

# Drug Addiction and Oral Health; A Comparison of Hallucinogen and Non-Hallucinogen Drug Users

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Received date: 09 Jun 2016; Accepted date: 30 Jun 2016; Published date: 05 Jul 2016.

Citation: Taghi KM, Arghavan T, Maryam A, Pourya B, Elham MG, et al. (2016) Drug Addiction and Oral Health; A Comparison of Hallucinogen and Non-Hallucinogen Drug Users. *Int J Dent Oral Health* 2(6): doi <http://dx.doi.org/10.16966/2378-7090.211>

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## Abstract

**Objectives:** Drug abuse is currently one of the most important health problems with an alarming prevalence all over the world. Cannabis resin seized in three countries of Afghanistan, Iran and Pakistan increased to 400 tons in 2012. Moreover, Iran is rated the fifth country with the highest amounts of amphetamine seized worldwide. Many studies have been conducted to evaluate complications of addiction to various illicit drugs including their effects on oral and dental health. The increasing prevalence of addiction to hallucinogen drugs led us to assess the complications associated with these drugs regarding oral health of the addicts.

**Study design:** In this cross sectional study conducted in 2014, 304 drug abusers including 188 subjects (61.8%) addicted to hallucinogens and 116 (38.2%) to non-hallucinogens, referring to addiction rehabilitation center of Chitgar in Tehran were entered as the study population. Required information was gathered through a face to face interview with the subject and a thorough physical examination (stethoscope, digital caliper, explorer, periodontal probe) of the oral cavity.

**Results:** Compared to non-hallucinogen addicts, hallucinogen users present with multiple oral-health-related complications including TMJ pain ( $P<0.001$ ), sensitivity of chewing muscles ( $P=0.027$ ) and cold and/or heat intolerance ( $P<0.001$ ). Lichenoid ( $P=0.010$ ) and hypertrophic lesions ( $P=0.022$ ) were more prevalent among them. Mandible's range of motion (ROM) significantly decreased in these subjects ( $P<0.001$ ) and the mean score of CPITN ( $P<0.001$ ) and DMFT ( $P=0.012$ ) indices were significantly higher.

**Conclusion:** Hallucinogen and non-hallucinogen users both present several oral-health-related complications; however, the former shows significantly more problems. This finding highlights that hallucinogen abusers need more oral and dental examinations regularly because they are at higher risk of developing pathologic oral lesions.

**Keywords:** Hallucinogen; Dental and oral health; Addiction; Drug abuse; GPD; CPITN; DMFT

## Introduction

Drug abuse is currently one of the most important health problems with an alarming prevalence all over the world [1]. According to the World Drug Report published by United Nations Office on Drugs and Crime (UNODC) in 2014, 162 to 324 million people aged 15 to 64 years old (3.5-7 percent of the world's population in that age group) were reported to have tried one kind of illicit drugs in the year 2013. It is estimated that 12.7 million people are IV drug users accounting for 0.27 percent of the population. The prevalence of opiate use in Iran is 1.5 percent of the adult population whereas it is 0.8 percent in Central Asia – twice the global average. Cannabis resin seized in three countries of Afghanistan, Iran and Pakistan increased to 400 tons in 2012; moreover, the highest amounts of amphetamine seized worldwide are reported in Mexico, United States, China, Thailand and Iran, in order [2]. So it seems that illicit drug abuse is one of the most important health-related problems in our country.

Direct complications of drug abuse include cardiac crisis, respiratory dysfunction, hepatic cirrhosis, nephropathy, infectious diseases such as

hepatitis, AIDS and tuberculosis, mental problems such as depression and also oral and dental health problems [3,4]. These problems to some extent can be attributed to neglecting health, which is a behavioral characteristic of addicts [5]. These people usually overlook their illnesses and only seek for professional help when their problems are aggravated, which can cause their treatment process major difficulties [6,7]. Overall, the physical illness decreases their life expectancy and quality of life [8]. Burden of disease for addiction was estimated by DALY standard unit, to be 0.8% in 2000 and its mortality rate was reported to be approximately 0.4% [9]. According to the national survey on burden of diseases in Iran, addiction to illicit drug is the fourth most important health problem in the country [10].

