United Nations
Office on Drugs and Crime

World Drug Report 2025

Methodological Annex

Research and Trend Analysis Branch

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United Nations
Office on Drugs and Crime

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1. Introduction

Considerable efforts have been made over the years to improve the estimates presented in the *World Drug Report*, which rely, to a large extent, on information submitted by Member States through the Annual Reports Questionnaire (ARQ). Nonetheless, challenges remain in producing such estimates because of the gaps and the varying quality in the available data. One major problem is the heterogeneity in the completeness and the time frame of data coverage in ARQs reported by Member States. Irregular reporting may result in absence of data for some years and may also influence the reported trend in a given year. In addition, submitted questionnaires are not always comprehensive, and much of the data collected are subject to limitations and biases. These issues affect the reliability, quality and comparability of the information received.

Sources of information

Under the International Drug Conventions, Member States are formally required to provide national drug control related information annually to the 'Secretary General' of the United Nations (i.e. the Secretariat in the UNODC). For this purpose, the Commission on Narcotic Drugs in 2020 endorsed the revised Annual Reports Questionnaire (ARQ) that is sent to Member States each calendar year for submission of responses and information on the drug situation.

The World Drug Report 2025 Web-based element (online segment) "Drug Market Patterns and Trends" is based on data primarily obtained from the ARQs submitted by Governments to UNODC. In 2020, the ARQ was updated and streamlined[1] and the data collection was fully moved to an online interface, created specifically for this purpose. The first time the data was collected in the online environment was in 2021. This may have led to some additional challenges in data comparability with the previous years. The data collected in the current ARQ, used in the World Drug Report 2025, normally refer to the drug situation in 2023. Out of 200 potential respondents to the ARQ for 2023 (including 193 United Nations Member States), UNODC received data from 133 countries. Europe had the best coverage (93 per cent

1 The current version of the ARQ can be accessed through this https://docs.un.org/en/E/CN.7/2020/12.

of countries in the region provided a reply), followed by Asia (70 per cent) and the Americas 69 per cent). In the case of Africa, 57 per cent of countries, and in the Oceania region, only two out of the 16 countries, responded to the Annual Report Questionnaire.

In general, the quantity of information provided on illicit drug supply is slightly better than that of information provided on drug demand.

In order to analyse the extent to which Member States provided information, a number of key questions in the ARQ were identified:

- For drug demand, data were collected mainly in annual modules A01-A06, but additional themes were covered in rotating modules R02 and R13. During the data collection campaign 2024 (ARQ2023), in total, 102 countries submitted the modules on registries and prevalence of drug use, (A01 and A02) 94 the module on mortality (A05), 95 the module on people with drug use disorders (A04), and 100 the modules on people who inject drugs and treatment (A03 and A06). However, this analysis does not take into account the completeness or quality of the information provided in response to each of the areas mentioned.

- For drug supply, data was predominantly collected in annual modules A07-A12, but additional themes were covered in rotating modules R01 and R08. During the data collection campaign 2024 (ARQ2023), in total, 104 countries submitted the module on seizures (A07), 106 on clandestine laboratories and cultivation and eradication (A08 and A09), and 99 countries submitted the module on price and purities. However, this analysis, again, does not take into account the completeness of responses of the quality of information provided in each of the sections mentioned.

- Additional topics related to drug policy frameworks were covered in modules A13 (Legislative, institutional, and strategic framework). Module A14 gathered information on Innovative methods for data. In total, 94 countries or territories submitted module A13, and 91 submitted module A14 of the ARQ 2023.

Information provided by Member States in the ARQ form the basis for the estimates and trend analysis provided in the World Drug Report. Often, this information and data is not sufficient to provide an accurate or comprehensive picture of the world's drug markets. When necessary and where available, the data from the ARQ are thus supplemented with data from other sources.

