Original article

The Consumption of New Psychoactive Substances and Methamphetamine

Analysis of Data From 6 German Federal States

Elena Gomes de Matos, Tessa-Virginia Hannemann, Josefine Atzendorf, Ludwig Kraus, Daniela Piontek

Summary

Background: The abuse of new psychoactive substances (NPS) and methamphetamine has severe adverse effects. Here we provide the first report of regional patterns in NPS and methamphetamine consumption in Germany, on the basis of epidemiologic data from six federal states (Bavaria, Hamburg, Hesse, North Rhine-Westphalia, Saxony, and Thuringia).

Methods: Data were derived from the 2015 Epidemiological Survey of Substance Abuse (Epidemiologischer Suchtsurvey) and supplemented with additional cases from the federal states that were studied. The numbers of persons included in the representative samples of persons aged 18 to 64 in each state were 1916 (Bavaria), 1125 (Hamburg), 1151 (Hesse), 2008 (North Rhine-Westphalia), 1897 (Saxony), and 1543 (Thuringia). Potential risk factors for the lifetime prevalence of consumption were studied by logistic regression.

Results: The lifetime prevalence of methamphetamine consumption in the individual states ranged from 0.3% (North Rhine-Westphalia) to 2.0% (Saxony). Thuringia and Saxony displayed values that were significantly higher than average. For NPS, the figures ranged from 2.2% (Bavaria) to 3.9% (Hamburg), but multivariate analysis revealed no statistically significant differences between the states. Higher age and higher educational level were associated with lower consumption of NPS and methamphetamine, while smoking and cannabis use were each associated with higher consumption.

Conclusion: NPS consumption is equally widespread in all of the federal states studied. Methamphetamine is rarely consumed; its consumption appears to be higher in Saxony and Thuringia. The risk factor analysis reported here should be interpreted cautiously in view of the low case numbers with respect to consumption.

Cite this as:

Gomes de Matos E, Hannemann TV, Atzendorf J, Kraus L, Piontek D:
The consumption of new psychoactive substances and methamphetamine—analysis of data from 6 German federal states. *Dtsch Arztebl Int* 2018; 115: 49–55.
DOI: 10.3238/arztebl.2018.0049

The use of psychoactive substances is subject to constant change due, for example, to lifestyle trends and fluctuating availability. Against this backdrop, the prevalence of new psychoactive substances (NPS) and methamphetamine is a subject of discussion in Germany (1).

The term NPS covers synthetically produced substances that mimic the effect of established drugs. A significant increase in NPS available on the European market has been seen in recent years (2, 3). Their spectrum of activity ranges from cannabis-like effects to effects comparable with those of conventional opioids. The forms of substances range from incense blends in which plant material is blended with synthetic cannabinoids (e.g., so-called Spice) to pure chemical substances (often referred to as “research chemicals”). NPS harbor a significant risk of intoxication and other adverse side effects (4–7). Unawareness of the modes of action and long-term risks of these substances prevents consumers from using appropriate harm reduction strategies and exposes them to the hazards of acute side effects (8–10). Dependency and withdrawal symptoms (11), as well as numerous deaths, have been reported in relation to NPS (2, 3, 7, 12). More recent estimates on the 12-month prevalence in the general adult population vary between 0.2% and 0.9%, depending on definition and year of survey (13, 14). Consumer surveys also suggest regional differences in prevalence, with higher rates seen in Bavaria (15).

Methamphetamine, also known as crystal meth, is chemically closely related to amphetamine; however, its use carries a greater potential for harm due to its greater potency and longer half-life (16, 17). Acute and long-term sequelae of use can include cardiovascular disease, psychosis, depression, and violent behavior (18–20). Methamphetamine users pose new challenges not only for emergency care services, but also in terms of addiction care; therefore, the need for specific treatments has prompted the publication of treatment guidelines on methamphetamine-related disorders (21).

