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Original Article

Investigating the Relationship Between Opium Addiction and Taste Disorder in Addicts Referred to Exir Salamat Addiction Center

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Abstract

Background: Disturbance in the sense of taste can destroy appetite and change eating habits, causing a significant decrease in the quality of life. The use of opium causes a disturbance in the sense of taste. Opium is a narcotic drug that can cause temporary or permanent damage to the taste system, making it a source of concern in dentistry. This research was conducted to determine the effects of opium consumption on the sensation of the four main tastes.

Methods: This study was conducted in a single-masked and descriptive-analytical manner. The study population included 107 opium addicts and 113 smokers who were in the same age group. None of the studied subjects had any systemic disease or consumed herbal or chemical drugs. The four substances, citric acid, sodium chloride, sucrose, and caffeine, were used to evaluate sourness, saltiness, sweetness, and bitterness, respectively. Finally, the obtained data were analyzed using SPSS version 26 and the Mann-Whitney *U* test. *P* values <0.05 were considered statistically significant.

Findings: Opium use did not have a significant effect on the perception of sweetness ($P=0.437$), saltiness ($P=0.536$), or sourness ($P=0.8$), but a significant effect was seen concerning the perception of bitterness ($P=0.0000002$);

Conclusion: It seems that opium addicts do not have significant problems in perceiving the taste of sweetness, sourness, and saltiness, but impairment was observed in the perception of bitterness.

Keywords: Addiction, Taste disorder, Taste threshold, Opium dependence, Quality of life

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Introduction

Taste disorders play a significant role in the quality of life and in the perception of the taste and pleasantness of food, as well as in avoiding the ingestion of toxins.[1] It can lead to work-related problems and even threaten a person's life.[2] Various diseases, such as anemia, Sjögren's syndrome, pregnancy, menopause, diabetes, sensory disorders, oral neurological issues, the use of certain drugs, and a history of radiotherapy and chemotherapy, can affect the sense of taste.[1,3]

Iran ranks second globally in terms of opium consumption. Addiction has increased in recent years, with varying prevalence in different provinces. Moreover, studies on addiction report the highest frequency in the 20–35 age group, and illiteracy or low education levels is reported in approximately 60 to 70% of addicts. The consumption of opium by 87.4% of students indicates the high prevalence of opium consumption among this population.[4]

There is limited research on taste disorders in medical literature. One possible reason is that taste functions are linked to the sense of smell, sensory systems, and pain perception (e.g., when eating spicy food), making it challenging to examine emotions arising from an individual system. Therefore, investigating taste disorders from a neurological perspective is essential to enhance awareness among healthcare professionals about taste disorders and aid in diagnosis.[2,5]

Considering that the existing research does not provide consistent and accurate data on the effects of opium on the sense of taste and perception of the four main tastes and the relationship between opium use and taste disorders, the present research aimed to study opium addicts at Exir Health Addiction Center and individuals visiting the

Dental Clinic of the Islamic Azad University of Medical Sciences in Tehran in 2022.

Methods

Study Setting

This study utilized a descriptive-analytical (case-control) study design. Data collection based on study objectives was carried out through written questionnaires and interviews. All individuals visiting Exir Health Addiction Center and those attending the Dental Clinic of Islamic Azad University of Medical Sciences in Tehran who agreed to participate in the study were included in the study.

Ethical Approval

The study obtained approval from the university ethics committee (ethical code: IR.IAU.DENTAL.REC.1400.042). Participants voluntarily participated in the study, and the objectives of the research were explained to all participants. Written consent forms were obtained from all volunteers, and they were reassured that all study results would be kept confidential. The contact number of the examiner was provided for any necessary follow-up. Furthermore, all study stages were carried out by a senior dentistry student under the guidance and approval of a specialist in oral diseases and the reference book of diseases.