As in previous years, seizure data made available to UNODC via the ARQ was complemented primarily with data from other government sources, such as other official communication with UNODC, official national publications, data provided to UNODC by the Heads of National Law Enforcement Agencies (HONLEA) at their regional meetings and data published by international and regional organisations such as Interpol/ICPO, World Customs Organization, the Inter-American Drug Abuse Control Commission (CICAD) and the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) which has been replaced in July 2024 by the European Union Drugs Agency (EUDA). Demand related information was obtained through a number of additional sources, including the national assessments of the drug situation supported by UNODC, the drug control agencies participating in the UNODC's 'Drug Abuse Information Network for Asia and the Pacific' (DAINAP), as well as various national and regional epidemiological networks such as the European Union Drugs Agency (EUDA), or the Inter-American Drug Abuse Control Commission (CICAD). Reports published by National governments and academic research published in the scientific literature were also used as additional sources of information. This type of supplementary information is necessary to present – to the extent possible – an unbiased comprehensive picture of the drug situation. This is useful as long as Member States lack the monitoring systems necessary to produce reliable, comprehensive and internationally comparable data.

To this end, UNODC encourages and supports the improvement of national monitoring systems. Major progress has been made in the area of illicit crop monitoring over the last three decades in some of the countries that have major illicit crop cultivations. In close cooperation with UNODC and with the support of major donors – these countries have developed monitoring systems designed to identify the extent of, and trends in, the cultivation of narcotic plants. These data form a fundamental basis for trend analysis of illicit crop cultivation and drug production presented in the World Drug Report.

There remain significant data limitations on the demand side, notably among countries in Africa and Asia. Despite commendable progress made in several Member States, in the area of prevalence estimates for example, far more remains to be done to provide a truly reliable basis for trend and policy analysis and needs assessments. The work currently being done on the World Drug Report provides yet another opportunity to emphasize the global need for improving the evidence base available to the policy makers and programme planners.

2. Drug use and health consequences

Data on drug use and health consequences

UNODC estimates of the extent of illicit drug use in the world have been published periodically since 1997. Assessing the extent of drug use (the prevalence and estimates of the number of drug users) is a particularly difficult undertaking because it involves in most settings measuring the size of a 'hidden' population. Regional and global estimates are reported with ranges to reflect the information gaps. The level of confidence expressed in the estimates varies across regions and drug types.

A global estimate of the level of use of a specific drug involves the following steps:

1. Identification and analysis of appropriate sources (starting from the ARQ);
2. Identification of key benchmark figures for the level of drug use in all countries where data are available (annual prevalence of drug use among the general population aged 15-64) which then serve as 'anchor points' for subsequent calculations;
3. 'Standardization' of existing data if reported with a different reference population than the one used for the *World Drug Report* (for example, from age group 12 and above to a standard age group of 15-64);
4. Adjustments of national indicators to estimate an annual prevalence rate if such a rate is not available (for example, by using the lifetime prevalence or current use rates; by aggregating prevalence of two drug types, like use of amphetamine and methamphetamine to obtain the joint estimates of prevalence of use for amphetamines overall; or extrapolating from lifetime or annual prevalence rates among the youth population to the adult population. The latter includes the identification of adjustment factors based on information from countries in the region with similar cultural, social and economic situations where applicable;
5. Imputation for countries where data are not available, based on data from countries in the same subregion. Ranges are calculated by considering the 10th and 90th weighted

percentile of the subregional distribution, using the target[2] population in the countries as weights;

6. Extrapolations of available results for a subregion were calculated only for subregions where prevalence estimates for at least two countries covering at least 20% of the population were available. If, due to a lack of data, subregional estimates were not extrapolated, a regional calculation was extrapolated based on the 10th and 90th percentile of the distribution of the data available from countries in the region. Since the World Drug Report 2019, when this methodology was revised, a weighted percentile procedure has been used that takes into account the population aged 15-64 in the countries;

7. Aggregation of subregional estimates rolled-up into regional results to arrive at global estimates.

For countries that did not submit information through the ARQ, or in cases where the data were older than 10 years, other sources were identified, where available. In nearly all cases, these were government sources. Many estimates needed to be adjusted to improve comparability (see below).