The 12-month prevalence of use in the adult general population in Germany is estimated to be 0.2% (12). However, treatment and crime statistics point to

IFT Institute for Therapy Research, Munich, Germany: Dipl.-Psych. Gomes de Matos, Hannemann, M. Sc. Psychology, Dipl.-Soz. Atzendorf, Prof. Dr. phil. Kraus, Dr. phil. Piontek

Institute for Psychology, Hildesheim University, Germany: Dipl.-Psych. Gomes de Matos

Centre for Social Research on Alcohol and Drugs (SoRAD), Stockholm University, Sweden: Prof. Dr. phil. Kraus

The Clinical Perspective

New psychoactive substances (NPS) and methamphetamine pose fresh challenges for the healthcare system. Some of their side effects, withdrawal symptoms, and dependency symptoms differ to a great extent from those of established substances. This study uses for the first time a representative sample of the resident population in six German federal states to identify regional differences in the use of NPS and methamphetamine.

After cannabis, NPS are the most commonly used illegal substances. No regional differences in NPS use were found. Therefore, it is desirable for healthcare professionals that are expected to come into contact with users to be familiarized with and given information on common NPS and the symptoms they can cause. This applies, for example, to addiction support staff, emergency physicians, and general practitioners. Pilot projects, such as the German *HaLT – Hart am Limit* (“Close to the Limit”), which collect information on NPS intoxications can serve to improve the hitherto scant knowledge available, particularly on the long-term effects of NPS.

Although prevalences of methamphetamine use are generally very low, this study highlights regional differences. The study largely confirms the regional burden close to the Czech border, as evidenced by treatment data. Since the problem appears to be a regional one, nationwide universal prevention campaigns are not advisable. Instead, the areas of medical care affected by the problem, including general medical and pediatric care, should be adapted to the increased burden in the relevant regions.

a greater burden on federal states close to the Czech Republic, which can be explained by the setting-up of production facilities there (17, 22–24). This study investigates and compares the prevalence of NPS and methamphetamine in six German federal states. In this way, it is possible to show suspected regional differences in a representative sample of the resident population aged between 18 and 64. Specific objectives include demonstrating the:

- Prevalence and frequency of use
- Risk factors for use
- Prevailing forms of NPS use
- Incidence of clinically relevant methamphetamine use.

Methods

Design and sample

The database was created from the 2015 Epidemiological Survey of Substance Abuse (ESA), a nationwide survey on the use of psychoactive substances in the German resident population aged between 18 and 64 years. Samples were selected in a two-step procedure. The first step involved determining a geographically representative sample of towns and districts. Personal addresses were then taken from the respective population registers in proportion to the population. In the six federal states of Bavaria, Hamburg, Hesse, North Rhine-Westphalia, Saxony, and Thuringia, samples were increased in terms of case numbers, thereby enabling representative statements to be made for these federal states. Certain sections of the population, such as homeless persons, prison inmates, or individuals undergoing inpatient treatment, were not covered in this procedure. Data was collected using a combination of methods, including telephone, written, and Internet-based surveys.

The adjusted sample sizes were $n = 1916$ (Bavaria), $n = 1125$ (Hamburg), $n = 1151$ (Hesse), $n = 2008$ (North Rhine-Westphalia), $n = 1897$ (Saxony), and

$n = 1543$ (Thuringia). The net response varied between 50.1% (Hamburg) and 60.2% (Saxony). A detailed description of the study design can be found in specific publications and on the study’s website (www.esa-survey.de) (25, 26).

Instruments

Study participants were asked whether they had used NPS or methamphetamine: ever in their lives (lifetime prevalence), in the previous 12 months (12-month prevalence), or in the previous 30 days (30-day prevalence). Respondents that had used methamphetamine in the previous 12 months were asked to indicate the frequency of use during this period. The three categories “once,” “two to nine times,” and “at least 10 times” are reported.

Individuals that had consumed NPS in the previous 12 months were asked about the type of use (herbal smoking mixtures, crystals or tablets, and liquids). Multiple entries were possible.

Clinically relevant methamphetamine use over the previous 12 months was measured using the severity of dependence scale (SDS) (27). This asks questions about problems with cutting down on use and loss of control. Indicators on the use of other substances included the average daily amount of alcohol (grams of pure alcohol) in the previous 12 months and tobacco or cannabis use in the same period (yes/no).

