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CLINICAL STUDY

THE OLFACTORY ABILITIES OF SMOKERS

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SUMMARY

Objectives: The present study aims to investigate the olfactory functions of the smokers and to evaluate the effect of the duration of smoking and the amount of cigarette that smoked per day on the olfactory functions.

Methods: We conducted a cross-sectional study including 68 smokers. All participants were performed Sniffin" Sticks olfactory testing. The duration of smoking and the amount of cigarette that smoked per day were also noted.

Results: The mean age of the participants was 42.4 ± 11.6 years. The majority of the smokers exhibited an overall decreased olfactory function as judged for the TDI score: functional anosmia in 7 (10.3%) participants; hyposmia in 54 (79.4%); and normosmia in 7 (10.3%). The olfactory functions had a negative correlation with the duration of smoking, whereas a similar correlation was not found between the cigarettes smoked per day and olfactory functions.

Conclusions: Smokers were found to be decreased olfactory abilities when their olfactory scores were compared to normative data. Also, an increase in smoking duration leads to a significant deterioration in the odor discrimination and odor identification functions.

Keywords: Smoking, Sniffin' Sticks, olfaction, odor discrimination, odor identification

SİGARA İÇENLERİN KOKU YETENEKLERİ

ÖZET

Amaç: Bu çalışmada, sigara içenlerin koku işlevlerini araştırmak ve sigara içme süresi ile günlük içilen sigara miktarının koku işlevlerine etkisini değerlendirmek amaçlanmıştır.

Yöntem: Sigara içen 68 kişiyi içeren kesitsel bir çalışma yaptık. Tüm katılımcılara Sniffin" Sticks test bataryası ile koku testleri yapıldı. Ayrıca sigara içme süresi ve günlük içilen sigara miktarı kaydedidi.

Bulgular: Katılımcıların yaş ortalaması 42.4 ± 11.6 idi. Sigara içenlerin çoğunluğu TDI skoruna göre azalmış bir koku alma işlevi sergilemiştir: 7 (% 10.3) katılımcıda fonksiyonel anosmi; 54'te hipozmi (% 79.4); ve 7'de normosmi (% 10.3). Koku alma fonksiyonlarının sigara içme süresi ile negatif korelasyonu vardı. Ancak, bir günde içilen sigara miktarı ile koku alma fonksiyonları arasında benzer bir ilişki bulunmadı.

Sonuç: Sigara içenlerin, koku skorları normatif verilerle karşılaştırıldığında, koku alma yeteneklerinin azaldığı bulundu. Ayrıca, sigara içme süresindeki bir artış, koku ayırımında ve koku tanımlama fonksiyonlarında önemli bir bozulmaya yol açmaktadır.

Anahtar Sözcükler: Sigara; Sniffin' Sticks; koku alma; koku ayırma; koku tanımlama

INTRODUCTION

Smoking is one of the most common habits in societies. Smoking causes various lower and upper respiratory tract infections as well as disrupting olfactory functions[1,2]. About 19% of the adult population across the world suffer from olfactory dysfunctions[3,4]. Considering that the olfactory sense is closely related to the gustatory perception, one can understand the importance of this sense in human life. Although, smoking is known as one of the toxic causes of olfactory dysfunction, several studies have also found no association between olfaction and smoking[1-6]. Furthermore, a recent meta analysis about olfaction and smoking, performed by Ajmani et al., showed us that there were no studies providing detailed smoking parameters (e.g., duration of smoking, amount of cigarettes smoked per day)[7]. That's why, we are unable to consider how these factors may affect the olfactory functions. Also, the effect of smoking on olfactory functions was only one of dozens of parameters that evaluated in those population based studies[1-6]. So, there

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was a heterogeneity in the results that showed in the literature about the effect of smoking on olfaction[7]. Recently, we performed a study including 28 patients, who had olfactory testings initially and 45 days after smoking cessation. We found that olfactory functions improved after a smoking cessation of 45 days[8].

In the present study, we aimed to investigate the olfactory functions in the smokers with more participants and also to evaluate the effect of the duration of smoking and the amount of cigarette that smoked per day on the olfactory functions.

MATERIAL and METHODS

We conducted a cross-sectional study, including 68 volunteers, who were admitted the family care department of our hospital.

All investigations were performed in accordance with the declaration of Helsinki on biomedical studies involving human subjects, and informed consent was obtained from all study subjects. The study was approved by the local Institutional Review Board.

Exclusion criteria included patients with a history of upper respiratory infections within the past three weeks, sinonasal disorders (nasal polyps, chronic rhinosinusitis, allergic rhinitis, severe septum deviation), a history of exposure to respiratory toxins other than cigarettes, malignancy, head trauma, neurologic, endocrine and psychiatric disorders. The duration of smoking and the amount of cigarette that smoked per day were also noted. All the smokers were evaluated by an otolaryngology specialist with endoscopic examination for excluding patients with sinonasal disorders.

Olfactory testing: Psychophysical testing of olfactory function was performed with the validated "Sniffin" Sticks" test (Burghart GmbH, Wedel, Germany)[9-11]. Olfactory testing comprised three tests, namely tests for odor threshold (testing by means of a single staircase procedure), odor discrimination (3-alternative forced-choice) and odor identification (4-alternative forced choice). For odor presentation the pen's cap was removed by the experimenter for approximately 3 s and the tip of the pen was placed approximately 1-2 cm in front of the nose. Instead of liquid dye the tampon of the pens for threshold testing was filled with phenyl ethyl alcohol (PEA, a rose-like odor) diluted in propylene glycol (dilution ratio 1:2, starting from 4%). Odors were presented in a total of 16 triplets of pens, one containing diluted phenyl ethyl alcohol and two containing only propylene glycol serving as blanks. Employing a three-alternative, temporal forced-choice paradigm, the subjects had to identify the pen that contained the odorant. Subjects were blindfolded to prevent visual identification of the odor containing pens. Thresholds were determined using a single staircase technique. In the present three-alternative, temporal forced-choice paradigm, two successive correct identifications of the pen containing the odor or one incorrect identification triggered a reversal of the staircase to the next higher or the next lower dilution step, respectively. Seven reversals had to be obtained. The odor thresholds were determined as the mean of the last 4 staircase reversals. Assessment of odor threshold was followed by a test of odor discrimination[9]. For odor discrimination 16 triplets of pens were presented, with two containing the same odorant and one containing the target odorant. The subjects' task was to identify the sample that had a different smell. To prevent visual detection of the target pen, subjects were blindfolded with a sleeping mask. The test result was a sum score of correctly identified pens. In a final step a test of odor identification was performed to completely assess the subject's objective function[9]. Odor identification was assessed by means of 16 common odors. Using a multiple forced-choice paradigm, identification of individual odors was performed from a list of four verbal descriptors each. The test result was a sum score of the correctly identified odors. Results from olfactory testing can be analyzed separately from each other. Overall olfactory function is expressed as the sum of the scores from the 3 individual tests[11].

TDI scores below 16.5 were accepted as functional anosmia, and TDI scores above 30.3 were accepted as normosmia, whereas TDI scores between 16.5-30.3 were accepted as hyposmia[9,11]. The normative data of the Sniffin" Sticks test battery was well defined both for the

European countries and our country , thus we prefered to compare our test results with the published normative data[10,12,13].

Statistical analysis: Data were analyzed by means of SPSS 21.0 (SPSS Inc., Chicago, IL). Pearson correlation analyses were performed between the duration of cigarette smoking, the amount of smoking and olfactory testings. The level of significance was set at 0.05.

RESULTS

This study was carried out in 68 volunteers (33 female and 35 male), between the ages of 22-65 years. The mean age of the patients was 42.4 ± 11.6 years.

The mean duration of smoking was 24 ± 10.6 years (range between 6 years and 50 years), and the participants were smoking 22.4 ± 9.6 cigarettes/day (range between 5 - 100 cigarettes per day). The majority of the patients exhibited an overall decreased olfactory function as judged for the TDI score: functional anosmia in 7 (10.3%) participants; hyposmia in 54 (79.4%); and normosmia in 7 (10.3%).

Descriptive statistics of the results from olfactory testings are given in Table 1.