In cases of estimates referring to previous years, the prevalence rates are unchanged and applied to new population estimates for the year 2023. Currently, only a few countries measure prevalence of drug use among the general population on an annual basis. The remaining countries that regularly measure it - typically the more economically developed - do so usually every three to five years. Therefore, caution should be used when interpreting any change in national, regional or even global prevalence figures, as changes may in part reflect newer reports from countries, at times with changed methodology, or the exclusion of older reports, rather than actual changes in prevalence of a drug type. Additional caution is required in the interpretation of prevalence rates based on 2020/2021 surveys, as many countries had to adjust methodologies owing to the situation related to the COVID-19 pandemic and rules and regulations in place to protect public health from it (e.g. lockdowns or social distancing rules

2 The target for general population estimates is the 15-64 population, while for youth estimates it corresponds to the 15-16 population.

leading to several surveys moving their data collections online). As a result, the comparability of 2020/2021 studies with previous studies is unknown and may be decreased.

Detailed information on drug use is available from countries in North America, a large number of countries in Europe, a number of countries in South America, the two economically most advanced countries in Oceania and a limited number of countries in Asia and Africa.

One key problem in national data is the level of accuracy, which varies strongly from country to country. Not all estimates are based on sound epidemiological surveys. In some cases, the estimates simply reflect the aggregate number of drug users found in drug registries, which cover only a fraction of the total drug using population in a country. Even in cases where detailed information is available, there is often considerable divergence in definitions used, such as chronic or regular users; registry data (people in contact with the treatment system or the judicial system) versus survey data (usually extrapolation of results obtained through interviews of a selected sample); general population versus specific surveys of groups in terms of age (such as school surveys), special settings (such as hospitals or prisons), or high risk groups, et cetera.

To reduce the error margins that arise from simply aggregating such diverse estimates, an attempt has been made to standardize - as a far as possible - the heterogeneous data set. Available estimates were transformed into one single indicator – annual prevalence among the general population – in most instances using regional average estimates and using transformation ratios derived from analysis of the situation in neighbouring countries. The basic assumption is that though the level of drug use differs between countries, there are general patterns found for the psychoactive substances for which regional and global estimates are generated (for example, young people consume more drugs than older people; males consume more drugs than females; people in contact with the criminal justice system show higher prevalence rates than the general population, et cetera) which apply to most countries. It is also assumed that the relationship between lifetime prevalence and annual prevalence among the general population or between lifetime prevalence among young people and annual prevalence among the general population, except for new or emerging drug trends, do not vary greatly among countries with similar social, cultural and economic situations.

UNODC does not publish estimates of the prevalence of drug use in countries with smaller populations (less than approximately 100,000 population aged 15-64) where the prevalence

estimates were based on the results of youth or school surveys that were extrapolated to the general adult population, as applying such methods in the context of small countries can result in inaccurate figures as the underlying samples for such extrapolations are often small and potentially biased.

Indicators

The most widely used indicator at the global level is the annual prevalence rate: the number of people who have consumed an illicit drug at least once in the twelve months prior to the study. Annual prevalence has been adopted by UNODC as one of key indicators to measure the extent of drug use. It is also part of the Lisbon Consensus on core epidemiological indicators of drug use which has been endorsed by the Commission on Narcotic Drugs. The key epidemiological indicators of drug use are:

1. Drug use among the general population (prevalence and incidence);
2. Drug use among the youth population (prevalence and incidence);
3. High-risk drug use (number of injecting drug users and the proportion engaged in high-risk behaviour, number of daily drug users);
4. Utilization of services for drug problems (treatment demand);
5. Drug-related morbidity (prevalence of HIV, hepatitis B virus and hepatitis C virus among drug users);
6. Drug-related mortality (deaths attributable to drug use).

