



## ORIGINAL ARTICLE

# Self-perceived oral symptoms and periodontal status among young intravenous heroin addicts: A cross-sectional case-control study

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## Abstract

**Background:** It is hypothesized that (a) self-perceived oral symptoms (OSs) are worse in intravenous heroin addicts (IHA) than controls; and (b) clinical periodontal inflammatory parameters (plaque index [PI], bleeding on probing [BOP], PD and clinical attachment loss [AL]), number of missing teeth (MT), and radiographic marginal bone loss (MBL) are higher in IHA compared with controls. The aim was to compare the self-perceived OSs and periodontal parameters among young IHA and controls.

**Methods:** Sociodemographic data, self-perceived OSs and duration and daily frequency of intravenous heroin use was gathered using a structured questionnaire. Full-mouth PI, BOP, PD, and clinical AL were measured, and number of MT were recorded. Mesial and distal MBL on all teeth was measured on digital radiographs. Odds ratios (OR) with 95% confidence intervals (CI) were computed for self-perceived OSs and periodontal parameters were assessed using the Mann Whitney U-test and logistic regression analysis. Sample-size was estimated, and level of significance was set at  $P < 0.05$ .

**Results:** OR (95% CI) for self-perceived loose teeth ( $P < 0.001$ ), pain in teeth ( $P < 0.001$ ), dry mouth ( $P < 0.001$ ), burning sensation in mouth ( $P < 0.001$ ), bleeding gums ( $P < 0.001$ ) and pain during chewing ( $P < 0.001$ ) were significantly higher in the test than control group. Number of MT ( $P < 0.05$ ), PI ( $P < 0.05$ ), clinical AL ( $P < 0.05$ ), and mesial ( $P < 0.05$ ) and distal ( $P < 0.05$ ) MBL were statistically significantly higher among individuals in the test group compared with the control group.

**Conclusion:** Self-perceived OSs and periodontal inflammatory parameters were worse in IHA than controls.

## KEYWORDS

dental plaque index, heroin, periodontal index, periodontal pocket, tooth loss

Heroin is an illegal and highly addictive drug that is made from the resin of poppy plants. It is usually injected in the veins of the arm and leg as the primary point for intravenous access.<sup>1</sup> In the past 10 years, deaths associated with heroin

addiction have increased in the United States.<sup>2</sup> In a recent study, Hudson et al.<sup>2</sup> assessed the mortality rates associated with heroin addiction rates in the U.S. city of Florida. The dreadful results of this surveillance study<sup>2</sup> showed that



heroin-related deaths in the Orange county Florida increased by 590% between the years 2010 and 2014. Although dosage is usually associated with drug-associated mortality, other complications of intravenous drug use, such as infections with hepatitis B and C virus and human immunodeficiency virus may also constitute a major cause of morbidity and mortality among intravenous drug users.<sup>3,4</sup>

Studies<sup>5-11</sup> have assessed the oral health status among intravenous injection drug users. It has been reported that the prevalence of dental caries is significantly higher among heroin addicts compared with controls (taking no addictive substances).<sup>10</sup> The increased prevalence of dental caries in heroin addicts has been associated with reduced flow rates and pH of stimulated and unstimulated saliva in these individuals compared with controls.<sup>10</sup> Similarly, results by Ma et al.<sup>8</sup> and Du et al.<sup>6</sup> showed that periodontal inflammatory parameters such as, gingival bleeding, probing depth (PD) and clinical attachment loss (AL) are poorer in heroin drug addicts compared with controls. However, in the studies by Ma et al.<sup>8</sup> and Du et al.<sup>6</sup> oral health status of former heroin users being treated at a rehabilitation center were included. To the authors' knowledge, there are no studies in indexed literature that have assessed the self-perceived oral symptoms (OSs) among intravenous heroin addicts (IHA). Moreover, there are no studies that have compared mesial and distal marginal bone loss (MBL) around teeth among IHA and controls. It is hypothesized that (a) self-perceived OSs are worse in IHA compared with controls; and (b) scores of clinical periodontal inflammatory parameters (plaque index [PI], bleeding on probing [BOP], PD, and clinical AL), number of missing teeth (MT) and radiographic MBL are higher in IHA compared with controls.

The aim of the present cross-sectional case-control clinical study was to compare the self-perceived OSs and clinical periodontal parameters among young IHA and controls.

## 1 | METHODS

### 1.1 | Ethical guidelines

The study was approved by the ethics committee of the Jinah Hospital, Karachi, Pakistan. Written informed consent was obtained from all participants before their inclusion into the study. All participants were informed that they reserved the right to leave the research project at any stage of the investigation without consequences. The study was performed in accordance with the declaration of Helsinki as revised in 2013.

