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Patterns of synthetic cathinones use and their impact on depressive symptoms and parafunctional oral behaviors

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Summary

Aim. The objective of the study was to determine the impact of synthetic cathinones usage on depressive symptoms and oral behaviors among recreational users.

Material and methods. Users of online drugs-related forums were asked to fill in a questionnaire via Google Forms Platform. The questionnaire contained questions about patterns of drugs use, *the Beck Depression Inventory II*, *the Oral Behaviors Checklist* (OBC), and questions about basic demographic data (age, gender).

Results. 150 participants (75 in the study group, 75 in the control group) took part in the study. In the study group (aged 15–28), all participants used cathinones and other psychoactive substances. 42 participants used cathinones during last month. Statistical analysis showed a correlation between amount of drugs types used and level of depressive symptoms for both groups (study group and control group), as well as a statistically significantly higher mean value of the OBC scores in a group of cathinones users than in controls. Correlation between the BDI-II and OBC results was statistically significant for both the study and control groups.

Conclusions. Considering easy access to synthetic cathinones, widely spread intoxications and young age of participants of this survey the subject needs to be widely researched. Psychoactive substances can predispose to development of depression and various forms of parafunctional oral behaviors.

Key words: synthetic cathinones, novel psychoactive substances, depressive symptoms, oral parafunctions

Introduction

Novel psychoactive substances (NPS) is a heterogeneous group of natural, semi-synthetic and synthetic compounds, generally referred to in Poland as 'afterburners' (in English, various terms are used, such as legal highs or designer drugs). The most common definition has been proposed by the European Monitoring Center for Drugs and Drug Addiction (EMCDDA): it is a new drug or psychotropic compound in pure form or in the form of a product that is not controlled by United Nations conventions on drugs/psychoactive compounds, and may trigger health damages comparable to those resulting from the use of substances listed in the conventions referred to [1]. In Poland, they still can be easily reached via Internet or in smartshops [2, 3].

Nowadays, it is proposed to divide legal highs based on their mechanism of action, by comparison to previously known psychotropic substances – one of such groups are psychostimulatory compounds mimicking the action of amphetamine, cocaine or ecstasy, and among them chemically the most commonly represented family of substances are synthetic cathinones [1]. They are analogs of the cathinone, naturally occurring in the leaves of Catha edulis, commonly referred to as khat [4–6]. Synthetic cathinones are a class of chemical compounds, many of which are classified as NPS, including butylone, dimethylcathinone, etcathinone, ethylone, 3-fluoromethcathinone, mephedrone, 3 – and 4-methylmethcathinone, methylenedioxypyrovalerone (MDPV), methylone, and pyrovalerone [2, 4]. Synthetic cathinones were widely rediscovered during past 10 years and started to be quickly sold as designer drugs, i.e., substances designed to have similar effect to classic drugs, because of their compounds legality in many countries [5]. They have recently emerged on the world market and became popular drugs of abuse. In 2005–2011, approximately 80 new substances of this group appeared in Europe [4]. They are commonly known as "bath salts", "plant food" and labeled "not for human consumption" to circumvent drug abuse legislation [1–3, 7, 8].

Synthetic cathinones are phenylethylamine derivatives. They are sometimes called bk-amphetamines due to the presence of a keto group in the beta position in the aminoalkyl chain attached to the phenyl ring [5, 6]. Cathinones are strong norepinephrine reuptake inhibitors, and within this group there is a differential effect on dopamine and serotonin transporters and variable ability to release various monoamines into synaptic spaces [4]. Most of them have sympathomimetic effects [3, 5]. There is little information available about synthetic cathinones pharmacokinetics in human beings. Experimental evidences on rats indicated that synthetic cathinones undergo extensive phase I metabolism. Phase II metabolites, such as sulfates or glucoronides, are excreted with urine [9].