Some of the abused drugs are not illegal such as cigarette and alcohol in foreign countries. In one type of categorization illicit drugs are classified as stimulants, depressants and hallucinogens. This classification is not definite and some drugs classified as stimulant might have hallucinogenic effects as well. In a common classification these drugs are categorized into two groups of hallucinogens including crystal (methamphetamine),

ecstasy (3,4-methylenedioxy-methamphetamine), marijuana and Lysergic Acid Diethylamide (LSD) and non-hallucinogens including opium, heroin and crack.

The oral and dental complications of drug abuse might be related directly to the substance, or the way the drugs are abused including oral, IV or smoking. Also the alterations in mood, cognition and thought of abusers can lead to changes in their hygienic behavior regarding their teeth and oral cavity [6,11]. Generally the oral and dental health problems accompanied by hallucinogenic drug abuse include xerostomia, improper hygiene, bad taste in mouth, extensive caries particularly in the buccal surface and inter-proximal, contraction and tenderness of masticator muscles leading to bruxism and dental erosions, periodontal diseases and temporomandibular joint disorders [12].

Many studies have evaluated the influence of opium on oral and dental health, but fewer studies have assessed the influence of hallucinogenic drugs. Regarding the increasing prevalence of addiction to hallucinogenic drugs, we aimed to evaluate the relation between abuse of these drugs and oral and dental health, compared to other kinds of drugs.

## Materials and Methods

With cooperation of Chitgar rehabilitation center, the objectives of this survey were explained to the addicts referring to this place. Subjects, abusing one of the illicit drugs for at least one year and willing to participate in the study were enrolled. Exclusion criteria was abusing the drug less than one year and not willing to participate in the study. 304 subjects were entered in this cross sectional study. Written informed consent was obtained from each subject.

Data gathered through a face to face interview with the subjects including demographic characteristics, type of drug, duration of drug abuse, route of administration, cigarette smoking, sensation of changes in oral cavity, dental caries, changes in chewing and pain sensation. Regarding to the type of drug, subjects abusing crystal (methamphetamine), ecstasy (3,4-methylenedioxy-methamphetamine), marijuana and Lysergic Acid Diethylamide (LSD) were categorized as hallucinogens and subjects using opium, heroin and crack were put into non-hallucinogens group.

Data regarding the oral and dental health, were gathered through a thorough physical examination evaluating the following variables: condition of temporomandibular joint concerning joint pain and/or sensitivity of chewing muscles based on patient's sign and symptoms, abnormal sounds such as click, crepitus and popping that were evaluated by an stethoscope, restriction of mandible's ROM (range of motion) measured by a digital caliper, the subject's dental health assessed by the DMFT index (Decayed, Missing and Filled teeth), the subject's periodontal health assessed by the CPITN index (Community Periodontal Index of Treatment Needs), pathologic lesion in the oral cavity including hypertrophic, aphthous, lichenoid and self-induced lesions, smoking melanosis and symptoms of xerostomia, bleeding on probing, the GPD index (gingival pocket depth) measured by a dental probe, dental mobility, plaque index and xerostomia assessment.

The mandible's ROM was assessed by measuring the maximum distance between edges of incisor teeth via a ruler in millimeters. The DMFT index was evaluated by counting the teeth that were missing, decayed or filled.

To assess the patients regarding their periodontal health the CPITN index was used, categorizing the patients according to the periodontal pockets in 6 sextants of the teeth.

- 0- No disease (no gingival pockets >3 mm)
- 1- Bleeding on probing (no gingival pockets >3 mm)
- 2- No periodontal pocketing > 3mm, calculus present

3- Shallow periodontal pockets 4-5 mm

4- Deep periodontal pockets > 6 mm

The total CPITN score was calculated by summing the scores of 6 sextants, out of 24.

Gingival pocket depth was also evaluated in 6 sextants of the teeth examining 6 sites of the teeth's sulcus. The total score was calculated as sum of depths measures for each sextant. To evaluate periodontal pocket depth, William's periodontal probe was used measuring the depth in millimeters. The same probe was utilized to assess bleeding on probing. The plaque index was calculated as the percentage of the sites with dental plaques of the total examined sites.