Gender, age, and educational level were included as sociodemographic variables. The latter was established on the basis of the International Standard Classification of Education (ISCED) and categorized into three groups (28, 29). A low level of education was assumed in the case of a school-leaving certificate up to intermediate (or equivalent) level without vocational training; an intermediate level of education in the case of vocational training or a higher education entrance qualification; and a high level of education in the case of a university degree or a master craftsman diploma (German “Meister”).

Statistical analysis

Indicators of use are presented separately according to federal state. Prevalences and case numbers on the frequency and form of use (NPS) are reported. Due to the low number of entries for the other indicators, only case numbers are listed.

Potential risk factors for the (lifetime) use of NPS or methamphetamine were each investigated using logistic regression. Predictors included federal state, gender, age, educational level, and the use of other substances. The reference category for the variable 'federal state' was the average value of all federal states studied.

The prevalence and regression estimators were calculated using a weighting variable. Thus, data were statistically adjusted to the population distribution in the federal states with regards to age, gender, school education, and community size. Each individual was given a value for the weighting variable, calculated from the prevalence of the sociodemographic characteristics mentioned above. Individuals from population groups that were underrepresented in the sample were given values above 1 and thus higher weighting. Individuals from over-represented population groups, on the other hand, were included in the calculation with a value below 1 and lower weighting. The use of weighted data precludes a direct conversion of case numbers into percentages. All analyses were performed using Stata 14.1 (Stata Corp LP, College Station, TX, USA).

Results

New psychoactive substances

The lifetime prevalence of NPS use varied between 2.2% ($n = 59$) in Bavaria and 3.9% ($n = 41$) in Hamburg (Figure 1). The 12-month prevalence in Hamburg ($n = 17$) and Saxony ($n = 19$) was a maximum of 1.4%. NPS use in the previous 30 days was only reported by respondents in Saxony and Thuringia (0.1% each, $n = 4$ and $n = 2$, respectively).

Multivariate analysis showed no state-specific deviations in lifetime prevalence from the average value (Table 1), nor were any gender differences identified. Higher age and educational level were associated with a lower risk for use. In contrast, the use of large quantities of alcohol, as well as tobacco and cannabis use were associated with a higher prevalence of NPS use.

The majority of users in most federal states reported that they had smoked NPS in the form of herbal mixtures (Table 2). Percentages were highest in Bavaria (90.9%) and Saxony (89.6%). Only in North Rhine-Westphalia were crystals/tablets the most widespread (84.3%). A high level of all forms of use was reported at approximately the same frequency in Saxony.

Methamphetamine

The lifetime prevalence of methamphetamine use was highest in Saxony (2.0%, $n = 28$), followed by Thuringia (1.7%, $n = 32$) and Bavaria (1.1%, $n = 19$;

FIGURE 1

Use of new psychoactive substances: data was gathered on lifetime prevalence (LP), prevalence in the previous 12 months (12 MP), and in the 30 days (30 DP) prior to the survey. n, Non-weighted number; %, weighted percentage

Figure 2). North Rhine-Westphalia had the lowest prevalence (0.3%, $n = 4$). The 12-month prevalence varied between 0.0% in Hesse and 0.8% in Thuringia ($n = 15$). Only respondents in Thuringia (0.2%, $n = 6$) and Hamburg (0.3%, $n = 1$) reported use within the 30 days prior to the survey.

As such, individuals in Saxony and Thuringia showed an above-average risk for lifetime use compared with other federal states (Table 1). Higher age and educational level were associated with reduced risk; tobacco and cannabis use, on the other hand, were associated with increased risk.

On the descriptive level, frequencies of use varied between federal states (Table 3): whereas in Hamburg and North Rhine-Westphalia no users reported at least 10-time use, this number was one (in 9) in Bavaria, seven (in 15) in Thuringia, and three (in 4) in Saxony. None of the methamphetamine users in Saxony reported one-off use.