Increase in the use of the new synthetic cathinones was observed in Europe in 2009 and in the United States one year later. Synthetic cathinones are mostly encountered as white or brown amorphous or crystalline powders, eventually in capsules. The dosage

varies between particular substances. According to data available in the Internet, an average dose, providing desired effects on the user's organism, ranges between 100 and 250 mg for mephedrone, where for MDPV the dose ranges between 5 and 10 mg. The effects depend on particular substance, they are claimed to be similar to those of cocaine, amphetamine or MDMA, and rather short, what results in redosing [8]. The effects of taking these substances include psychomotor agitation, increased psychophysical efficiency, ease of socializing, increased empathy, euphoria, loquacity, intensification of sensory perception, loss of appetite, insomnia [4]. Synthetic cathinones users gather on online forums to discuss dosage, effects and ways to buy this type of substance. However, because of variety of substances, there is a considerable variation in potency and toxicity of synthetic cathinones, which follows many intoxications. Adverse reactions after taking synthetic cathinones include: cardiovascular (due to sympathomimetic effect, which may even result in myocardial infarction, myocarditis, cardiac arrest), neurological (sleep disorders, muscle tremors, convulsions, headache and dizziness, paresthesia, hyperthermia, visual impairment) and psychiatric disorders (anxiety, panic attacks, hallucinations, confusion, cognitive dysfunction, delusions, loss of impulse control, loss of motivation, depression, anhedonia, suicidal thoughts and tendencies) [4, 10]. Some of intoxications are fatal [4, 8].

The use of synthetic cathinones is also associated with a wide spectrum of acute and chronic disorders of masticatory organ. The intensity and nature of the impact of synthetic cathinones on the masticatory organ is largely dependent on the type and dose of cathinone, the length and frequency of its intake, the intake of other substances that may cause adverse interactions, and the general health of the user. In addition to reduced salivation, caries development, periodontal disease, among the implications associated with the masticatory organ, bruxism and facial tics are increasingly mentioned. This may lead to pathological tooth wear and oral mucosa lesions. Increased motor and sensory activity caused by the use of synthetic cathinones is also important in the masticatory organ context. Synthetic cathinones, by stimulating the central nervous system, may cause nervousness, hyperexcitability, hyperreactivity, irritability, restlessness, and tremor that may be reflected in the functioning of the masticatory muscles [11]. This can lead to the onset and intensification of parafunctional oral behaviors.

Because online forums seems to be a good source of information about usage of new psychoactive substances [10], we have noticed that users of synthetic cathinones more often report parafunctional oral behaviors and depression. The term oral behavior refers collectively to behaviors other than functional requirements for the stomatognathic system, such as chewing, swallowing, speech or breathing [12]. Parafunctional oral behaviors can occur both during sleep and in the waking state. One of the most common behaviors occurring during sleep is bruxism (rhythmic – phasic and non-rhythmic – tonic), which in healthy people is not considered to be pathologi-

cal [12, 13]. However, there are also other behaviors that affect the condition of the stomatognathic system during sleep. These include myoclonus, rhythmic movement disorders and nocturnal epileptic seizures.

The occurrence of bruxism during sleep is estimated at 13% among adults [14–16]. One of the risk factors often mentioned by scientists in the context of bruxism are psychological factors, which include stress exposition and resistance, personality traits, applied treatment, and comorbid anxiety disorders [14, 16]. Oral parafunctional behaviors occurring in the waking state are much more difficult to determine due to their often hidden nature. Considered as common, generally accepted and correct behaviors, they can remain unnoticed by the patient for a long time. They occur with high frequency, include teeth, soft tissue around the mouth, tongue, masticatory muscles and other border structures. They are often also related to the profession performed by the patient. The increase in their occurrence is also closely related to the psychoemotional state of the patient [12, 13]. The most common parafunctional behaviors include clenching and grinding teeth and tightening of the masticatory muscles, which are elements that indicate the presence of bruxism during the waking state. It is estimated that it may affect 22–31% of adult population [14–16]. Parafunctional oral behaviors have a negative effect on the stomatognathic system and may result in many disorders in the region. *The Oral Behavior Checklist* (OBC) is a set of questions regarding the frequency of individual oral behaviors both during sleep and during wakefulness [13].

Many medical professionals are unaware of synthetic cathinones and dangers that appear with their usage [17]. Medical literature lacks information regarding the growing number of parafunctional oral behaviors and presence of depressive symptoms in patients taking cathinones, however, researchers reported that oral health and quality of life are associated [18]. The authors of this paper decided to investigate the impact of synthetic cathinones on depressive symptoms and parafunctional oral behaviors. During planning research the authors noticed that several other research teams claimed to gather data on drug use via online forums, which they considered to be an easily available source information [19].