Patients were asked 5 questions regarding xerostomia signs and symptoms. Each positive answer was accounted as 1 score and the total score of the patient was calculated as sum of these scores out of 5. Mobility was graded according to the millimeters a tooth moved when forced by a dental mirror.

Collected data were entered into SPSS v.22 software and were analyzed. The differences between the two groups of hallucinogen abusers and non-hallucinogen addicts regarding qualitative variables were analyzed by Chi-Square test and the differences between the mean of the quantitative variables were evaluated via Independent Samples T-test.

## Results

Subjects were categorized by the drug they abused into two groups of hallucinogens and non-hallucinogens. Differences between the two groups regarding qualitative and quantitative variables are illustrated in tables 1 and 2 respectively.

77 subjects (25.3%) were addicted to crystal, 11 (3.6%) to ecstasy, 26 (8.6%) to LSD, 74 (24.3%) to marijuana, 25 (8.2%) to grass, 75 (24.7%) to opium, 24 (7.9%) to heroin and 17 (5.6%) to crack. Overall 188 subjects (61.8%) were addicted to hallucinogens and 116 (38.2%) to non-hallucinogens.

Of the 304 included subjects 275 (90.5%) were male and 29 (9.5%) were female. The difference between the two groups of hallucinogens and non-hallucinogens regarding their gender was significant ( $P=0.042$ ) (Table 1). The mean age of the study population was  $32.7 \pm 7.08$  with a minimum and maximum of 22 and 57 years. The mean age of the subjects categorized as hallucinogens was  $29.62 \pm 4.91$  and non-hallucinogens was  $37.73 \pm 7.23$  and the differences were found to be statistically significant ( $P<0.001$ ) (Table 2).

Overall, 219 subjects (72%) had high school diploma or university educational license. It was 80.8% and 57.7% among hallucinogens and non-hallucinogens, respectively. The differences between the two groups were found to be significant ( $P=0.02$ ) (Table 1). 240 subjects (78.9%) were smokers as well. The prevalence of smoking among hallucinogen users was not significantly different from non-hallucinogen addicts ( $P=0.185$ ) (Table 1). There were no statistically significant difference between the two groups regarding gender and marital status.

The mean duration of drug abuse was  $6.44 \pm 4.47$  years with the minimum of 1 year and maximum of 29 years. The mean duration was  $4.52 \pm 2.24$  and  $9.56 \pm 5.66$  among hallucinogen and non-hallucinogen users respectively and the difference was found to be significant ( $P<0.001$ ) (Table 2). 31 (10.2%) reported using drugs once a day, 178 (58.6%) twice a day and 95 (31.3%) three times a day with significantly more frequent uses among non-hallucinogens ( $P=0.029$ ) (Table 1). 168 subjects (55.3%) smoked the drug, 89 (29.3%) administered it orally, 8 (2.6%) sniffed the drug and 39 (12.8%) were IV drug users. Among the hallucinogen users 89 (47.3%) smoked the drug, 79 (42%) used it orally, 4 (2.1%) sniffed the drug and 16 (8.5%) were IV drug users. These figures in the non-hallucinogens

group were 79 (68.1%), 10 (8.6%), 4 (3.4%) and 23 (19.8%) respectively and the differences were statistically significant ( $P < 0.001$ ) (Table 1).

250 addicts (82.2%) complained of changes in their oral cavity. 210 subjects declared cavities and 209 were complaining of changes in chewing. 205 subjects had toothache. The differences observed between the two groups regarding none of these variables were found to be statistically significant (Table 1). 165 patients had pain in TMJ. 62.8% of the subjects in the hallucinogen group complained of pain in their TMJ while this figure in the non-hallucinogen group was 40.5% and the differences were significant ( $P < 0.001$ ) (Table 1). 180 subjects reported abnormal sounds of TMJ. The prevalence of this complaint among hallucinogen addicts was significantly higher than non-hallucinogen addicts i.e. 64.9% versus 50% of the subjects ( $P = 0.010$ ) (Table 1). 166 subjects had sensitivity in their masticator muscles and this problem also was significantly more prevalent among hallucinogen addicts with 59.6% versus 46.6% ( $P = 0.027$ ) (Table 1). The mean of TMJ's ROM index was 40.23 mm with maximum and minimum of 50 mm and 31 mm. This figure for hallucinogen addicts and non-hallucinogen addicts was  $38.27 \pm 4.58$  and  $43.4 \pm 3.82$  and the differences were significant ( $P < 0.001$ ) (Table 2).