Efforts have been made to present the overall drug situation from countries and regions based on these key epidemiological indicators.

The use of annual prevalence is a compromise between lifetime prevalence data (drug use at least once in a lifetime) and data on current use (drug use at least once over the past month). Accurate data on current use would, in many cases, require larger samples than countries are willing to afford while data on life-time prevalence have only a limited use when drug use among the general population is considered. The annual prevalence rate is usually shown as a percentage of the youth and adult population. The definitions of the age groups vary, however, from country to country. Given a highly skewed distribution of drug use among the different age cohorts in most countries, differences in the age groups can lead to diverging results.

Applying different methodologies may also yield diverging results for the same country. In such cases, the sources were analysed in-depth, and priority was given to the most recent data and to the methodological approaches that are considered to produce the best results. For example, it is generally accepted that nationally representative household surveys are reasonably good approaches to estimating cannabis, ATS or cocaine use among the general population, at least in countries where there are no adverse consequences for admitting illicit drug use. Thus, household survey results were usually given priority over other sources of prevalence estimates.

When it comes to the use of opiates (opium, heroin, and other illicit opiates), injecting drug use, or the use of cocaine and ATS among regular or dependent users, annual prevalence data derived from national household surveys tend to grossly under-estimate such use, because heroin or other problem drug users often tend to be marginalized or less socially integrated, and may not be identified as living in a 'typical' household (they may be on the streets, homeless or institutionalized). Therefore, a number of 'indirect' methods have been developed to provide estimates for this group of drug users, including benchmark and multiplier methods (benchmark data may include treatment demand, police registration or arrest data, data on HIV infections, other services utilization by problem drug users or mortality data), capture-recapture methods and multivariate indicator methods. In countries where there was evidence that the primary 'problem drug' was opiates, and an indirect estimate existed for 'problem drug use' or injecting drug use, this was preferred over household survey estimates of heroin use. Therefore, for most of the countries, prevalence of opioid or opiates use reported refers to the extent of use of these substances measured through indirect methods.

For other drug types, priority was given to annual prevalence data found by means of household surveys. In order to generate comparable results for all countries, wherever needed, the reported data was extrapolated to annual prevalence rates and/or adjusted for the preferred age group of 15-64 for the general population.

Extrapolation methods

Adjustment for differences in age groups

Member States are increasingly using the 15-64 age group, though other groups are used as well. Where the age groups reported by Member States did not differ significantly from 15-64,

they were presented as reported, and the age group specified. Where studies were based on significantly different age groups, results were typically adjusted. A number of countries reported prevalence rates or number of drug users for the age groups 15+ or 18+. In such cases, adjustments were generally based on the assumption that there was no significant drug use above the age of 64; the reported number of drug users based on the population age 15+ (or age 18+) was shown as a proportion of the population aged 15-64.

Methodology to produce joint estimates for more than one type of drugs

In the collection of information on prevalence of drug use, a number of instances arise where data are available for specific types of drugs, but prevalence data are needed at a higher level of aggregation. In other words, prevalence data may be available for two particular kinds of drugs but may also be needed in the form of a single figure which takes into account both types at the same time. This is especially relevant in the case of closely related types of drugs. For example, the prevalence of use of cocaine salts and “crack” cocaine may be known, but in addition the prevalence of cocaine in general may be needed. If no empirical data is available from Member States, a joint estimate is produced by aggregating the different types of drugs according to the following method:

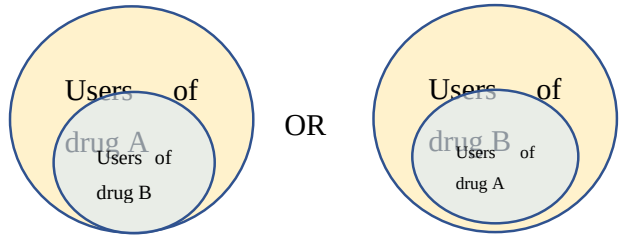
The methodology to calculate the estimate for prevalence of use of two drugs considers the extent to which the group of users of one drug overlaps with the group of the users of the other drug, for the same reference period (i.e. lifetime, past year or past month).

The prevalence rates of two types of drugs are combined to obtain the estimate of the prevalence of any of the two drugs, which is derived as the midpoint of a lower (minimum) estimate and an upper (maximum) estimate. These two estimates represent two opposite extreme scenarios: in one scenario all the users of one type of drug also consume the other drug, whereas in the other scenario none of the persons consuming the first drug consume the other drug (and vice versa).

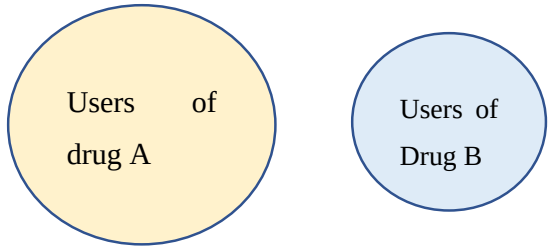
Given any two drugs A and B, we denote by PA and PB the prevalence of use of drugs A and B, respectively. We aim to obtain an estimate of the prevalence of use of at least one of the drugs A and B (e.g. use of cocaine = use of cocaine salts or crack cocaine). We shall call this value Z = PA&B.

The lower estimate (Z min) corresponds to the scenario where all the users of one drug are to be found among the users of the other drug. Therefore, the lower (minimum) joint estimate corresponds to the highest value (maximum) among the two values of prevalence.

$Z_{min} = \max (P_A, P_B)$



The upper (maximum) joint estimate reflects the opposite scenario, where the group of users of drug A is completely separate from the group users of drug B; that is, none of the users of drug A consume drug B (and vice versa).



Therefore, the upper (maximum) joint estimate for the two drugs is the sum of the prevalence of the drug A and drug B; in other words, $\mathbf{Z_{max} = P_A + P_B}$.

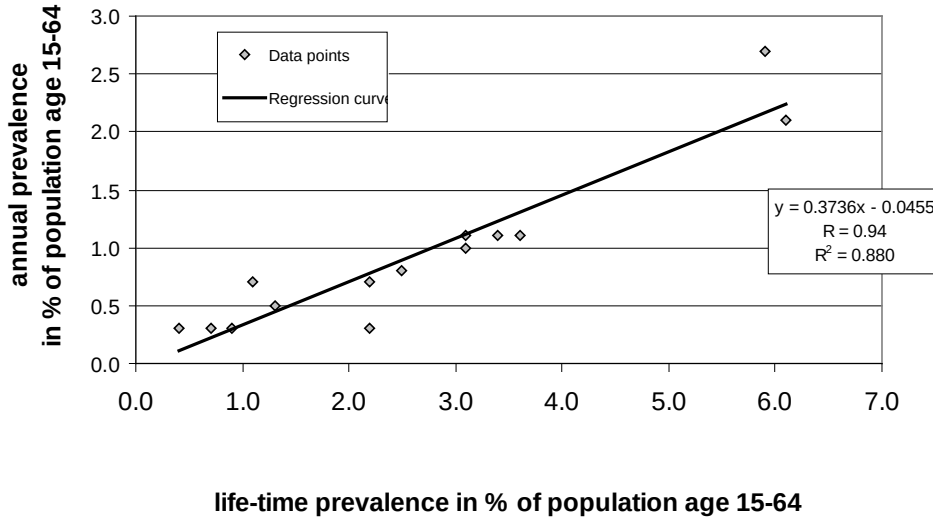
The best estimate is obtained as the midpoint between Z_{min} and Z_{max}; that is $\mathbf{Z_{best} = (Z_{max} + Z_{min})/2}$. This represents a scenario in between the two extremes, where some of drug A users consume also drug B.

Extrapolation of results from lifetime prevalence to annual prevalence

Some countries have conducted surveys in recent years without asking the question whether drug consumption took place over the last year. In such cases, results were extrapolated to reach annual prevalence estimates. For example, country X in West and Central Europe reported a lifetime prevalence of cocaine use of 2%. As an example, taking data for lifetime and annual prevalence of cocaine use in countries of West and Central Europe, it can be shown that there is a strong positive correlation between the two measures (correlation coefficient R = 0.94); that is, the higher the lifetime prevalence, the higher the annual prevalence and vice versa. Based on the resulting regression line (with annual prevalence as the dependent variable

and lifetime prevalence as the independent variable) it can be estimated that a country in West and Central Europe with a lifetime prevalence of 2% is likely to have an annual prevalence of around 0.7% (see figure). Almost the same result is obtained by calculating the ratio of the unweighted average of annual prevalence rates of the West and Central European countries and the unweighted average lifetime prevalence rate (0.93/2.61 = 0.356) and multiplying this ratio with the lifetime prevalence of the country concerned (2% * 0.356 = 0.7%).

Figure. Example of annual and lifetime prevalence rates of cocaine use in West and Central Europe



Sources: UNODC, Annual Reports Questionnaire Data / EMCDDA, Annual Report.

A similar approach was used to calculate the overall ratio by averaging the annual/lifetime ratios, calculated for each country. Multiplying the resulting average ratio (0.387) with the lifetime prevalence of the country concerned provides the estimate for the annual prevalence (0.387 * 2% = 0.8%). There is a close correlation observed between lifetime and annual prevalence (and an even stronger correlation between annual prevalence and monthly prevalence). Solid results (showing small potential errors) can only be expected from extrapolations done for a country in the same region. If instead of using the West and Central European average (0.387), the ratio found in the USA was used (0.17), the estimate for a country with a lifetime prevalence of cocaine use of 2% would instead amount to 0.3% (2% * 0.17). Such an estimate is likely to be correct for a country with a drug history similar to the USA, which has had a cocaine problem for more than three decades, as opposed to West and Central Europe, where a significant cocaine problem is largely a phenomenon of the last

decade. Therefore, data from countries in the same subregion with similar patterns in drug use were used, wherever possible, for extrapolation purposes.

Both approaches—the regression model and the ratio model—were used to determine upper and lower uncertainty range estimates calculated at a 90% confidence interval among those aged 15-64 years in the given country. The greater the range, the larger the level of uncertainty around the estimates. The range for each country is reported in the statistical annex, where available.

Extrapolations based on school surveys

Analysis of countries which have conducted both school surveys and national household surveys shows that there is, in general, a positive correlation between the two variables, particularly for cannabis, ATS and cocaine. The correlation, however, is weaker than that of lifetime and annual prevalence or current use and annual prevalence among the general population. But it is stronger than the correlation between opiate use and injecting drug use and between treatment demand and extent of drug use in the general population

These extrapolations were conducted by using the ratios between school surveys and household surveys of countries in the same region or with similar social structure where applicable. As was the case with extrapolation of results from lifetime prevalence to annual prevalence, two approaches were taken: a) the unweighted average of the ratios between school and household surveys in the comparison countries with an upper and lower uncertainty range estimate calculated at a 90% confidence interval; and b) a regression-based extrapolation, using the relationships between estimates from the other countries to predict the estimate in the country concerned, with an upper and lower uncertainty range estimate calculated at a 90% confidence interval. The final uncertainty range and best estimate are calculated using both models, where applicable.

Extrapolations based on treatment data

For a number of developing countries, the only drug use-related data available was drug users registered or treatment demand. In such cases, other countries in the region with a similar socio-economic structure were identified, which reported annual prevalence and treatment data. A ratio of people treated per 1,000 drug users was calculated for each country. The results from

different countries were then averaged and the resulting ratio was used to extrapolate the likely number of drug users from the number of people in treatment.

National, regional and global estimates of the number of people who use drugs and the health consequences of drug use

In order to obtain regional and global estimates of the numbers of people who use drugs, the estimated prevalence rates of countries were applied to the population aged 15-64, as provided by the United Nations Population Division for the year 2023.

In the tables presented in the World Drug Report for regional and global estimates, totals may not add up due to rounding.

Ranges have been produced to reflect the considerable uncertainty that arises when data are either extrapolated or imputed. Ranges are provided for estimated numbers and prevalence rates in the Report. Larger ranges are reported for subregions and regions with less certainty about the likely levels of drug use – in other words, those regions for which fewer direct estimates are available, for a comparatively smaller proportion of the region's population, or for regions for which the existing estimates show a comparatively larger variability.

Countries with one published estimate (typically those countries with a representative household survey, or an indirect prevalence estimate that did not report ranges) did not have uncertainty estimated. This estimate is reported as the 'best estimate'.

To account for populations in countries with no published estimate, the 10th and 90th percentile in the range of direct estimates within the subregion was used to produce a lower and upper estimate. Similarly, to previous World Drug Reports in this report a weighted percentile procedure was implemented, that takes into account the population in the 15-64 age group in each country. For example, suppose there are four countries in the Near and Middle East / South-West Asia subregion with sufficiently recent past year prevalence estimates for cocaine use: Afghanistan (0.00 per cent, a point estimate), Iran (Islamic Republic of) (0.00 per cent – 0.22 per cent , best estimate 0.11 per cent), Israel (0.50 per cent – 0.70 per cent, best estimate 0.60 per cent) and Pakistan (0.00 per cent – 0.04 per cent, best estimate 0.01 per cent). In order to obtain a best estimate for the subregion, the weighted average of the best estimates for prevalence over these four countries is applied to the population of the remaining countries in

the subregion without prevalence data. To obtain a range for the subregion, the weighted 10th percentile of the lower bounds of the uncertainty ranges (0.00 per cent, 0.00 per cent, 0.50 per cent and 0.00 per cent), namely 0.00%, and the 90th percentile of the upper bounds (0.00 per cent, 0.22 per cent, 0.70 per cent and 0.04 per cent), namely 0.21 per cent, were considered. It is important to note that, as Israel accounts for only about 3 per cent of the population within the 15-64 age group in these four countries, the resulting weighted percentiles are not heavily influenced by the higher prevalence present in this country. The percentages of 0.00 and 0.21 were applied to the population of the remaining countries without prevalence data, in combination with the national level data for Afghanistan, Iran (Islamic Republic of), Israel and Pakistan, to derive subregional lower and upper estimates of 0.01 and 0.13 per cent respectively.

In some cases, not all the subregions in a region had sufficient country-level data to allow the above calculations. In such cases, for the purposes of arriving at estimates at regional level, lower and upper estimates at the sub-regional level were derived based on the data points from the entire region, specifically by considering the weighted 10th and 90th percentiles respectively of the lower and upper country-level estimates. These results were then combined with the other subregions to arrive at upper and lower estimates, and hence best estimates, at regional level.

This produces conservative (wide) intervals for subregions where there is geographic variation and/or variance in existing country-level estimates; but it also reduces the likelihood that skewed estimates will have a dramatic effect on regional and global figures, as the weighted percentiles procedure will give a smaller weight to relatively small countries, which tend to be more likely to present an extreme prevalence (outlier values).

As in the previous World Drug Reports, the region of Oceania was divided into four subregions (Australia and New Zealand, Melanesia, Micronesia, and Polynesia), while in previous years prior to 2018 no subregional estimates of annual prevalence among the population aged 15-64 were available. