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# Are periodontitis, dental caries and xerostomia more frequently present in recreational ecstasy users?


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**Emma E. J. van Kempen,<sup>1</sup> Jan G. A. M. de Visscher<sup>2</sup> and Henk S. Brand<sup>1</sup>** set out to determine whether there is a difference in oral health between those who use ecstasy and those who don't.

## Abstract

**Objectives** The aim of this retrospective study was to determine whether there is a difference in oral health between recreational ecstasy users and non-recreational drug users.

**Study design** In a cross-sectional study, dental records of 149 individuals visiting an academic dental clinic in Amsterdam who reported recreational ecstasy use, defined as no more than twice a week, were systematically analysed and compared to a group of age- and sex-matched non-drug users randomly selected from this institute. The parameters retrieved from the dental records were decayed, missed and filled teeth index (DMFT), number of endodontically treated teeth, presence of active caries lesions, periodontitis, tooth wear, xerostomia and self-reported use of oral hygiene devices.

**Results** Periodontitis, active caries lesions and xerostomia were statistically significantly more present in ecstasy users. Ecstasy users brush their teeth significant less frequently per day than non-recreational drug users. There were no significant differences in DMFT and in the devices used for brushing/interdental cleaning and frequency of use of these interdental devices between both groups.

**Conclusion** Periodontitis, active caries lesions and xerostomia are more frequently present in recreational ecstasy users compared to age- and sex-matched non-users.

## Introduction

From the late 1970s, 3,4-methylene-dioxymethamphetamine (MDMA) was marketed as a psychoactive drug in California under the name of ecstasy. From 1980, ecstasy became a popular orally-taken drug among people who lived in urban areas, commonly being used during festivals, parties and in clubs.<sup>1,2</sup> The description 'recreational drug use' is a relatively new term which non-clinically describes the use of drugs with the intention to enhance life, to induce euphoria or to create pleasure. It is mainly used by young adults and clubbers and recreational use is usually without harmful physiological, behavioural and cognitive symptoms.<sup>3,4,5</sup>

MDMA is a psychoactive substance and when administered it gives the user a relaxed feeling and an increase in empathy and energy, while eating and sleep are suppressed.<sup>1</sup> These clinical symptoms are due to the influence of MDMA on the serotonergic system in the brain by releasing the neurotransmitters 5-hydroxytryptamine, dopamine and noradrenaline.<sup>6</sup>

Experience of desired effects of MDMA occurs from a dose of 80–100 mg. From 120 mg, the experience of negative effects increases and at 180 mg, the positive effects are almost negligible compared to the negative effects.<sup>2,7</sup> Adverse effects of MDMA include, among others, tachycardia, urinary retention, hypertension, restlessness, hallucinations, hyperthermia and hyponatremia.<sup>1,8</sup> Ecstasy use can lead to dependence but the physiological basis of ecstasy use and withdrawal syndrome may be weaker than with other drugs,

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such as alcohol and opioids.<sup>4</sup> It is unknown how many people are inhibited in their daily functioning as a result of ecstasy use.<sup>2</sup> Ecstasy is often used in combination with other psychoactive substances, usually in combination with alcohol and/or energy drinks or in combination with cannabis.<sup>9,10</sup> The main reasons to combine ecstasy with other substances are to strengthen the positive effects of the drug or to reduce its negative side effects. The combination of MDMA with alcohol could reduce the negative effect of hyperthermia and water retention. Combination with cannabis seems to relieve the unpleasant after effects of MDMA, such as depressed feelings, anhedonia and dysphoria.<sup>9</sup>

The sympathomimetic effect of ecstasy has been reported to influence oral functions by causing bruxism and xerostomia during use.<sup>11,12,13,14,15,16</sup> The various oral health effects of MDMA have been documented in case reports and case series but were not systematically compared to non-users. The aim of the present study was to compare the oral health parameters of a sample of individuals visiting the Academic Centre of Dentistry Amsterdam (ACTA) who report to use ecstasy on a recreational basis, with a group of age- and sex-matched individuals who report not to use any drugs. It was hypothesised that recreational ecstasy-users have poorer oral health than non-users.