According to the DMFT index, the mean number of teeth with caries was 12.61 with a maximum of 23 teeth. The mean of missing teeth was 10.22 with a maximum of 32 and the mean of filled teeth was 2.77 with a maximum of 12. Hallucinogen addicts had significantly more decayed teeth ( $P = 0.013$ ), less missing teeth ( $P < 0.001$ ) and more filled teeth ( $P < 0.001$ ) (Table 2).

The mean, minimum and maximum of CPITN score were 15.25, 4 and 22, respectively. Hallucinogen addicts had significantly higher mean of CPITN compared to non-hallucinogen addicts with  $15.64 \pm 3.29$  compared to  $14.61 \pm 3.75$  ( $P = 0.049$ ) (Table 2).

206 subjects (67.8%) did not present any apparent mobility of their teeth while 80 subjects (26.3%) had a moderate mobility grade and 18 subjects (5.9%) had severely mobile teeth. The differences between the two groups were not significant (Table 2).

The mean of plaque index was calculated to be 77.88 with maximum and minimum of 65 and 90. The mean among hallucinogen group was  $78.24 \pm 6.48$  and for non-hallucinogen group was  $77.28 \pm 6.26$  and the differences were not significant (Table 2). Pathologic lesions were detected in 133 subjects including 41 aphthous lesions, 37 lichenoid lesions, 66 smoking melanosis, 41 hypertrophic lesions and 36 self-induced lesions. The total pathologic lesions were significantly more prevalent in hallucinogen addicts ( $P = 0.005$ ). Of the pathologic lesions evaluated, lichenoid ( $P = 0.010$ ) and hypertrophic ( $P = 0.022$ ) lesions were the only lesions significantly more prevalent among the hallucinogen group (Table 1).

Xerostomia symptoms were found in 236 subjects and the difference between the two groups regarding this variable was not significant ( $P = 0.603$ ). 184 subjects had bleeding on probing. 78.4% of the non-hallucinogen addicts presented with bleeding on probing which was significantly different from the hallucinogen group with 49.5% ( $P < 0.001$ ) (Table 1). 208 were sensitive to cold and warm and this problem was significantly more prevalent in non-hallucinogen group with 81.9% compared to hallucinogen group with 60.1% ( $P < 0.001$ ) (Table 1).

The mean of sum of GPD (gingival pocket depths) in 6 sextants was 26.19 with a minimum of 7 and maximum of 32. The mean of GPD was higher in non-hallucinogen group but the differences were not significant ( $P = 0.103$ ) (Table 2). As for the xerostomia index, 15 subjects were scored 1, 48 were scored 2, 73 were scored 3, 112 were scored 4 and 56 were scored 5. The mean of the total score was higher among hallucinogens with  $3.53 \pm 1.07$  compared to non-hallucinogens with  $3.38 \pm 1.17$ , but the differences were not found to be statistically significant ( $P = 0.256$ ) (Table 2).

## Discussion

Hallucinogens, popular in the 1960s, have unfortunately been making a strong comeback. With new synthetic hallucinogens on the market, it's vital that people understand the dangers of abusing these drugs so that the severe damage they can cause can be prevented. In this regard we conducted this survey to evaluate oral and dental complications of hallucinogen abuse. Other studies have also evaluated this matter that is discussed here.

According to the study by Darling et al. [13] in 1993 conducted on 300 subjects, xerostomia, leukoedema and traumatic oral ulcers were found to be significantly more prevalent among cannabis users. We found that among the 49 marijuana users, 38 complained of xerostomia and xerostomia index was higher among cannabis users but the differences were not statistically significant.

Fazziet al. [14] evaluated the effects of illicit drugs on oral health in 1999. They reported that major oral health problems associated with cannabis abuse include an increased risk of squamous cell carcinoma, xerostomia and severe gingivitis. They mentioned that hallucinogens have few direct effects on oral cavity including xerostomia, bruxism and problems associated with nutritional changes in these individuals. Our study showed that hallucinogen users were more likely to complain about xerostomia, had higher xerostomia index scores and TMJ pain, abnormal TMJ sounds and chewing muscle sensitivity and bleeding on probing were more prevalent among them.