Exclusion Criteria

Individuals with specific diseases, especially those affecting the sense of taste, such as Sjögren's syndrome, anemia, dry mouth, neurological sensory disorders, diabetes, consumers of medical drugs, and those wearing dentures, were excluded from the study. Those with caffeine restrictions, as well as patients with cardiovascular diseases, heart arrhythmias, severe anxiety, stomach ulcers or reflux, seizures, liver and kidney disorders, individuals with a history of iron deficiency, cerebral infarction, chronic sinusitis, gastrectomy, chronic otitis, and COVID-19, and pregnant women were also excluded. Additionally, users of antibiotics, neurological drugs, cardiac drugs, thyroid medications, psychotropic drugs, antihistamines, anti-neoplastic drugs, bronchodilators, anti-inflammatory drugs, smoking cessation drugs, antifungals, and antiviral agents were excluded from the study.[5-9]

Furthermore, the following questions were asked to determine xerostomia:

Is your saliva very little or very abundant?

Do you need to drink fluids to help swallow dry foods?

Do you feel dryness in your mouth while eating?

A "very little" response to the first question and a positive response to questions 2 or 3 were considered indicative of individuals experiencing some degree of dry mouth. A response of "very abundant" or "no attention" to the first question and negative responses to questions 2 or 3 were considered indicative of the absence of dry mouth, and the subjects were excluded from the study.[10]

Definitions of taste threshold: Solutions for taste detection were prepared with various concentrations, and the taste detection test was performed at low to high concentrations. The lowest concentration detected by the test participant was considered the taste threshold.[1]

Taste disorder: By preparing 20 solutions consisting of five different concentrations of the four main tastes (sodium chloride, sucrose, citric acid, and caffeine), the taste thresholds of individuals for different concentrations were examined. The lack of taste perception or incorrect recognition was considered a taste disorder.[1]

Addiction definition: Addiction to drugs is a periodic or chronic state of intoxication resulting from repeated use of a drug (natural or synthetic). Its characteristics include an excessive desire or need for continued drug use and obtaining it by any means, an inclination to increase the dose, psychological dependence, and overall physical dependence on the effects of the drug, as well as adverse effects on the individual and society. An addict is someone who has psychological dependence and overall physical dependence on the effects of the drug, consuming an average of 1.5 grams of opium daily.[11]

Study Groups

The case group included 107 individuals addicted to opium attending Exir Health Addiction Center. The control group consisted of smokers selected from visitors to the Faculty of Dentistry of the Islamic Azad University of Medical Sciences, Tehran. A total of 113 individuals were chosen and the study groups were matched based on age range (20 years and above), sex, and oral health status. All study participants in both groups were free of systemic diseases and did not use chemical or herbal drugs regularly. The two groups were also matched in terms of age and sex (frequency matching).

Study Method

The participants were examined between 9 and 10 a.m.,[12] and they were advised not to eat or drink anything for two hours before the experiment and not to use toothpaste.[6,12]

The study was conducted as a whole-mouth examination. Solutions with different molar concentrations of the four primary tastes, sodium chloride, citric acid, sucrose, and caffeine, were prepared. The solutions were prepared separately in 20 glasses, each containing 500 cc of the specific taste solution.

The required equipment and materials included disposable dental mirrors, water syringes, gloves, 5 ml syringes, and solutions of citric acid, sodium chloride, sucrose, and caffeine, each in five concentrations. These solutions were stored in labeled, sealed containers provided and coded to room temperature by a pharmacist.

Preparation of the Study Solutions

The taste solutions were prepared at the Research Center

for Pharmaceutical Sciences, School of Pharmacy, Tehran University of Medical Sciences. The solutions were stored at room temperature during the study. Pharmaceutical-grade sodium chloride, sucrose, citric acid, and caffeine powders were purchased from Merck to prepare the solutions. The desired concentrations were prepared based on Table 1, and the calculated amounts were dissolved in pure water. Pure water was provided for participants to rinse their mouths before testing each concentration. The solutions, each with a volume of 500 cc, were prepared separately and stored in the refrigerator for up to one week after production.