**Material and methods**

This cross-sectional comparative analysis of the patient database of ACTA, the Netherlands, was performed between November 2018 and July 2019. The study was

*‘The sympathomimetic effect of ecstasy has been reported to influence oral functions by causing bruxism and xerostomia during use.’*

performed in accordance with the Declaration of Helsinki and reviewed and approved on 8 November 2018 by the institutional Ethics Review Committee (ERC) of ACTA (protocol number 2018048). The institutional ERC of ACTA confirmed that the Medical Research Involving Human Subjects Act (in Dutch: Wet Medisch Wetenschappelijk Onderzoek met Mensen) does not apply to this study.

The medical history forms in the patient database axiUm (Exan group, Coquitlam, British Columbia, Canada) of the period 2002–2019 were electronically searched for reported recreational ecstasy use.

Inclusion criteria for recreational ecstasy subjects were: use of recreational ecstasy (defined as regular drug use for no more than twice a week); being older than 18 years of age; (partially) dentate; and information about previous dental treatment, available in axiUm.

For every individual reporting use of ecstasy, a non-drug user of ACTA with the same age and sex was randomly selected for comparison.

Inclusion criteria for non-drug control

individuals were: same sex and a maximum of one-month age difference from the ecstasy-using subject; visiting the academic dental clinic in the same year as the user subjects; and no use of any recreational psychoactive drugs (except smoking tobacco and consumption of alcohol).

An automatic electronic search in the patient database of 18,700 individuals of ACTA identified 181 subjects (1%) who reported the use of ecstasy. In total, 31 individuals were excluded: 22 due to restricted access to the electronic health and dental records; 4 for missing data in the records; 3 for being non-recreational ecstasy users and 1 was younger than 18 years of age. For one patient, no comparable non-using patient was available. This resulted in a final study sample of 149 ecstasy users and 149 non-drug users.

*Data extraction procedure*

Data were systematically extracted from axiUm by one investigator using a standard data extraction sheet and were anonymously entered into an Excel spreadsheet. If a parameter was not retrievable, information was labelled as missing data. The following data were extracted from a single visit of the subjects: the DMFT index; restored, missing, endodontically treated teeth; and presence of active caries lesions. The DMFT index and endodontically treated teeth were extracted from the dental status or determined based on the available intra-oral pictures and/or dental radiographic images. To determine the presence of active caries lesions, the dental records and dental radiographic images were screened for the need of restorative treatment. The presence or absence of periodontitis was extracted from the dental records. The diagnosis of periodontitis was based on clinical periodontal examination and included a probing depth of >3 mm and alveolar bone loss during radiographic assessment. The presence of reported tooth wear to the dentin was based on information from dental records and available clinical

**Table 1 Demographic characteristics of recreational ecstasy users and non-drug users. Datasets are presented as mean ± SD or percentages**

Demographics	Ecstasy users	Non-users	P value
Age (years)	30.3 ± 9.5	30.1 ± 9.4	-
Sex (female:male)	49:100	49:100	-
Tobacco smokers	49.0% (n = 70)	14.3% (n = 21)	<0.001 *
Sex of smokers (female:male)	21:49	04:17	-
Cigarettes (per day)	5.1 ± 8.8	0.8 ± 2.7	<0.001 **
Frequency in ecstasy use (per year)	7.1 ± 8.5	-	-
Polydrug use	44.3% (n = 66)	-	-
Cannabis use	35.7% (n = 50)	-	-
Frequency of cannabis use (per week)	1.6 ± 5.8	-	-

Key:  
 \* = Chi-squared test  
 \*\* = Mann-Whitney U test

intra-oral pictures. The presence of patient-reported xerostomia (yes/no), oral mucosal lesions, use of manual or electric toothbrush, frequency of brushing and use and frequency of interdental cleaning devices was based on information from the dental records.

**Statistical analysis**

All data are presented as percentages or mean ± standard deviation (SD). Datasets were not normally distributed (Kolmogorov-Smirnov test). For the statistical analysis of the datasets, Kruskal-Wallis tests, chi-squared tests and Mann-Whitney U tests were used. All data were analysed using IBM SPSS Statistics version 25 for Windows (IBM Corp. Armonk, NY, USA) Differences with a p <0.05 were considered statistically significant.