Material and methods

Procedure

This study was carried out in accordance with the recommendations of Good Clinical Practice and the Declaration of Helsinki. The protocol was approved by the Bioethical Committee of Wroclaw Medical University, Wroclaw, Poland receiving acceptance No. KB – 82/2018.

The main problem here was reaching out to NPS users because of social stigma that comes with drug abuse, as well as in relation to the criminalization of traffick-

ing or possession of such substances. Internet forums provide anonymity that allows getting more data.

Two requirements must be met when collecting data: (1) possibility to use a questionnaire platform and (2) access to the groups which are interested in completing the survey. When it comes to the first requirement, as of November 2017, Google.com provides 124,000,000 results for "make online survey". The authors decided to use a Google original platform – Google Forms, which they were most familiar with. When it comes to the second requirement, the authors searched for online forums and also groups on Facebook focusing on NPS use. Facebook groups proved to be a better source of information because Facebook enables interaction with drugs users much easier and the notifications about new comments or posts are visible to users who interacted instantly, whereas in forums people had to check the thread themselves. The survey was advertised for 10 weeks from May 2017 to July 2017 via Facebook groups focusing on psychoactive substance use and web forum Hyperreal.info.

Questionnaires

Google Forms survey proposed by the authors contained three questionnaires.

The synthetic cathinones use survey created and used by Ashrafioun et al. [19] in an article about patterns of use of synthetic cathinones among recreational users. The questionnaire used in the study was translated into Polish language and contained typical sociodemographic questions (age, gender, sexual orientation, education history, relationship status) and specific questions about synthetic cathinones use: age of first intake, circumstances of drug use (typical places and time of intake, presence of other people also taking drug or solitary intake), typical amounts spent to purchase synthetic cathinones, frequency of use, typical intoxication level, subjective experience of craving, duration of typical high, stability of use over the previous year, most recent use, experience of subjective effects, number of quit attempts and treatment seeking for synthetic cathinones abuse [19].

Beck Depression Inventory II (BDI-II). The original English version of *the Beck Depression Inventory II* (BDI-II), created by Aaron T. Beck, is a 21-question multiple-choice self-report inventory, one of the most widely used psychometric tests for measuring the severity of depressive symptoms [20].

Oral Behavior Checklist (OBC). The original English version of *the Oral Behavior Checklist* (OBC) is a diagnostic tool for temporomandibular disorders, created by Schiffman et al. [21]. The questionnaire assesses number and frequency of parafunctional oral behaviors.

By advertising the survey the authors received 150 responses (75 for the study group and 75 for the control group matched by age). The obtained data were subjected to statistical analysis. The analysis of the results was performed using STATISTICA

PL Version 12, (Tulsa, Oklahoma, USA). In analyzes, the level of statistical significance was set at $\alpha = 0.05$. The results were compared to those from the control group matched by age and not receiving synthetic cathinones. In the analysis, parametric statistical tests were preferred, however, if the data did not meet particular assumptions (e.g., non-normal data distribution), particular variables were log-transformed (and then again checked for normality of data distribution) or non-parametric methods were used. The log-transformation for BDI-II scores was done after a constant value of 10 was added to the original score. This allowed transforming data also for those patients who scored zero in the BDI-II.

Results

Sample characteristics

The mean age of respondents in the study group was 22 years (± 3.4), in addition, the majority were men (53.33%). 68% of individuals in the study group lived in a large city (more than 200,000 inhabitants), the vast majority had at least lower secondary education (85.33%) and were heterosexual (77.33%). Just over half of them remained in a relationship (53.33%). A demographic characteristic of the study group is presented in Table 1.

Table 1. **Demographic characteristic of the study group (synthetic cathinones users)**

Variable	Mean (SD) or %
Age in years	22.0 (3.4)
Gender	
Male	53.33%
Female	47.67
Place of residence	
Rural area	2.67%
Small city	8.00
Medium city	21.33
Large city	68.00
Education	
Primary school	0.00%
Lower secondary school	14.67
Technical school	0.00
High school	56.00
University	29.33

table continued on the next page

Sexual orientation	
Heterosexual	77.33%
Bisexual	20.00
Homosexual	2.67
Relationship status	
In relationship	57.33%
In open relationship	6.67
Single	36.00

The mean age of respondents in the control group was 24.6 (± 1.9) years, most of the respondents were women (56%). In this group, also the majority of participants (65.33%) lived in a large city (more than 200,000 inhabitants), moreover, everyone had at least lower secondary education. 84% declared heterosexual orientation, 58.67% were in a relationship. A demographic characteristic of the control group is presented in Table 2.