TABLE 1

Results of logistic regressions to predict the lifetime prevalence of new psychoactive substance and methamphetamine use

	New psychoactive substances			Methamphetamine		
	OR	95% CI	n Sample/ users	OR	95% CI	n Sample/ users
German federal state						
Bavaria	1.13	[0.81; 1.58]	1899/59	1.28	[0.68; 2.40]	1896/19
Hamburg	0.99	[0.65; 1.50]	1110/41	0.62	[0.29; 1.33]	1104/8
Hesse	0.88	[0.59; 1.33]	1144/32	0.86	[0.29; 2.55]	1136/5
North Rhine-Westphalia	1.11	[0.73; 1.70]	1990/36	0.37	[0.10; 1.37]	1981/4
Saxony	1.15	[0.76; 1.73]	1883/55	2.04 ^(*)	[1.15; 3.62]	1891/28
Thuringia	0.79	[0.54; 1.17]	1529/52	1.96 ^(*)	[1.13; 3.39]	1532/32
Gender (female)	0.78	[0.53; 1.13]	5369/133	0.78	[0.43; 1.41]	5351/44
Age ^{*1}	0.97 ^(*)	[0.96; 0.99]	9555/275	0.97 ^(*)	[0.95; 0.99]	9444/96
Educational level ^{*2}						
Medium	0.44 ^(*)	[0.27; 0.73]	5066/147	0.35 ^(*)	[0.16; 0.80]	5211/52
High	0.29 ^(*)	[0.18; 0.49]	3401/67	0.26 ^(*)	[0.10; 0.67]	3464/20
Alcohol consumption (g/week) ^{*1}	1.03 ^(*)	[1.01; 1.04]	9109/252	1.01	[1.00; 1.03]	9104/91
Tobacco use (12 months)	2.94 ^(*)	[1.90; 4.54]	2756/181	4.89 ^(*)	[2.58; 9.28]	2739/77
Cannabis use (12 months)	3.87 ^(*)	[2.50; 5.98]	852/118	6.39 ^(*)	[3.20; 12.76]	841/54

Controlled for interview type (written, telephone, online); the reference for the variable "federal state" was the average value of the federal states included; ^(*)p < 0.05; ^{*1}: continuous variables; OR corresponds to the change in odds when the variables change by one unit (1 year or gram); ^{*2}: reference category: "low educational level"; OR: odds ratio; 95% CI: 95% confidence interval

TABLE 2

Form of NPS used according to German federal state

	Bavaria		Hamburg		Hesse		NRW		Saxony		Thuringia	
	n	%	n	%	n	%	n	%	n	%	n	%
Herbal mixtures	17	90.9	15	77.7	7	77.0	12	71.5	14	89.6	17	77.7
Crystals/tablets	6	48.1	9	57.8	6	60.0	12	84.3	10	86.0	12	67.5
Liquids	6	38.3	6	31.7	4	37.0	9	55.8	9	86.9	7	39.2

n: Non-weighted number; NPS: new psychoactive substances; NRW: North Rhine-Westphalia; %: weighted percentage. Multiple entries possible

Nine individuals across all six federal states showed signs of clinically relevant methamphetamine use. One individual came from Bavaria, one from North Rhine-Westphalia, two from Saxony, and five from Thuringia.

Discussion

This study investigated the prevalence of NPS and methamphetamine use in six German federal states, as well as suspected regional differences, on the basis of a representative sample of the adult resident population. A more detailed analysis was performed primarily descriptively on the basis of case numbers, since only

very few respondents reported using the substances in question. Despite its exploratory nature, the study yields important findings on the prevalence of substances for which epidemiological data are still scant.

NPS are the second most common illegal substances in Germany after cannabis (13, 30). Since comparable studies of NPS have been conducted in only a handful of countries, an international comparison is difficult. Lifetime prevalence is estimated to be 20% in the US (31). It is likely that the difference between the US and Germany is overstated, as the US study included a more detailed catalog of NPS, listing them separately by substance group. However, the

clear discrepancy between prevalences indicates that, even when the same definition is used, the prevalence of use in Germany is lower. There were no differences between federal states in the current study. Therefore, a higher prevalence in Bavaria, as suggested in other studies, could not be confirmed.

Herbal smoking mixtures represented a frequent type of use among NPS users in all federal states. This type of NPS in particular can cause severe side effects due to the unknown and constantly changing substances found in the products (6, 32). Crystals and tablets were used primarily in North Rhine-Westphalia and Saxony. The highest use of liquid NPS was also reported in Saxony. However, due to the small case numbers, these regional patterns can only be considered as indications requiring further investigation.