**Results**

**Baseline characteristics of the sample**

In total, 100 of the 149 ecstasy users were men (67.1%) and 49 (32.9%) were women. The average frequency of ecstasy use was 7.1 ± 8.5 times per year (Table 1).

Ecstasy users were more likely to smoke tobacco than non-using subjects (49.0% vs 14.3%, p <0.001).

In comparing both tobacco smoking groups (tobacco ecstasy vs tobacco non-users), the average number of cigarettes smoked per day was 5.1 ± 8.8 for the ecstasy using sample and 0.8 ± 2.7 for the non-ecstasy-using sample. In both samples, more men than women smoked tobacco. Many ecstasy users used other recreational psychoactive drugs (44.3%), mainly cannabis (35.7%).

Ecstasy users reported more frequent use of prescribed psychotropic medication (9.4% vs 2.0% for non-ecstasy-users, chi-squared p = 0.006) and the use of antiretroviral medication for HIV (6.7% vs 0.0%, chi-squared p = 0.001) Use of asthma medication (6.0% and 4.7%, respectively) and other medication (2.7% for both groups) did not differ significantly.

**Presence of periodontitis**

In six cases there was no information about the presence of periodontitis available in the records. In the remaining records, the diagnosis of periodontitis was reported as being more than two times more frequent in the ecstasy user sample than in the non-drug user sample (Table 2).

**Presence of active caries**

In 18 cases there was no information available about the presence of active caries lesions. In

**Table 2 The presence of periodontitis, active caries, tooth wear, xerostomia, linea alba, DMFT index, the number of restored, endodontically treated and missing teeth, oral hygiene habits in ecstasy users and age- and sex-matched non-users**

Subject	Ecstasy	Non-users	P value
<b>Periodontitis</b>			
Presence	25.7% (n = 37)	11.5% (n = 17)	<0.001*†
<b>Active caries</b>			
Presence	62.7% (n = 84)	32.2% (n = 47)	<0.001*†
<b>Tooth wear</b>			
Presence	55.0% (n = 60)	60.3% (n = 73)	0.485*
<b>Xerostomia</b>			
Presence	25.7% (n = 29)	5.8% (n = 8)	<0.001*†
<b>Linea alba</b>			
Presence	32.1% (n = 34)	23.7% (n = 32)	0.148*
<b>DMFT index</b>	7.0 (± 6.5) (n = 140)	5.8 (± 5.6) (n = 149)	0.139**
<b>Restored teeth</b>	4.9 (± 5.1) (n = 141)	5.0 (± 5.2) (n = 149)	0.883**
<b>Endodontically treated teeth</b>	0.55 (± 1.2) (n = 140)	0.64 (± 1.4) (n = 149)	0.794**
<b>Missing teeth</b>	1.0 (± 2.7) (n = 143)	0.7 (± 1.9) (n = 149)	0.600**
<b>Oral hygiene device</b>			
Manual toothbrush	57.3% (n = 75)	51.1% (n = 67)	-
Electrical toothbrush	33.6% (n = 44)	42.0% (n = 55)	-
Both	9.2% (n = 12)	6.9% (n = 9)	-
<b>Frequency of brushing</b>			
<2 times a day	25.0% (n = 35)	15.0% (n = 21)	-
≥2 times a day	75.0% (n = 105)	85.0% (n = 119)	-
<b>Interdental cleaning device</b>			
Use of device	67.4% (n = 95)	75.5% (n = 108)	-
<b>Frequency interdental cleaning</b>			
Per week	2.7 ± 3.4 (n = 137)	3.6 ± 4.1 (n = 134)	-

Key:  
 \* = Chi-squared test  
 \*\* = Mann-Whitney U test  
 † = Statistically significant difference with a p value <0.05

the remaining records, active caries lesions were more frequently identified in the ecstasy users than in non-users (Table 2).

**Tooth wear**

In 116 cases there was no information about the presence of tooth wear available. No statistically significant difference was found in presence of tooth wear between the ecstasy users and the non-users.

**Xerostomia**

In 47 cases there was no information available about the presence of xerostomia. Xerostomia was more frequently reported by ecstasy users than by non-users (Table 2).