Table 2. **Demographic characteristic of the control group (synthetic cathinones non-users)**

Variable	Mean (SD) or %
Age in years	24.5(1.9)
Gender	
Male	44.00%
Female	56.00
Place of residence	
Rural area	5.33%
Small city	1.33
Medium city	28.00
Large city	65.33
Education	
Primary school	0.00%
Lower secondary school	0.00
Technical school	0.00
High school	33.33
University	66.67
Sexual orientation	
Heterosexual	84.00%
Bisexual	5.33
Homosexual	10.67

table continued on the next page

Relationship status	
In relationship	58,67%
In open relationship	1.33
Single	40.00

Synthetic cathinones use

The mean age of the first contact with synthetic cathinones was 18.8 (± 3.4) years. The typical location of use was friend's apartment (in 36% of cases), own apartment (25.33%), club/bar (21.33%), and other places (17.3%). Synthetic cathinones use initiation usually took place between 9 p.m. and midnight (45.33%), and between 6 p.m. and 9 p.m. (40%). The duration of high was 2–3 hours in 23%, 6 or more hours in 22.67%, 1–2 hours in 18.67%, 4–5 hours in 14.67%, 3–4 hours in 12%, and less than 1 hour in 9.33%. Almost every second respondent re-dosed every time (49.33%). Typical amount spent on synthetic cathinones was up to 50 PLN (approx. 15 USD) in 42.67%, 50–100 PLN (approx. 15–30 USD) in 40.00%, 100–200 PLN (approx. 30-60 USD) in 9.33%, and more than 200 PLN (approx. more than 60 USD) in 8.00%. The main drug administration route was snorting (77.33%). The frequency of use in most cases was less than once a month in 53.33% and at least once a month intake was declared in 32.00%. Synthetic cathinones were obtained from a dealer in 33.33%, a friend in 28.00%, the internet in 25.33% other sources in 12.00%, and smartshops in 1.33%. Respondents typically use drugs with two or more other people (53.33%). According to respondents, frequency of synthetic cathinones use in the past year decreased in 54.67%, remained at the same level in 26.67% and increased in 18.67%. 3.67% of the respondents reported most recent use within the last 6 months, 22.67% – within the last week, 20% – within the last month, 13.33% – within the last year and within the last 24 hours. More than a half of respondents never tried quitting (53.33%), 17.33% tried quitting once and 29.33% tried twice or more. Four out of five respondents were never treated due to drug abuse (81.33%), 92.00% were never treated of synthetic cathinones abuse. Almost all of the respondents never had problems with law because of synthetic cathinones use (98.67%). Characteristic of synthetic cathinones use is presented in Table 3.

Table 3. **Synthetic cathinones use**

Variable	Mean or %
Age of first synthetic cathinones use in years	18.8 (3.4)
Location of typical use	
Own apartment	25.33%
Friend's apartment	36.00
Club/bar	21.33
Other	17.33

table continued on the next page

Time of a day to initiate use	
6 p.m. to 9 p.m.	40.00%
9 p.m. to midnight	45.33
Midnight to 3 a.m.	5.33
3 a.m. to 6 a.m.	1.33
6 a.m. to noon	0.00
Noon to 6 p.m.	8.00
Duration of high	
Less than hour	9.33%
1–2 hours	18.67
2–3 hours	22.67
3–4 hours	12.00
4–5 hours	14.67
6 and more hours	22.67
How often re-dose	
Never	0.00%
25% of the time	22.67
50% of the time	12.00
75% of the time	16.00
Almost always	49.33
Typical amount spent when purchasing synthetic cathinones	
Up to 50 PLN	42.67%
50–100 PLN	40.00
100–200 PLN	9.33
More than 200 PLN	8.00
Administration route	
Snorting	77.33%
Oral	2.67
Injection	8.00
Smoking	12.00
Other	0.00
Frequency of use	
Every day	5.33%
At least once a week	9.33
At least once a month	32.00
Less than once a month	53.33