In 2003 Verheyden et al. [15] assessed the short and long term effects of MDMA on oral health of 428 subjects. They found significant increase in xerostomia and bruxism in these addicts which was compatible with our results. We also found that 80% of the crystal users had xerostomia signs on examination and 69% of them had sensitivity of the chewing muscles.

In 2005, Cho et al. [16] found that marijuana abuse is significantly related to dental caries and periodontal diseases. Moreover cannabis smoke can act as a carcinogen, inducing dysplastic changes and pre malignant lesions in oral mucosa. Cannabis users are also more prone to infections that might be due to immunosuppression caused by this drug. In order to evaluate periodontal health, we used CPITN index which was highest among marijuana users with a mean of 16.8, indicative of more severe periodontal problems in these individuals. These subjects also had the highest GPD scores after heroin users with a mean of 27.16. These findings were also confirmed by Thomson et al. [17] in 2008 declaring that marijuana use is an independent risk factor for periodontal disorders and increases the risk of periodontitis by 7 times.

Silverstein et al. [18] reported a mean DMFT score of 13.2 among 77 illicit drug users in 2006. They found that oral health was worse among addicts to barbiturates, hallucinogens and heroin. The difference in DMFT score between the two groups of hallucinogen and non-hallucinogen was statistically significant in the current study.

Two review articles in 2005 and 2006 conducted by Curtis et al. [19] and Goodchild et al. [20] respectively, yielded similar results and found significant relation between crystal use and bruxism, dental erosions, xerostomia and rampant tooth decay known as meth mouth. These findings were also confirmed by Hamamoto et al. [21] in 2009 and Ravenel [22] in 2012. We also found the same results as these surveys.

In our study we found that addicts to crystal had the highest prevalence of TMJ pain, TMJ abnormal sounds and chewing muscle sensitivity after LSD users. The mean score of xerostomia index was also highest in these subjects after LSD. These findings were compatible with the results of studies conducted by Brand et al. [23] and McGrath et al. [24].

		Hallucinogen				P value
		Hallucinogen		Non-hallucinogen		
		Count	Column N%	Count	Column N%	
Age group	<27	11	9.50%	72	38.30%	<0.001
	27-32	13	11.20%	63	33.50%	
	32-37	38	32.80%	46	24.50%	
	>37	54	46.60%	7	3.70%	
Gender	Male	110	94.80%	165	87.80%	0.042
	Female	6	5.20%	23	12.20%	
Education	Illiterate	22	19%	18	9.60%	<0.001
	Elementary	27	23.30%	18	9.60%	
	High school	34	29.30%	67	35.60%	
	Diploma	17	14.70%	35	18.60%	
	University	16	13.80%	50	26.60%	
Do you smoke	No	29	25%	35	18.60%	0.185
	Yes	87	75%	153	81.40%	
Times used per day	1	5	4.30%	26	13.80%	0.029
	2	72	62.10%	106	56.40%	
	3	39	33.60%	56	29.80%	
How do they use	Smoke	79	68.10%	89	47.30%	<0.001
	Oral	10	8.60%	79	42%	
	Nasal	4	3.40%	4	2.10%	
	IV	23	19.80%	16	8.50%	
Change in mouth	No	23	19.80%	31	16.50%	0.459
	Yes	93	80.20%	157	83.50%	
Dental caries	No	37	31.90%	57	30.30%	0.773
	Yes	79	68.10%	131	69.70%	
Change in chewing	No	38	32.80%	57	30.30%	0.656
	Yes	78	67.20%	131	69.70%	
Pain sensation	No	40	34.50%	59	31.40%	0.575
	Yes	76	65.50%	129	68.60%	
TMJ pain	No	69	59.50%	70	37.20%	<0.001
	Yes	47	40.50%	118	62.80%	
TMJ abnormal sounds	No	58	50%	66	35.10%	0.01
	Yes	58	50%	122	64.90%	
TMJ muscle sensitivity	No	62	53.40%	76	40.40%	0.027
	Yes	54	46.60%	112	59.60%	
Pathologic lesions	No	77	66.40%	94	50.00%	0.005
	Yes	39	33.60%	94	50.00%	
Aphthous	No	98	84.50%	165	87.80%	0.416
	Yes	18	15.50%	23	12.20%	
Lichenoid lesion	No	109	94.00%	158	84.00%	0.01
	Yes	7	6.00%	30	16.00%	
Smoking Melanosis	No	96	82.80%	142	75.50%	0.138
	Yes	20	17.20%	46	24.50%	
Hypertrophy	No	107	92.20%	156	83.00%	0.022
	Yes	9	7.80%	32	17.00%	
Self Induced	No	104	89.70%	164	87.20%	0.526
	Yes	12	10.30%	24	12.80%	
Xerostomia signs	No	27	23.30%	39	20.70%	0.603
	Yes	89	76.70%	149	79.30%	
Bleeding on probing	No	25	21.60%	95	50.50%	<0.001
	Yes	91	78.40%	93	49.50%	
Sensitivity to cold and warm	No	21	18.10%	75	39.90%	<0.001
	Yes	95	81.90%	113	60.10%	