### 1.2 | Inclusion and exclusion criteria

The inclusion criteria were as follows: (a) Self-reported IHA (test group); (b) individuals who reported have never used any

addictive drugs or substances (control group). The exclusion criteria were: (a) tobacco smokers; (b) smokeless-tobacco product users; (c) self-reported habitual alcohol consumption; (d) completely edentulous individuals; (e) third molars; (f) individuals that reported to have undergone any form of periodontal maintenance therapy within the past 6 months.

### 1.3 | Participants

Between October 2016 and June 2017, a cross-sectional case-control study was conducted at the Department of Dentistry, Jinah Hospital, Karachi, Pakistan. All participants were homeless and poverty-driven, that is, they had underprivileged living, housing and educational standards.<sup>12,13</sup> These individuals were residing on streets near the hospital. IHA were defined as individuals who injected heroin at least once daily since the past 12 months (test group). Controls were defined as poverty-driven individuals who reported to have never used any form of addictive drug. A standardized oral health-related questionnaire was administered to the volunteering participants. The participants were then invited to the outpatient division at the Department of Dentistry, Jinah Hospital, Karachi, Pakistan for a clinical and radiographic examination.

### 1.4 | Questionnaire

Information regarding age, gender, self-perceived OSs (loose teeth, pain in teeth, bleeding gums, dry mouth, burning sensation in mouth, and pain while chewing), family history of addictive drug use, daily tooth brushing, reason/s for using heroin injections and duration and daily frequency of intravenous heroin injection was gathered using a questionnaire. Education level was defined as follows: (a) School level: up to 10th Grade<sup>14</sup>; (b) college level: 2 years education after school level<sup>15</sup>; (c) University level: further education after college level<sup>16</sup>; and (d) illiterate: individuals that could not read or write in any language.<sup>17</sup> The questionnaire was administered to the participants by a trained investigator (AM).

### 1.5 | Clinical periodontal examination

Full-mouth PI<sup>18</sup>, BOP<sup>19</sup>, clinical AL,<sup>20</sup> and PD (in millimeters [mm])<sup>21</sup> were measured at six sites per tooth (mesiobuccal, midbuccal, distobuccal, distolingual, and palatal, midlingual and palatal, and mesiolingual and palatal) on all maxillary and mandibular teeth. A graded probe (Hu-Friedy Manufacturing, Chicago, IL) was used to measure the PD. The number of missing teeth (MT) was also counted. Fractured teeth with embedded root remnants were considered missing. Clinical periodontal examination was performed by a trained and calibrated examiner (AM) who was blinded to individuals in the test and control groups. The overall kappa value for intraexaminer reliability was 0.86.

## 1.6 | Marginal bone loss

In both groups, full mouth intraoral digital radiographs (4 bitewings of posterior teeth, 5 periapical radiographs in maxillary anterior and posterior teeth and 3 periapical radiographs in the mandibular anterior and posterior teeth) were taken using a digital radiographic machine (GENDEX™, Intraoral Xray Systems, NOMAD PRO2™, Hatfield, PA). The long cone paralleling technique was used to standardize the angulations of the radiographs.<sup>22,23</sup> All radiographs were viewed on a calibrated computer screen (Samsung SyncMaster digital TV monitor, Seoul, Korea)<sup>#</sup> using a software program (GENDEX™, VIXWIN™ Platinum, Hatfield, PA). Marginal bone loss (MBL) was defined as the vertical distance from 2 mm below the cementoenamel junction (CEJ) to the most crestal position of the alveolar bone.<sup>24</sup> Teeth surfaces where the alveolar crest and/or the CEJ were not clearly visible because of technical reasons (including interdental caries, restorations, overlapping teeth, and poor radiographic quality) were not sought. One trained and calibrated investigator (AM) blinded to the study groups performed the radiographic evaluations. The overall *kappa* for the intraexaminer reliability was 0.88.

## 1.7 | Statistical analysis

Statistical analysis was performed using a software program (SPSS Version 18, Chicago, IL). Odds ratios (OR) with 95% Confidence Intervals were computed for OSs and periodontal parameters (PI, BOP, PD, clinical AL, and MBL) were assessed using the Mann Whitney U-test in a statistically significant manner with the independent variables. The data was adjusted for socioeconomic status (SES), daily oral hygiene maintenance and education status and assessed using logistic models. Power analysis was performed using a software package (nQuery Advisor 5.0, Statistical Solutions, Saugus, MA). The sample size estimation was based on the supposition that a mean difference of 0.5 mm and 1 mm in MBL and PD, respectively, should be detected at a significance level of 0.05. It was estimated that inclusion of at least 34 individuals per group to attain a study power of 88%. P-values less than 0.05 were considered statistically significant.