table continued on the next page

Location to obtain synthetic cathinones	
Internet	25.33%
Dealer	33.33
Friend	28.00
Smartshop	1.33
Other	12.00
Number of people typically using with	
Alone	14.67%
With one other person	32.00
With two or more other people	53.33
Stability of use in the past year	
Increased	18.67%
Remained the same	26.67
Decreased	54.67
Most recent use	
Within the last 24 hours	13.33%
Within the last week	22.67
Within the last month	20.00
Within the last 6 months	30.67
Within the last year	13.33
Number of quit attempts	
Never	53.33%
Once	17.33
Two or more times	29.33
Drug abuse treatment	
Yes	18.67%
No	81.33
Synthetic cathinones abuse treatment	
Yes	8.00%
No	92.00
Problems with the law	
Yes	1.33%
No	98.67

Other psychoactive substances use

All of the respondents from the study group reported using at least one other of psychoactive substances: alcohol – 81.33%, marihuana – 76%, amphetamine – 70.67%, MDMA – 68%, LSD/DMT/ hallucinogenic mushrooms – 61.33%, other substances

– 44%, cocaine – 24%, substances of 2 C-x groups – 20%, methamphetamine/ketamine – 10.67%.

Depression

After performing statistical analysis, the authors reported significant correlation between using psychoactive substances other than synthetic cathinones and BDI-II scores. Higher severity of depression was reported in respondents using more types of psychoactive substances ($rs = 0.47$; $N = 150$; $p < .001$), but the analysis concerned both the study and control group together. Analogous correlation analyzed in the study group alone was statistically insignificant ($rs = 0.08$; $N = 75$; $p = 0.49$), indicating that depressive symptoms in synthetic cathinones users are not directly related to the number of other psychoactive substances used by the respondent.

A statistically significant correlation was found between the log-transformed age of first contact with synthetic cathinones and the log-transformed severity of depressive symptoms (measured with the BDI-II) (Pearson's $r = – 0.37$; $N = 75$; $p = 0.01$). In general, the lower the age of first contact was, the greater severity of depressive symptoms appeared. The Student's *t*-test showed no statistical differences in the transformed BDI-II scores reported when considering the frequency of synthetic cathinones use – less than once a month ($N = 40$; $M = 3.25$) vs. once or more than once a month (($N = 35$; $M = 3.34$): $t(73) = – 0.86$; $p = 0.39$). Similarly, there were no statistically significant differences in the severity of depression between respondents who had been ($N = 14$; $M = 3.37$) and had never been ($N = 61$; $M = 3.27$) treated for drug abuse ($t(73) = – 0.78$; $p = 0.44$).

Analysis by the Kruskal-Wallis test showed that there are statistically significant differences in BDI-II scores ($H(2, N = 75) = 7.33$; $p = 0.03$) between groups of people who:

i. never attempted to stop taking synthetic cathinones ($N = 40$) or
ii. attempted once ($N = 13$) or
iii. attempted twice or more ($N = 22$).

Detailed post-hoc analyzes showed that the severity of depressive symptoms was statistically significantly lower ($z = 2.70$; $p = 0.02$) in respondents who never attempted to quit cathinones ($M = 16.35$) compared to those who attempted quitting at least twice ($M = 24.82$). The severity of depressive symptoms did not differ significantly ($z = 0.84$, $p \approx 1.0$) between those who never tried to stop taking synthetic cathinones and those who attempted to quit once ($M = 19.54$). The severity of depressive symptoms also did not differ significantly ($z = 1.29$; $p = 0.59$) between those who made one attempt to quit synthetic cathinones and those who made two or more attempts. However, a trend – the more times a person tried to quit cathinones, the more severe depressive symptoms (in BDI-II) – was observed.

BDI-II scores in synthetic cathinones users are presented in Table 4.