The participants rinsed their mouths with distilled water before starting the experiment and sat in a quiet and safe room in an upright position.[1,8,11]

The process for each of the four tastes was as follows: first, 3 cc of the least concentrated solution in the series of concentrations for that taste (Solution No. 1) was given to the individual to swirl in their mouth for 30 seconds and then spit out. If the subject recognized the taste, their taste threshold was recorded as the first concentration. If not, they would be tested sequentially with higher concentrations (i.e., Solution No. 2, then No. 3, and so on) until the individual identified the taste. Between each taste recognition test, participants rinsed their mouths with 5 cc of distilled water for 30 seconds to remove the previous taste from their mouths.[1]

Statistical Analysis

Finally, the determined recognition concentrations in the two study and control groups were compared using the Mann-Whitney *U* test. The level of taste perception in the two study groups was compared using non-parametric models for comparing two independent sets of data, considering the distribution of response variable values.

Results

The study was conducted on 220 individuals, including 107 opium addicts and 113 smokers. Generally, the addicted individuals had poor oral hygiene, as among them, 9 individuals had average oral hygiene, and 98 individuals had poor oral hygiene. In the smoker group, 40 individuals had good oral hygiene, 50 individuals had average oral hygiene, and 23 individuals had poor oral hygiene. The average age of the opium addicts was 30.18 years, and the average age of smokers was 34.99 years. The study participants did not consume alcohol. Moreover, regarding their economic status, the participants referred to the Department of Oral and Maxillofacial Diseases were considered almost the same.

Figure 1 presents the distribution of study participants based on taste perception thresholds for different concentrations of sodium chloride. As shown in this figure, at a concentration of 0.0005, 8 smokers (7.1%) and 12 opium addicts (11.2%) correctly identified the taste.

At a concentration of 0.001, 4 smokers (3.5%) and 1 opium addict (0.9%) correctly identified the taste. At a concentration of 0.005, 22 smokers (19.5%) and 23 opium addicts (21.2%) correctly identified the taste. At a concentration of 0.01, 79 smokers (69.9%) and 71 opium addicts (66.4%) correctly identified the taste. According to the results of the Mann-Whitney *U* test, there was no significant difference in taste perception between the two groups ($P=0.536$).

Figure 2 illustrates the distribution of study participants based on the taste perception threshold at different concentrations of sucrose.

As shown in this figure, at a concentration of 0.0005, 12 smokers (10.6%) and 11 opium addicts (10.4%) correctly identified the taste. At a concentration of 0.001, 8 smokers (7.1%) and four opium addicts (7.3%) correctly identified the taste. At a concentration of 0.005, 14 smokers (12.4%) and 12 opium addicts (11.2%) correctly identified the taste. At a concentration of 0.01, 79 smokers (69.9%) and 80 opium addicts (74.1%) correctly identified the taste. According to the results of the Mann-Whitney *U* test, there was no significant difference in sweetness perception between the two groups ($P=0.437$).

Figure 3 displays the distribution of study participants based on taste perception thresholds at different concentrations of citric acid.

As shown in this figure, at a concentration of 0.0005, 16 smokers (14.2%) and 12 opium addicts (11.2%) correctly identified the taste. At a concentration of 0.001, 47 smokers (41.6%) and 46 opium addicts (42.9%) correctly identified the taste. At a concentration of 0.005, 39 smokers (34.5%) and 41 opium addicts (38.3%) correctly identified the taste. At a concentration of 0.01, 11 opium addicts (9.7%) and 8 opium addicts (7.1%) correctly identified the taste. According to the results of the Mann-Whitney *U* test, there was no significant difference in sourness perception between the two groups ($P=0.8$).