**Oral mucosa**

In 57 records there was no information available about the presence of a linea alba. The presence of a linea alba did not differ between both samples of individuals. The

**Table 3** The presence of periodontitis, active caries, tooth wear, xerostomia, linea alba, DMFT index, the number of restored, endodontically treated and missing teeth, and oral hygiene habits in ecstasy-only, ecstasy-cannabis and ecstasy-polydrug users. The p value represents the results of Kruskal-Wallis, Mann-Whitney U and chi-squared tests. Due to missing data on cannabis and polydrug use, the totals from Table 3 are not equal to those of Table 2

Subject	Ecstasy-only	Ecstasy-cannabis	Ecstasy-polydrug	P value
<b>Periodontitis</b>				
Presence	22.5% (n = 16)	34.2% (n = 13)	25.0% (n = 6)	0.413
<b>Active caries</b>				
Presence	53.6% (n = 37)**	73.5% (n = 25)**	77.3% (n = 17)*	0.046?
<b>Tooth wear</b>				
Presence	56.1% (n = 32)	50.0% (n = 14)	47.1% (n = 8)	0.753
<b>Xerostomia</b>				
Presence	16.7% (n = 10)**	42.3% (n = 11)**	31.6% (n = 6)	0.036?
<b>Linea alba</b>				
Presence	31.7% (n = 19)	23.8% (n = 5)	44.4% (n = 8)	0.384
<b>DMFT index</b>	5.9 (± 6.6) (n = 71)*	8.1 (± 6.7) (n = 36)	8.3 (± 5.5) (n = 23)*	0.044?
<b>Restored teeth</b>	4.4 (± 5.3) (n = 71)	5.3 (± 5.1) (n = 36)	5.6 (± 4.7) (n = 23)	0.246
<b>Endodontically treated teeth</b>	0.4 (± 0.7) (n = 71)	1.0 (± 1.8) (n = 36)	0.5 (± 1.1) (n = 23)	0.27
<b>Missing teeth</b>	1.2 (± 3.4) (n = 71)	0.8 (± 1.2) (n = 36)	1.1 (± 2.4) (n = 23)	0.415
<b>Oral hygiene device</b>				<b>0.372</b>
Manual toothbrush	56.7% (n = 38)	54.8% (n = 17)	77.3% (n = 17)	-
Electrical toothbrush	35.8% (n = 24)	35.5% (n = 11)	13.6% (n = 3)	-
Both	7.5% (n = 5)	9.7% (n = 3)	9.1% (n = 2)	-
<b>Frequency of brushing</b>				<b>0.055</b>
<2 times a day	19.4% (n = 14)	20.6% (n = 7)	43.5% (n = 10)	-
≥2 times a day	80.6% (n = 58)	79.4% (n = 27)	56.5% (n = 13)	-
<b>Interdental cleaning device</b>				
Use of device	64.8% (n = 46)	74.3% (n = 26)	62.5% (n = 15)	0.545
<b>Frequency interdental cleaning</b>				
Per week	2.7 (± 3.5) (n = 69)	3.6 (± 4.5) (n = 33)	2.4 (± 2.8) (n = 24)	0.598

Key:

\* = Significant difference between ecstasy-only and ecstasy-polydrug users (post hoc Mann-Whitney U test)

\*\* = Significant difference between ecstasy-only and ecstasy-cannabis users (post hoc Mann-Whitney U test)

† = Statistically significant difference with a p value <0.05

following abnormalities of the oral mucosa were also identified in dental records of individuals: aphthous ulcers in two ecstasy users and in two non-users. In 3 of the 149 ecstasy users, acute ulcerative necrotising gingivitis was observed. One of these individuals was also HIV positive.

#### DMFT index and restored, missing, endodontically treated teeth

No information was available about the DMFT index in nine individuals, the number of missing teeth in six cases, the number of restored teeth in eight cases and the number

of endodontically treated teeth in nine cases. There was no statistically significant difference in DMFT index or the number of restored, endodontically treated and missing teeth between ecstasy users and non-users (Table 2).