Table 4. **BDI-II scores in the study group**

Indicator	Respondents who checked more than 0 (%)
Sadness	65 %
Pessimism	72 %
Past failure	72 %
Loss of satisfaction	69 %
Guilty feelings	64 %
Punishment feelings	45 %
Self-dislike	55 %
Self-criticism	65 %
Suicidal thoughts or wishes	52 %
Crying	36 %
Agitation	57 %
Loss of interest	63 %
Indecision	57 %
Feeling of worthlessness	45 %
Loss of energy	72 %
Changes in sleeping pattern	69 %
Irritability	63 %
Changes in appetite	53 %
Concentration	68 %
Tiredness	69 %
Loss of interest in sex	41 %

Parafunctional oral behaviors

Student's *t*-test showed that the respondents from the study group had statistically higher total results in the OBC when compared to the control group ($M = 21.29$ vs. $M = 16.24$; $t(148) = 3.20$; $p = 0.002$). Calculation of Spearman's rank correlation coefficient showed that in the study group there was no statistically significant link between the intake other psychoactive substances and OBC score ($rs = 0.19$; $N = 75$; $p = 0.11$). In the control group, the intake of other psychoactive substances was positively correlated with OBC score ($rs = 0.39$; $N = 75$, $p = 0.001$). Information about OBC scores in synthetic cathinones users is presented in Table 5.

Table 5. **OBC scores in the study group**

Item	Respondents who did not check "none of the time" (%)
Clench or grind teeth when asleep, based on any information you may have	39 %
Sleep in a position that puts pressure on the jaw (for example, on stomach, on the side)	71 %
Grind teeth together during waking hours	37 %
Clench teeth together during waking hours	44 %
Press, touch, or hold teeth together other than while eating (that is, contact between upper and lower teeth)	68 %
Hold, tighten, or tense muscles without clenching or bringing teeth together	55 %
Hold or jut jaw forward or to the side	39 %
Press tongue forcibly against teeth	51 %
Place tongue between teeth	41 %
Bite, chew, or play with your tongue, cheeks or lips	77 %
Hold jaw in rigid or tense position, such as to brace or protect the jaw	36 %
Hold between the teeth or bite objects such as hair, pipe, pencil, pens, fingers, fingernails, etc	56 %
Use chewing gum	80 %
Play musical instrument that involves use of mouth or jaw (for example, woodwind, brass, string instruments)	3 %
Lean with your hand on the jaw, such as cupping or resting the chin in the hand	59 %
Chew food on one side only	47 %
Eating between meals (that is, food that requires chewing)	91 %
Sustained talking (for example, teaching, sales, customer service)	48 %
Singing	49 %
Yawning	76 %
Hold telephone between your head and shoulders	44 %

Depression and parafunctional oral behaviors

Statistical analysis of the severity of depressive symptoms (BDI-II results were transformed by adding 10 to the original assessment and then natural logarithm was calculated) and OBC scores showed the existence of a positive correlation of these two variables (Pearson correlation, both groups counted together; $r = 0.53$; $N = 150$;

$p < 0.001$). In both groups the correlations between OBC and depressive symptoms severity calculated separately were positive and statistically significant (study group: $r = 0.38$; $N = 75$; $p = 0.001$; control group: $r = 0.60$; $N = 75$; $p < 0.001$).

Discussion

Synthetic cathinones became new drugs of abuse in recent years due to its relatively high availability and compounds legality in many countries [1, 2, 5]. Through the internet they can be widely advertised as replacement for 'classic', 'illegal' drugs – substances with much better known use and clinical significance. Even if owning and trading these substances is considered legal, they remain highly toxic and dangerous to health, and their use is associated with high risk due to the small amount of clinically useful information about them [22–25]. There is an increasing number of medical reports of toxic reactions to synthetic cathinones [4, 26]. To better understand the risks associated with synthetic cathinones, we need information about the recreational use of these substances, which might constitute the majority of usage cases.

Previous studies including surveys focused on young social groups. In most of them, it has been found that the use of synthetic cathinones in general is rare. In 2015, Palamar [27], in an annual survey of drug use by high school students in the United States, stated that only about 1% of high school seniors declared episodes of using synthetic cathinones. Similar results were obtained in a survey examining people using night-time life. 1% of respondents declared contact with synthetic cathinones [28]. Surveys that indicated more frequent use of synthetic cathinones by young people focused on participants in events related to electronic dance music. In 2016, Palamar et al. [29] conducted an online survey aimed at people who visit night clubs. 10% of respondents declared that they took synthetic cathinones at least once in their lives. In the study of participants of events accompanied by electronic music in New York, focusing on the use of new psychoactive substances, 7% of participants declared the use of at least one of the 26 listed synthetic cathinones [30]. In another survey, conducted among participants of such events and published in 2018 [31], the use of synthetic cathinones was declared by about 3.5% of the survey participants. The authors of this article have not found comparable publications on the Polish population of beta-cathinone users.