Pearson correlation analyses were performed for investigating the effect of cigarette smoking period and the amount of cigarettes smoked per day. We find that there was statistically significant negative correlation between the cigarette smoking period and Sniffin" Sticks olfactory testings, namely odor discrimination, odor identification and TDI scores (p values; 0.033, 0.008, 0.003 respectively), whereas we did not find a similar correlation between odor threshold score and smoking duration. On the other hand, we did not find a similar correlation between the amount of cigarettes smoked per day and olfactory testings. Correlation analyses were showed at Table 2.

Table 1. Descriptive statictics of the olfactory testings

	Mean ± standard deviation	Minimum-maximum values
Odor threshold score	5.7 ± 2.8	1-11.25
Odor discrimination score	7.9 ± 2.1	3-12
Odor identification score	9.6 ± 2.3	3-14
TDI	23.1 ± 5.1	11.5-33.5

Table 2. Correlation analyses between the cigarette smoking period, the amount of cigarette smoked per day and the olfactory testings (Pearson correlation was performed, r value was showed only for statistically significant data)

		Odor Threshold	Odor Discrimination	Odor Identification	TDI
Cigarette smoking period	p	0.1	0.033	0.008	0.003
	r		-0.26	-0.31	-0.36
The amount of cigarette smoked per day	p	0.064	0.08	0.23	0.81

TDI: Sum score of odor threshold, discrimination and identification subtests

DISCUSSION

The current investigation had two major findings. I) We found that the majority of the participants had decreased olfactory functions, when we compared the Sniffin" Sticks scores of the participants and the published normative data of Sniffin" Sticks[9-12]. II) The olfactory functions had a negative correlation with the duration of smoking, whereas a similar correlation was not found between the cigarettes smoked per day and olfactory functions.

A meta-analysis by Ajmani et al. reported that the olfactory functions of smokers were impaired compared to those of non-smokers[7].

Katotomichelakis et al. evaluated the olfactory functions of smoking patients by "Sniffin" Sticks" test, and, similar to the results of Ajmani et al., revealed that smoking impaired the olfactory functions. They also showed that odor identification deficits in smokers were 6 times higher than non-smokers[2]. Similarly, Vennemann et al. found a significant reduction in the olfactory functions[3]. In our study, we found that the olfactory functions in smoking patients were similar to those reported in the literature. These results may be attributed to a significant thinning of the olfactory epithelium and increased apoptosis activity in the epithelium in smokers[14,15]. Furthermore, chemical irritants in the cigarette composition initiate inflammation by activating the inflammatory mediators in the organism, which may be effective in this process. In particular, inflammation in the sinusoidal region leads to the edema and prevents odor particles from reaching the olfactory epithelium. Smoking causes loss of microvia in the sustentacula cells in neuroepithelium and long cilia loss in the olfactory cells and leads to respiratory metaplasia[16]. Replacement of the olfactory epithelium with the respiratory epithelium results in the odor particles not being delivered to the primary olfactory center in the brain. This, in turn, results in disruptions in the odor threshold, odor identification and odor discrimination functions.

No studies have been conducted showing the adverse effects of smoking duration on the olfactory functions. The present study revealed the negative effects of an increase in the smoking duration on the olfactory functions rather than the amount of cigarette consumed daily. Long-term smoking will cause permanent damage to the olfactory epithelium due to chemical irritants. Besides, high amounts of reactive oxygen radicals and other carcinogens in cigarettes will prevent the renewal of olfactory epithelium[17]. In addition to damaging the olfactory epithelium, smoking inhibits cell growth in the regeneration step and leads to a vicious cycle[18]. Continued smoking will make it impossible to break this vicious cycle and cause olfactory dysfunctions.

This study had some limitations. At first, the study had not a control group, however the normative data of the Sniffin" Sticks olfactory test batery was well defined as mentioned above in the text. Secondly, a study including large smoker populations might be better to understand the effect of the amount of smoked cigarette per day on olfactory functions.

CONCLUSION

Smoking causes deterioration of the olfactory functions in smokers. An increase in smoking duration leads to a significant deterioration in the odor discrimination and odor identification functions. Moreover, a significant decrease takes place in the TDI scores. There is a need for studies to be conducted with large patient populations.

Declaration of interests

There is no financial conflict of interest to declare for any of the authors.

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