#### Dental hygiene

The usage of an electrical, manual or both brushing devices did not differ between both samples (Table 2). The majority of the ecstasy users brushed their teeth twice or more a day, which was statistically less frequent than in the non-drug-user sample

(Table 2). More than half of the subjects in the ecstasy-user sample, as well as in the non-drug-user sample, used interdental cleaning devices. There was a tendency towards statistical significance for a lower frequency of interdental cleaning in individuals who use ecstasy (Table 2).

Of the 149 ecstasy users, 25 reported to use ecstasy more than once a month and 91 less than once a month (of the others, no information about frequency was available). The two groups of ecstasy users showed no significant differences with regards to use of interdental cleaning devices, type of

toothbrush, frequency of brushing, smoking history and presence of caries, periodontitis and xerostomia (chi-squared all >0.05).

When stratifying according to concomitant use of other drugs, the following differences in oral health were observed among ecstasy users (Table 3):

- Periodontitis: the frequency of periodontitis did not differ significantly between ecstasy-only users and those who used ecstasy in combination with other drugs
- Xerostomia: ecstasy-cannabis users and ecstasy-polydrug users reported xerostomia more frequently than ecstasy-only users
- Active caries: ecstasy-polydrug users suffered significantly more frequently from active caries compared to ecstasy-only users. There is a tendency towards statistical significance in the prevalence of active caries in ecstasy-cannabis users versus ecstasy-only users ( $p = 0.052$ )
- DMFT index: DMFT index was significantly higher in ecstasy-polydrug users compared to ecstasy-only users ( $8.3 \pm 5.5$  vs  $5.9 \pm 6.6$  [ $p = 0.015$ ])
- Oral hygiene: there is a tendency towards statistical significance in brushing frequency ( $\geq 2$  times a day) when comparing ecstasy-only, (80.6%), ecstasy-cannabis, (79.4%) and ecstasy-polydrug users (56.5%).

## Discussion

This report describes the difference in oral health and dental hygiene procedures of ecstasy users and individuals who reported no use of recreational psychoactive drugs except smoking tobacco and the consumption of alcohol. In this study, it was found that ecstasy users suffered more frequently from periodontitis, active caries lesions and xerostomia.

Lack of oral hygiene is a well-known risk factor for the development and progression of periodontitis. This series showed differences in the frequency of tooth brushing and interdental cleaning between ecstasy users and non-users whereby the frequency and intensity of users was less. Animal studies show that MDMA has an effect on the development and progression of periodontitis, possibly due to an alteration in reactivity of the immunoregulatory system in the brain.<sup>17,18</sup> The ecstasy-user sample reported more frequent smoking of tobacco, as well as frequent use of cannabis and other psychoactive drugs, which are known risk factors for the development of periodontitis.<sup>19,20,21,22,23,24,25</sup> Therefore, we

***'The higher caries rate in cannabis and polydrug users might be related to a more cariogenic diet, with a higher sugar consumption in combination with xerostomia.'***

cannot exclude that the higher percentage of periodontitis found in the ecstasy-user sample, as compared to the non-drug user sample, is not due to the use of ecstasy alone but may also be (partly) the result of other drugs used, smoking and other lifestyle factors. Periodontal disease reported in the dental records may have been diagnosed in the past and stabilised, characterised by no progression in attachment loss and alveolar bone loss, when the data were extracted from the dental records. To elucidate the potential effect of recreational ecstasy use on the periodontium, a regular, full periodontal status with more detailed information about inflammation (bleeding index), additional dental radiographic images and more detailed information about lifestyle factors seems required.

A significant difference was found in the presence of active caries lesions between ecstasy users and non-drug users. This study showed that ecstasy-polydrug users suffer significantly more frequently from active caries compared to ecstasy-only users. There was also a tendency towards statistical significance in the presence of active caries in ecstasy-cannabis users versus ecstasy-only users. Cannabis and/or polydrug use have previously been reported to be associated with higher rates of caries.<sup>25,26</sup> The higher caries rates in cannabis and polydrug users might be related to a more cariogenic diet, with a higher sugar consumption in combination with xerostomia.<sup>23,26</sup> Although ecstasy users had more active caries lesions, no significant difference was found in DMFT index of ecstasy users compared to non-drug users. Only when comparing ecstasy-polydrug users to ecstasy-only users was a significant difference in DMFT index found, which could be explained by the fact that a small dental restoration, or a missing tooth, contributes equally to the DMFT index as an active caries lesion.