Figure 4 demonstrates the distribution of study participants based on taste perception thresholds at

Table 1. The desired molar concentrations of NaCl, sucrose, citric acid, and caffeine[1]

Solution/molar	Concentration 1	Concentration 2	Concentration 3	Concentration 4	Concentration 5
NaCl	0.0005	0.001	0.005	0.05	0.5
Sucrose	0.0005	0.001	0.005	0.05	0.5
Citric acid	0.0005	0.001	0.005	0.05	0.5
Caffeine	0.0002	0.0005	0.001	0.01	0.1

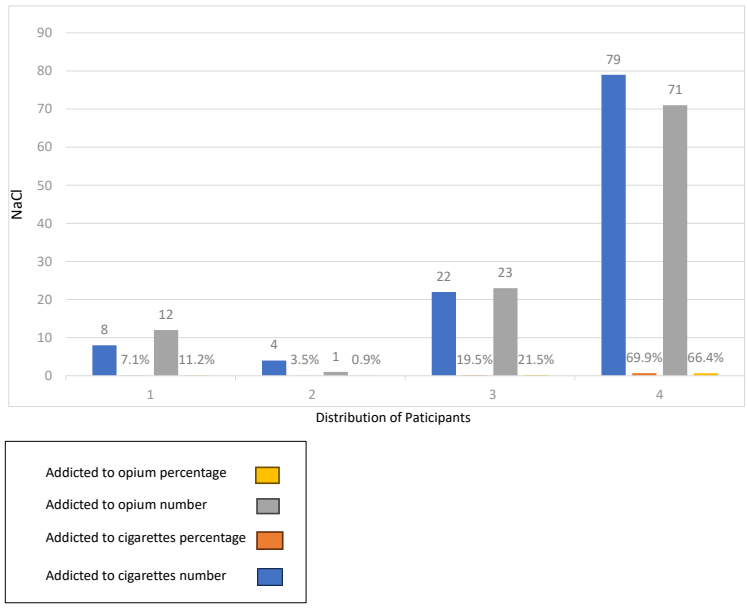

Figure 1. Distribution of participants based on different taste sensations of NaCl

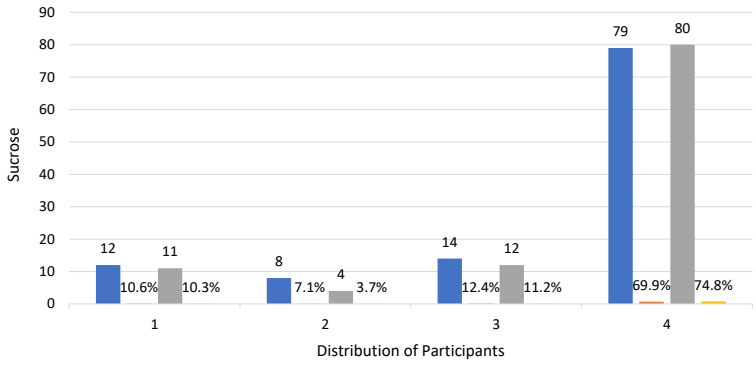

Figure 2. Distribution of participants based on different taste sensations of sucrose

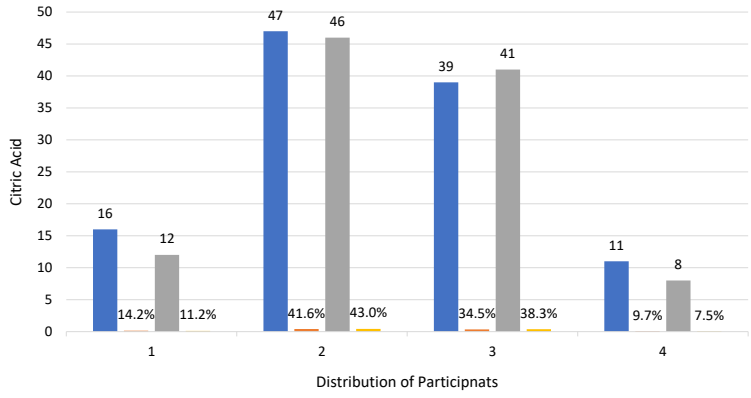

Figure 3. Distribution of participants based on different taste sensations of citric acid

different concentrations of caffeine.