**Table 1:** Differences between hallucinogen and non-hallucinogen addicts regarding qualitative variables

	Hallucinogen				P value
	Non-hallucinogen		Hallucinogen		
	Mean	Standard Deviation	Mean	Standard Deviation	
Age	37.73	7.23	29.62	4.91	<0.001
Addiction period	9.56	5.66	4.52	2.24	<0.001
Mandible's ROM	43.40	3.83	38.27	4.58	<0.001
DMFT decay	12.04	3.38	12.96	2.92	0.013
DMFT missing	12.91	3.84	8.56	3.95	<0.001
DMFT filled	2.27	1.46	3.08	1.97	<0.001
DMFT	27.22	4.17	24.60	5.01	<0.001
Maximum Mobility Grade	.36	.57	.39	.62	0.655
Plaque Index	77.28	6.27	78.24	6.49	0.205
CPITN	14.61	3.75	15.65	3.29	0.012
GPD	26.60	3.52	25.94	3.36	0.103
Xerostomia Index	3.39	1.17	3.54	1.07	0.256

**Table 2:** Differences between hallucinogen and non-hallucinogen addicts regarding quantitative variables

According to Morioet al. [25] subjects addicted to crystal tend to drink more carbonated beverages, spend less time brushing their teeth and they are more likely to smoke. They present with more apparent plaques on their teeth, have less molar teeth and tooth decay is more prevalent among them rather than the control group. Congruous with these results we also found that the mean of plaque index and decayed teeth were highest among crystal users after ecstasy addicts with 79.48 and 13.91, respectively.

In 2014, Van Zyl et al. [26] presented an overview of substance abuse and oral health. He also mentioned the association between ecstasy abuse, dry mouth and bruxism. Cannabis was reported to be related to gingival enlargement, xerostomia, caries and periodontal diseases. It may also cause stomatitis with leukoedema of the buccal mucosa and hyperkeratosis and plays a significant role in HPV-16 associated oropharyngeal cancers. This study also yielded similar results on the association between ecstasy, dry mouth and bruxism. We also found a higher prevalence of xerostomia in marijuana users.

Overall, our results were compatible with the results of previous surveys regarding hallucinogen drug abusers. None of these studies have compared complications of hallucinogens with non-hallucinogens, which is the hallmark of our study.

Due to the limitations in our survey, we did not compare the oral and dental health of hallucinogen abusers with non addicts. We did not take multiple drugs into account as well. For each subject only the major drug of abuse was considered, so further investigations are required regarding these factors.

## Conclusion

Putting it all together, compared to non-hallucinogen addicts, hallucinogen users are at higher risk of developing pathologic oral lesions. The total pathologic lesion were significantly more prevalent in hallucinogen addicts ( $P=0.005$ ) and of the pathologic lesions evaluated, lichenoid ( $P=0.010$ ) and hypertrophic ( $p=0.022$ ) lesions were the only lesions significantly more prevalent among the hallucinogen group.

## Conflict of Interest

Hereby, all authors declare that there is no conflict of interest in design, perform and writing this research.

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