No significant differences between both samples of individuals (ecstasy users versus

non-users) were found in the type of device used for toothbrushing, the use of interdental cleaning device and its frequency. However, a significant difference was found in brushing frequency (ecstasy users versus non-users). Ecstasy-polydrug users were found to brush less than two times a day and it seems that oral hygiene habits possibly contribute to the increased presence of periodontitis and active caries lesions in ecstasy users.

Multiple studies reported the subjective adverse effect of a dry mouth when taking MDMA.<sup>11,12,16,27,28,29</sup> This corresponds with the present study where a significantly higher percentage of xerostomia was reported by ecstasy users. The exact duration of the xerostomia related to ecstasy use is unknown. Previous studies have suggested that the xerostomia appears to be a short-term effect, up to 48 hours, especially in women.<sup>11,12,16,29</sup> Although xerostomia is reported as a subjective adverse effect, hyposalivation may also be present. MDMA has an affinity for the peripheral noradrenergic neurotransmission on  $\alpha_2$ -adrenergic receptors.<sup>30,31</sup> Possibly salivary hypofunction is induced by activation of these  $\alpha_2$ -adrenergic receptors.<sup>32</sup> Loss of the protective effects of saliva, such as buffering and neutralisation of acids and remineralisation and antibacterial effects, may contribute to an increase of oral manifestations such as caries, tooth wear and periodontitis, seen with psychoactive drug use.

Other factors contributing to xerostomia may be related to an increased physical activity during ecstasy use and the combined use with other (recreational) psychoactive drugs.<sup>20,22,23,33,34</sup> In the present study, 44.3% of the ecstasy users also reported the use of other recreational psychoactive drugs, mainly cannabis. Ecstasy-cannabis users report significantly more frequent xerostomia compared to ecstasy-only users. Ecstasy users used significantly more prescribed psychotropic medication. This could also contribute to the higher reported prevalence

of xerostomia. Xerostomia is a commonly reported side effect of psychotropic medication.<sup>35</sup> Ecstasy users also used antiretroviral medication for HIV more frequently, but this seems to have no influence on salivary flow rate or xerostomia<sup>36,37,38,39</sup>

Ecstasy use has, in many cases, been associated with bruxism.<sup>11,12,13,15,16,28,29</sup> Bruxism after ecstasy use has been reported to occur for up to 48 hours after use.<sup>11</sup> Since bruxism has a multifactor aetiology, recreational drug-associated bruxism may be induced by a change in dopamine and 5-hydroxytryptamine due to an imbalance of the dopamine mesocortical pathway.<sup>40</sup> The influence of the sensitivity of  $\alpha_2$  adrenoceptors to MDMA in the regulation of the jaw opening reflex and the occurrence of bruxism during ecstasy use has only been reported in animal studies but it may also play a role in the occurrence of bruxism during ecstasy use in humans.<sup>41</sup> Other possible cofactors contributing to bruxism may include combined tobacco, alcohol and/or (caffeinated) energy drink

in tooth wear was found between ecstasy users and non-users. Differences between previous studies and our study could be explained by a lack of a tooth wear scoring system in this study.

Two studies, performed 20 years before the present one, reported that 93% of users consumed carbonated drinks in addition to ecstasy.<sup>27,28</sup> Variations have been reported in the prevalence of tooth wear between different studies and the prevalence of tooth wear in the general Dutch population increased in time.<sup>50</sup> These factors could have contributed to the lack of a significant difference between tooth wear in ecstasy users and the non-users.

A *linea alba*, present as a white line on the buccal mucosa at the level of the occlusal level, is generally caused by conscious or unconscious suctioning and biting on the buccal mucosa. The presence of a *linea alba* could be an indication for bruxism.<sup>51</sup> In this study, no significant difference was found in the presence of a *linea alba* between ecstasy users and non-users. Together with the lack

visited the dental clinic and reported use of ecstasy. There was no information available about how long a subject has been using ecstasy and whether or not they reduced, continued/discontinued or intensified the drug use.