As shown in this figure, at a concentration of 0.0002, 16 smokers (14.2%) correctly identified the taste, while 19 opium addicts (17.4%) incorrectly identified the taste. At a concentration of 0.0005, 17 smokers (15%) and 47 opium addicts (43.9%) correctly identified the taste. At a concentration of 0.001, 19 smokers (16.8%) and 29 opium addicts (27.1%) correctly identified the taste. At a concentration of 0.01, 61 smokers (54%) and 12 opium addicts (11.2%) correctly identified the taste. According to the results of the Mann-Whitney *U* test, there is a significant difference in bitterness perception between the two groups ($P = 0.00000002$).

Discussion

The study demonstrated that there was no significant

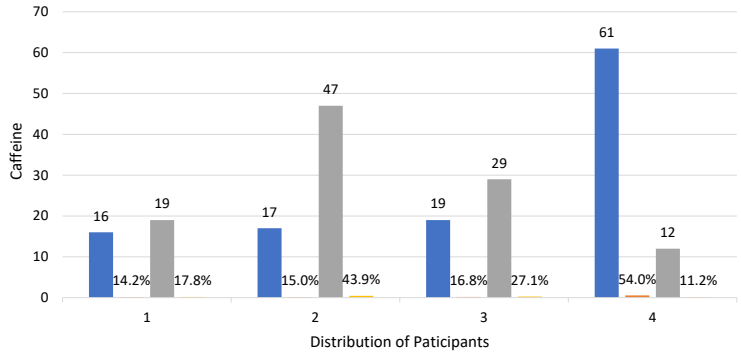

Figure 4. Distribution of participants based on different taste sensations of caffeine

difference in taste perception between the study group (opium addicts) and the control group (smokers) in terms of saltiness ($P=0.536$), sweetness ($P=0.437$), and sourness ($P=0.8$). However, a significant difference was observed in bitterness perception ($P=0.00000002$).

In a study conducted by Brion et al on the functional impairment of chemical receptors in alcohol-related disorders, taste, and olfactory perception were significantly reduced in individuals with chronic alcoholism and Korsakoff's syndrome.[8] They excluded alcohol consumers from their study population, and taste perception was assessed using the taste strip test.

A study by Garfield et al showed an association between opioid dependence and sweet taste. Three groups of participants provided ratings of "sweetness," "liking," and "desire" of four solutions with various concentrations of sucrose. Higher methadone dose was associated with a shift towards liking sweeter concentrations. Among people currently dependent on opioids, reduced sensitivity to low levels of sweetness and increased preference for sweeter flavors may be associated with increased dependence on opioids.[13] This result is inconsistent with the results of the present study. This difference may be based on methadone usage in participants or different cultures.

Kan et al investigated the impact of antibiotics on taste and olfactory perception using the FAERS database published by the FDA. They reported that some antibiotics could cause taste and smell disorders. Notably, the study accounted for sex and age and assessed taste and smell disorders within two to five days of starting antibiotic treatment.[4]

In a study by Doty et al the intensity and quality of taste disorders related to zopiclone, along with its association with age, sex, body mass index, body weight, and taste measurement using taste strips, were investigated. In their study, women showed more severe and prolonged taste disorders than men, with stronger effects in the morning than in the evening.[14] They used multiple taste strips and four concentrations to assess each taste and quinine strips to assess bitterness.

Pugnaloni conducted a study on type 2 diabetes and taste perception in individuals with controlled blood sugar levels. Diabetic individuals and the elderly showed lower taste test scores compared to healthy individuals. The research found no association between taste impairment in diabetic individuals and sex or disease duration.[15] Differences between the two studies include sample size, taste test methods, statistical analysis, and the presence of diabetes in the sample population.

Kale et al investigated the effect of chewing tobacco on taste perception, comparing those who chewed tobacco with individuals who did not chew tobacco. The study assessed taste sensation changes using aqueous solutions. The results of the study demonstrated a noticeable decrease in the perception of salty taste among tobacco chewers when compared with tobacco nonchewers. There was a remarkable difference in the perception of basic tastes among tobacco chewers and controls.[6] Discrepancies between the results may be attributed to differences in the study and control groups, sample sizes, and the examination of a single concentration for each taste.