A number of studies suggest that NPS use is not restricted to a specific population group, but is widespread among party goers (33), students (30, 34), and on the open drug scene (35). Continuous monitoring of NPS can help to promptly inform key people, such as emergency physicians, addiction support staff, and political decision-makers, about new developments.

The lifetime prevalence of methamphetamine use was higher in Thuringia and Saxony compared with other federal states. Thus, epidemiological data show an increased incidence in those federal states that also stand out in terms of seizures of substances or treatment data (22, 24). It is assumed that proximity to the border with the Czech Republic is responsible for this geographical preponderance, since a large part of the methamphetamine available in Europe is produced there (15). At the same time, data from Bavaria as a neighboring federal state do not paint a clear picture. The reasons for this, as well as the possible inference of implications for prevention, remain to be investigated.

Methamphetamine is used significantly less frequently compared with NPS. International comparisons reveal a much lower prevalence in Germany compared with the US, Australia, or Southeast Asia (16). For example, the lifetime prevalence in the US is 5.9% (36). However, due to the high risk of health effects, selective and indicated prevention and intervention measures should be established for risk groups. Since the majority of the population has not yet come into contact with methamphetamine, large national campaigns are not recommended, since these carry the risk of drawing attention to the substance and promoting the spread of the drug (37).

Although studies on user motivation show that the substance is often taken to improve performance (23), the low prevalence rates indicate that methamphetamine is not seen as an “everyday drug” in any of the German federal states, as sometimes portrayed in the media (1). However, the European Monitoring Centre for Drugs and Drug Addiction considers the harm to public health caused by methamphetamine to be significant, even at low prevalence rates, due to its strong negative effects (17).

FIGURE 2

Use of methamphetamine: data was gathered on lifetime prevalence (LP), prevalence in the previous 12 months (12 MP), and in the 30 days (30 DP) prior to the survey. n, Non-weighted number; %, weighted percentage

Young age, low educational level, and the use of other psychoactive substances, in addition to federal state (for methamphetamine), were also associated with the use of both NPS and methamphetamine. These risk factors do not differ from those already known for other illegal drugs (38). However, these results, especially those relating to methamphetamine, need to be interpreted with caution, due to small consumer numbers, and require further investigation.

Limitations

In contrast to other sources of data on the prevalence of drug use, such as wastewater analysis, epidemiological surveys permit the identification of individual patterns of use. However, it is scarcely possible to survey some of the highly marginalized or institutionalized groups of the population (39). There is also a risk of underestimating prevalence due to the social desirability bias. However, one can assume that the distortion caused by response behavior is equally pronounced on a regional

TABLE 3

Frequency of consumption among methamphetamine users (12-month) according to German federal state

	Once	2–9 Times	≥ 10 Times
Bavaria	■ ■ ■	■ ■ ■ ■ ■	■
Hamburg	■	■ ■	
Hesse			
North Rhine-Westphalia		■	
Saxony		■	■ ■ ■
Thuringia	■ ■ ■ ■ ■	■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■

Cases are shown; one box corresponds to one case.

Key messages

- New psychoactive substances (NPS) are the most common illegal drugs after cannabis; there is no evidence of regional differences.
- Key facilities, such as emergency departments, should be constantly kept abreast of current developments in—and trained in the symptoms caused by—the use of NPS.
- The prevalences of methamphetamine use are generally lower than those of NPS use. Saxony and Thuringia have the highest lifetime prevalences of use.
- Due to its low prevalence, nationwide prevention campaigns and excessive media coverage of methamphetamine are not recommended.
- All areas of medical care in the affected regions should be trained in the symptoms associated with methamphetamine use and geared up to the challenges it poses.

level and does not affect the comparison between federal states. Despite the considerable size of the sample, the prevalence rates precluded the possibility of gender stratification. However, multivariate analysis revealed no gender differences requiring such stratification. The fact that study participants themselves classified substances as NPS can be seen as a further limitation of the study (40). Although an internationally accepted explanation of the term was provided, it remains unclear whether respondents classified the consumed substances correctly. Similarly, due to admixtures and impurities, it is unclear to what extent users were able to judge which substances they were taking. However, respondents' answers should be interpreted as the intention to consume and not as information on the actual chemical composition of the substances used.