Not all data could be collected from the dental records of an extensive dental examination, so some data were collected from dental records of periodic dental examinations or intake appointments. The available dental records did not always contain all the required information that was necessary for this study. Dental clinical examination and entering the resulting data was mainly performed by various dental students. This may have introduced inconsistencies in the retrieved information.

The current retrospective cross-sectional study design is not optimal to address the research question. However, it is impossible to address the research question with a randomised controlled trial or clinical trial, for ethical and legal reasons. This means that the ideal approach to address the research question seems to be a long-term prospective study, where a large group of ecstasy users and a control group would be periodically seen by dentists using a standardised oral inspection protocol. Such future prospective studies could also include important variables such as dietary habits and a more detailed medical history, enabling multivariate analysis.

Approximately 1% of all treated patients at the ACTA reported the use of ecstasy. This percentage is considerably lower than the reported 7.7% for the total Dutch population<sup>53</sup> and lower than the prevalence of 2.4–3.5% for the United Kingdom.<sup>54</sup> This may suggest that not all individuals disclose their recreational drug use when asked. Dental students might also find it difficult to discuss the use of recreational psychoactive drugs with their patients, as has been reported in previous studies.<sup>55,56</sup> As suggested by the Netherlands Institute of Mental Health and Addiction, the recent increase of individuals reporting usage spontaneously or when asked about ecstasy use might indicate a reduced taboo in discussing recreational drug use during recent years.<sup>53</sup>

The majority of individuals reporting the use of ecstasy in the present study were men (67%). This number is representative for the general Dutch population using ecstasy. In 2015, 61% of the ecstasy users were men and 39% were women.<sup>57</sup>

The sample of this study of patients visiting the ACTA was hospital-based. On average, they have a lower socioeconomic status and less financial means. Therefore, the results of the present study cannot be fully extrapolated to the general population.

***‘Several studies reported oral automutilation by orofacial movements after ecstasy use ... ecstasy users try to reduce the effects of these by using chewing gum, lollipops and/or pacifiers’***

use.<sup>10,42</sup> In addition to bruxism, pain of the chewing muscles and the temporomandibular joint has been reported.<sup>12,16</sup> Several studies reported oral automutilation by orofacial movements after ecstasy use, mainly consisting of multiple ulcerations of the tongue and the buccal mucosa, damage to the lower lip and oedematous swelling of the upper and lower lips.<sup>11,43,44,45,46,47</sup> Ecstasy users try to reduce the effects of these movements by using chewing gum, lollipops and/or pacifiers.<sup>14,15</sup>

Several studies have reported an increased tooth wear associated with ecstasy use whereby tooth wear in dentin was mainly present in the premolar and molar regions.<sup>15,27,28</sup> Increase of the progress of tooth wear may be due to bruxism in combination with an acidic oral environment, caused by consumption of energy drinks and/or alcohol, associated with ecstasy use and reduced saliva secretion.<sup>10,12,14,15,27,48,49</sup> In the current study, no significant difference

of difference in tooth wear between the two samples, this suggests that there are no long-term effects of bruxism in oral tissues in recreational ecstasy users.

In this study, no data on dietary habits in combination with ecstasy use were registered. In previous studies, 34–54% of ecstasy users reported loss of appetite after use, which could last up to 48 hours.<sup>11,29</sup> However, dietary habits of ecstasy users do not give a difference in body mass index between recreational ecstasy users and non-users.<sup>52</sup> The loss of appetite could possibly have an effect on the frequency of eating, which is relevant for dental health. Therefore, future studies should try to obtain more detailed information on dietary habits related to the use of drugs in general and ecstasy in particular.

The present study has several limitations. Due to its retrospective character, the data were collected at a single moment when the subject

## Conclusion

Despite its limitations, this study shows that there is a significant difference in diagnosed periodontitis, active caries lesions and reported xerostomia between recreational ecstasy users compared to a non-using sample.

### Ethics declaration

The authors declare no conflicts of interest.

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### Author contributions

Emma E. J. van Kempen: conceptualisation; data curation; formal analysis; investigation; methodology; project administration; and writing – original draft. Jan G. A. M de Visscher: supervision; writing – review and editing; and validation. Henk S. Brand: conceptualisation; data curation; methodology; project administration; formal analysis; validation; resources; and supervision.

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