been reported that there is a decrease in oxygen saturation after smoking in different studies (19,30,31). It has been found that the greatest effect of rising in CO is related to the "smoking time" (19). In our study, only hookah smokers had an average CO of 45.35±30.74 ppm (min=5, max=100), only cigarette smokers had 16.22±11.97 ppm (min=3, max=100), hookah-cigarette smokers had 45.65±25.87 ppm. Similar to other studies, cigarette smoking group CO levels were found to be different from the other two groups in our study. There was no difference between the CO level of the hookah and the hookah-cigarette group, we think that this was originated from the fact that we can not standardize the smoking duration and the last smoking periods of participants in the hookah-cigarette group.

Powerful aspect of our research is to be done in the society and to have a small number of studies in this matter. However, due to time constraints, the number of participants in our study was limited, and the fact that initial CO levels were not measured constituted weaknesses of our research. The influence of inhalation depth and number of inhalations on breathing CO levels during smoking can also be a confounding factor. A planned study with larger groups and with baseline CO measurements will increase the reliability of the analyzes.

Conclusion

Hookah smokers have higher amount of CO in breath than cigarette smokers. This level is further increased when the smoking frequency and amount were taken into account. In addition to cigarette smoking, hookah smokings harm to human health should be better explained and awareness should be created with health professionals and the media. There is also a need for more detailed and comprehensive research on the harmful effects of hookah.

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