## 2 | RESULTS

### 2.1 | General characteristics of the study groups

In total, 37 individuals in the test group and 35 in the control group were included. All participants were homeless and poverty-driven males that labelled “street begging” as their occupation.

**TABLE 1** General characteristics of the study groups

Sociodemographic parameters	Test group	Control group
<i>n</i>	37	35
Gender (male)	37	35
Mean age (range)	33.6 ± 3.4 years	35.5 ± 1.6 years
Monthly income (in USD) <sup>a</sup>	96.42 ± 12.5	103.55 ± 6.4
Education status		
School level (n)	6	6
College level (n)	—	—
University level (n)	—	—
Illiterate (n)	31	29
Duration of heroin addiction	7.4±1.6 years	NA
Daily frequency of intravenous heroin use	2.1±0.5 times	NA
Family history of addictive drug use	34	4
Toothbrushing		
Once daily	5	5
Twice daily	—	—
Three times or more	—	—
Sometimes	32	30

<sup>a</sup>The monthly income was recorded in Pakistani rupees and converted into United States Dollars (USD). One United States dollar was equivalent to 105.36 Pakistani rupees. — = None  
NA: Not applicable

The mean ages of individuals in the test and control groups were 33.6±3.4 and 35.5±1.6 years, respectively. In the test and control groups, 83.7% and 82.8% individuals, respectively were illiterate. In the test group, the individuals were using intravenous heroin injections 2.1±0.5 times daily since 7.4 ±1.6 years. In the test and control groups, 86.5% and 85.7% individuals, respectively reported that they sometimes brushed their teeth. A family history of addictive drug usage was more often reported by individuals in the test compared with the control group (Table 1).

### 2.2 | Reasons for heroin addiction

Thirty-one (83.8%) individuals reported that they started taking heroin injections as a recreation and were influenced by friends. Four (10.8%) individuals reported that they started using heroin injections because of low esteem. Two (5.4%) individuals did not provide any reason for intravenous drug usage.

### 2.3 | Self-perceived oral symptoms

There was a statistically significant difference in the OR (95% CI) for self-perceived loose teeth (5.4 [4.8–6.1]) (*P* < 0.001), pain in teeth (5.1 [4.7–5.6]) (*P* < 0.001), dry mouth

**TABLE 2** Self-perceived oral symptoms among individuals in the test and control groups

	Group comparison for self-perceived oral symptoms	Yes (n)	No (n)	Odds ratios (95% confidence interval)	P-value
Loose teeth	Test group (n = 37)	29	8	5.4 (4.8-6.1)	<0.001
	Control group (n = 35)	14	21		
Pain in teeth	Test group (n = 37)	25	12	5.1 (4.7-5.6)	<0.001
	Control group (n = 35)	13	32		
Dry mouth	Test group (n = 37)	31	6	40 (36.5-44.6)	<0.001
	Control group (n = 35)	4	31		
Burning sensation in mouth	Test group (n = 37)	28	9	33.2 (31.7-36.5)	<0.001
	Control group (n = 35)	3	32		
Bleeding gums	Test group (n = 37)	28	9	2.9 (2.4-3.5)	<0.001
	Control group (n = 35)	18	17		
Pain during chewing	Test group (n = 37)	24	13	2.5 (1.8-3.1)	<0.001
	Control group (n = 35)	15	20		

(40 [36.5–44.6]) ( $P < 0.001$ ), burning sensation in mouth (33.2 [31.7–36.5]) ( $P < 0.001$ ), bleeding gums (2.9 (2.4–3.5)) ( $P < 0.001$ ) and pain during chewing (2.5 [1.8–3.1]) ( $P < 0.001$ ) among individuals in the test group compared with the control group (Table 2).

## 2.4 | Clinical periodontal parameters and marginal bone loss

Number of missing teeth ( $P < 0.05$ ), PI ( $P < 0.05$ ), clinical AL ( $P < 0.05$ ), and mesial ( $P < 0.05$ ) and distal ( $P < 0.05$ ) MBL were statistically significantly higher among individuals in the test group compared with the control group. There was no statistically significant difference in BOP and PD in both groups (Table 3).

## 3 | DISCUSSION

The present study is based on the hypothesis self-perceived oral symptoms are more often reported by IHA (test group) compared with individuals not using to any form of opioids (control group). The reported results are in accordance with this hypothesis. It is well-known that poor education and an underprivileged living standard are significant risk factors of periodontal disease.<sup>25</sup> In the present study, all individuals in the test group had an underprivileged SES and were mostly illiterate. To minimize the potential risk of bias, individuals in the control group also comprised of individuals with no education and deprived living standards. Another risk factor of periodontal disease is advancing age.<sup>26</sup> In the present study, participants in both groups were young subjects (approximately 30 years old) with no statistically significant difference in mean ages.