Chéruel et al conducted a study on the impact of smoking and smoking cessation on taste. The study revealed that smokers who had recently quit had a higher taste threshold than non-smokers, requiring higher concentrations of any taste to feel it. Improvement of taste sensation after quitting smoking began in the front and lateral areas of the tongue after two weeks, continued in the dorsum after 9 weeks, and became apparent in the circumvallate papillae after approximately 2 months, with all areas showing similar taste thresholds after 8 months.[16]

The influence of drugs on an individual varies depending on genetic factors, nutrition, and medical conditions. Some drugs have a chronic impact on taste buds, and the salivary flow rate and receptor mediums also affect drug absorption. Discontinuation of drugs can lead to the return of taste, but it is time-dependent.[17]

Cigarette smoking affects the shape, size, and blood supply of taste papillae, reducing the number of taste buds. It also results in a decrease in blood levels of zinc, vitamin E, folic acid, and vitamin B. Nicotine affects the nerve endings on the tongue's surface, particularly in the circumvallate papillae, which are less sensitive. An increase in smoking dependence leads to an increase

in taste threshold and reduced taste discrimination. A reverse correlation between the number of cigarette packs consumed and the number of circumvallate papillae has been observed.[16]

The use of cigarettes and various drugs is a significant issue in society, leading to conditions such as halitosis, changes in microbial flora, periodontal diseases, multiple cavities, voice disorders, swallowing problems, and taste and smell disorders. Quitting smoking increases taste perception, especially for sweet tastes, improves the quality of life, enhances food enjoyment and appetite, and leads to weight gain.[18-20]

This impact motivates researchers to encourage patients to quit smoking and shows the importance of maintaining oral health. Drug use alters the oral microbiome, reducing the quality of life for those affected. The cessation of drugs occurs gradually, and the effects of quitting also gradually manifest in the body. There are limited studies conducted on the effects of drug use and drug cessation on oral health, and further research is needed to explore the mechanisms influencing the taste threshold.[19]

Unfortunately, the overall prevalence of opium addiction in Iran is 2.3%. In addition, men are at greater risk than women. On the other hand, the physical and especially oral side effects of drug abuse overshadow the personal and social efficiency of the person due to its adverse effect on appearance. This issue adds to the feeling of isolation in addicts. With the intensification of this feeling, the severity of addiction increases, and the possibility of the person quitting addiction decreases. This shows the necessity of attention to oral and dental health alongside drug addiction management in these people.[21] Chronic opiate use leads to clinical opioid use disorder in more than half of the users, and this disorder is associated with psychological distress, increasing its physical and mental burden in high-risk groups.[22]

Strengths and Limitations

Due to the COVID-19 pandemic, the research process faced numerous challenges, which were overcome through the researcher's persistent efforts. One of the limitations of this study is the lack of control over participants' diets and food preferences, which may have affected the obtained results.

Another limitation is that due to the unavailability of taste test strips, only the full-mouth method was employed in this study. As the researcher did not have access to an electric taste measurement device, the research was facilitated using solutions.

Conclusion

According to the results, opium addiction may lead to changes in taste buds, causing a disturbance in the chemical function of taste perception. Opium addicts showed a significant difference in bitterness perception compared to smokers.

Recommendations

It is recommended to emphasize the importance of quitting opium use by referring addicted individuals to addiction treatment centers and implementing extensive health programs in the community. Moreover, due to the lower oral health standards of addicted individuals, there is a need for health education and more regular examinations in addiction treatment centers for these individuals.

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Authors' Contribution

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Writing–original draft: Arezoo Alaee.
Writing–review & editing: All authors.

Competing Interests

The authors declare no conflict of interest.

Ethical Approval

The study obtained approval from the university ethics committee (ethical code: IR.IAU.DENTAL.REC.1400.042). Participants voluntarily participated in the study, and the objectives of the research were explained to all participants. Written consent forms were obtained from all volunteers, ensuring the confidentiality of results. The contact number of the examiner was provided for any necessary follow-up. Furthermore, all study stages were carried out by a senior dental student under the guidance and approval of a specialist in oral diseases and the reference book of diseases.

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