The main problem in reaching out to drug users is social stigma that comes with drug abuse in most of the countries. The second problem is the illegality of drug possession and trade that may expose its users to problems with law, what might contribute to reluctance to participation in studies. An important element of obtaining information on drug use patterns is to win the trust of respondents based on anonymity. That is why the authors have reached participants through internet forums and Facebook groups. The size of the group of respondents is a serious limitation of the study, although the survey was advertised and easy to reach.

Another limitation of the study was the inability to investigate the effect of isolated use of synthetic cathinones on the studied parameters. Most respondents reported intake of more than one psychoactive substance. However, the small overall number and difficulties in access to the respondents did not allow for the creation of a representative study group using only synthetic cathinones.

Despite the limitations of the study, the findings provide that the mean age of the first synthetic cathinones use is 19 years. All of the respondents reported using other psychoactive substances, mainly alcohol and marihuana. Almost half of respondents use synthetic cathinones once a month or more often, typically by snorting, in an apartment with friends. Almost 50% of respondents re-dose after use to maintain the duration of substance effect.

Therapy of addiction to cathinones is not very popular, although the development of addiction, tolerance and withdrawal syndromes in particular in the course of abuse of mephedrone, MDPV and methylone have been described [4]. Fifty three percent of respondents never tried to quit synthetic cathinones usage, 91% have never been treated for synthetic cathinones abuse, 82% have never been treated for any psychoactive substances abuse. It is probably associated with a very low social awareness and permission to take this type of substances. This, in turn, might be the result of the widespread belief in the harmlessness of these substances, reinforced by their producers and dealers [1].

One of the more common phenomena associated with the abuse of psychoactive substances is the coexistence of a wide spectrum of physical and mental disturbances [32]. Depression is one of the most common disorders [33, 34]. In this study, the authors reported significant correlation between the number of psychoactive substances taken by the respondents and BDI-II scores. Higher BDI-II scores were reported in respondents using more psychoactive substances.

The use of synthetic cathinones may result in many acute and chronic symptoms of orofacial pathologies, including the increased number and incidence of parafunctional oral behaviors [35–37]. The association between the use of psychoactive substances and pathological oral behaviors is bi-directional. Firstly, there are scientific reports about increased motor activity in people taking psychoactive substances, including novel psychoactive substances [38, 39], Secondly, emotional disorders, which influence the increase in pathological oral behaviors and temporomandibular disorders development, can occur more often in psychoactive substances users [40, 41]. The OBC was introduced because in the authors' opinion it allows showing the occurrence of pathological oral behaviors in a simple way. Although items 1–6 of the OBC are the most relevant for this manuscript, items 7–21 are an integral part of the OBC and have also been introduced (see Table 5).

In addition, behaviors such as yawing, which might suggest increased daytime sleepiness, are also important because a single use of a cathinone suppresses the need

for sleep, while the use in series deregulates sleep completely. Therefore, depending on the cathinone being taken, it will stimulate users all the time causing insomnia (MDPV) or will no longer stimulate them with further use causing insomnia that will appear alternating with hypersomnia (chloromethcathinone). The use of synthetic cathinones may also be the cause of increased psychomotor drive of users manifested by teeth clenching, more frequent chewing gum, singing, word-of-mouth. Being under the influence of psychoactive substances is also associated with reduced control of the body during sleep, which may result in parafunctional sleep positions (positions in which unnatural pressure on the mandible is exerted).

This study has confirmed a positive and statistically significant correlation between the use of psychoactive substances and high OBC scores, the correlation between the intake of synthetic cathinones and the increased number and frequency of parafunctional oral behaviors. Results suggest that preventive and therapeutic measures should be carefully planned and this group of potential patients should be further investigated, including larger populations, the use of more surveys and implementation of clinical research focusing on therapeutic options.

Conclusions

The association of synthetic cathinones use with a higher risk of depressive symptoms and increased number of parafunctional oral behaviors seems to be obvious, but should be further studied. This will allow determination of the risk of possible psychiatric and temporomandibular disorders in people abusing these substances.

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