In the present study, PI was significantly higher among individuals in the test compared with the control group even

though only a very limited number of individuals in both groups reported to brush their teeth at last once daily (13.5% and 14.3% individuals in the test and control groups, respectively). One explanation for this is a reduction in the salivary flow rate among individuals in the test group. Saliva is a complex oral fluid that besides helping in speech, mastication, and deglutition, protects the teeth and oral mucosal surfaces from pathogenic microbes.<sup>27–29</sup> In the study by Protrka et al.,<sup>10</sup> salivary flow was assessed among heroin addicts and nonaddicted controls. The results showed a statistically significant association between heroin addiction and reduced production of unstimulated ( $P < 0.001$ ) and stimulated saliva ( $P < 0.002$ ). The results also showed a lower salivary pH in addicted compared with nonaddicted individuals.<sup>10</sup> The authors support the study by Protrka et al.<sup>10</sup> in which, OR (95% CI) for self-perceived dryness in mouth were significantly higher among heroin-addicted compared with nonaddicted individuals. The exact mechanism through which heroin addiction enhances periodontal destructions remains unclear; however, it is hypothesized that a web of events (and not merely poor oral hygiene) are associated with the increased periodontal destruction in IHA compared with controls with similar oral health statuses. It has been suggested that constant drug abuse damages cellular and humoral immunity.<sup>8</sup> It is further theorized that because of persistently poor oral hygiene status, chronic xerostomia, and suppressed immunity, levels of periodontopathogenic microbes (such as *Porphyromonas gingivalis* and *Aggregatibacter Actinomycetemcomitans*) are higher in IHA compared with controls. Further, long-term use of heroin injections has been associated with systemic disorders such as diabetes, arthritis and thyroid diseases<sup>30</sup>; which are also risk factors of periodontal disease.<sup>31–33</sup> These are possible events that may have contributed in exacerbating periodontal disease in terms of increased clinical AL and mesial and distal MBL in IHA than controls; however





**TABLE 3** Periodontal parameters among individuals in the test and control groups

Parameters (mean±SD)	Test group (n = 37)	Control group (n = 35)
Number of missing teeth (n)	13.1 ± 2.4 <sup>a</sup>	6.5 ± 1.5
Plaque index (%)	82.1 ± 6.6 <sup>a</sup>	64.3 ± 8.6
Bleeding on probing (%)	78.6 ± 5.8	70.6 ± 7.5
Probing depth (in mm)	8.2 ± 0.5	7.7 ± 0.4
Clinical attachment loss (in mm)	5.1 ± 0.5 <sup>a</sup>	4.6 ± 0.3
Marginal bone loss (in mm)		
Mesial (in mm)	6.6 ± 0.8 <sup>a</sup>	4.2 ± 0.5
Distal (in mm)	6.8 ± 0.3 <sup>a</sup>	4.4 ± 0.4

<sup>a</sup>Compared with the control group (P < 0.05)

further studies are needed to justify these hypotheses. One important outcome of the present study is that despite being young (nearly 30 years old), IHA demonstrated significantly higher MBL than controls. Although periodontal inflammatory conditions have been reported to be more common in individuals ≥60 years old than younger subjects (45 years old)<sup>25</sup>; it seems that IHA become susceptible to periodontal destruction and tooth loss at much younger ages. Following the questionnaire administration and clinical and radiographic evaluations, all participants received a complimentary full-mouth supra-gingival plaque debridement using an ultrasonic scaler (Dental Equipment Woodpecker Uds-J Ultrasonic Scaler EMS Compatible Original, Guangzhou, China). In addition, detrimental effects of intravenous drug abuse were explained to participants and importance of a regular oral hygiene maintenance was also discussed with all participants.

Studies<sup>34–36</sup> have shown that intravenous access points can cause several local complications such as erythema and pain, necrosis, thrombophlebitis, venous sclerosis, and occlusion of blood vessels. Such complications may tempt intravenous drug users to use alternate intravenous access points, such as the femoral vein.<sup>37</sup> The authors propose that healthcare providers, public health practitioners, and policy makers could use such information to protect the health of intravenous drug users. Moreover, it is recommended that public health awareness programs should routinely be conducted to educate the public about the detrimental effects of drug addiction on overall health. Further, healthcare providers should also be educated about and encouraged to use syringe disposal services as recommended by the World Health Organization.<sup>38</sup> These measures may help to reduce if not prevent the risk for morbidity and mortality among opioid drug users.

## 4 | CONCLUSION

Self-perceived OSs and periodontal inflammatory parameters were worse in IHA than controls.

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