Summary

The available data show that NPS use pertains to a higher percentage of the population in Germany compared with other illegal drugs. This is of particular importance to emergency departments and addiction treatment facilities, since they are confronted with the

sometimes devastating consequences of NPS use. There is no indication of regional differences in the six federal states investigated. Looking at the population as a whole, methamphetamine is consumed by only a very small percentage. Comparatively high prevalences are noticeable in Thuringia and Saxony. Addiction care is not the only area that needs to adapt to this regional burden—all areas of medical care in these regions need to be geared up to this particular challenge.

Funding

The German Epidemiological Addiction Survey (ESA) 2015 was funded by the Federal Ministry of Health (*Bundesministerium für Gesundheit*, BMG) (ref: IIA5 2514DSM200).

Additional samples and federal state analyses were supported by the state ministries:

- Bavarian State Ministry of Health and Care (*Bayerisches Staatsministerium für Gesundheit und Pflege*)
- Ministry of Health and Consumer Protection Hamburg (*Behörde für Gesundheit und Verbraucherschutz Hamburg*)
- Hessian Ministry of Social Affairs and Integration (*Hessisches Ministerium für Soziales und Integration*)
- Ministry for Health, Equalities, Care and Ageing of the State of North Rhine-Westphalia (*Ministerium für Gesundheit, Emanzipation, Pflege und Alter des Landes Nordrhein-Westfalen*)
- Saxon State Ministry of Social Affairs and Consumer Protection (*Sächsisches Staatsministerium für Soziales und Verbraucherschutz*)
- Thuringia Ministry of Social Affairs, Family and Health (*Thüringer Ministerium für Soziales, Familie und Gesundheit*).

Funding was not subject to conditions.

Conflict of interests

Prof. Kraus and Dr. Piontek received funding from Lundbeck GmbH for a research project on the epidemiology of alcohol addiction.

The remaining authors state that they have no conflicts of interest.

Manuscript submitted on 27 June 2017, revised version accepted on 19 October 2017.

Translated from the original German by Christine Schaefer-Tsorpazidis.

References

1. Betzler F, Heinz A, Köhler S: Synthetic drugs—an overview of important and newly emerging substances. *Fortschr Neurol Psychiatr* 2016; 84: 690–848.
2. European Monitoring Centre for Drugs and Drug Addiction (EMCDDA): New psychoactive substances in Europe. An update from the EU Early Warning System. Luxembourg: Publications Office of the European Union 2015. www.emcdda.europa.eu/system/files/publications/65/TD0415135ENN.pdf (last accessed on 4 December 2017).
3. European Monitoring Centre for Drugs and Drug Addiction (EMCDDA): Europäischer Drogenbericht 2016: Trends und Entwicklungen. Luxemburg: Amt für Veröffentlichungen der Europäischen Union 2016. www.emcdda.europa.eu/system/files/publications/2637/TDAT16001DEN.pdf (last accessed on 4 December 2017).
4. Hohmann N, Mikus G, Czock D: Effects and risks associated with novel psychoactive substances: mislabeling and sale as bath salts, spice, and research chemicals. *Dtsch Arztebl Int* 2014; 111: 139–47.
5. Tait RJ, Caldicott D, Mountain D, Hill SL, Lenton S: A systematic review of adverse events arising from the use of synthetic cannabinoids and their associated treatment. *Clin Toxicol* 2017; 54: 1–13.
6. Zamengo L, Frison G, Bettin C, Sciarone R: Understanding the risks associated with the use of new psychoactive substances (NPS): High variability of active ingredients concentration, mislabelled preparations, multiple psychoactive substances in single products. *Toxicol Lett* 2014; 229: 220–8.
7. Baumann MH, Solis E, Watterson LR, Marusich JA, Fantegrossi WE, Wiley JL: Symposium bath salts, spice, and related designer drugs: The science behind the headlines. *J Neurosci* 2014; 34: 15150–8.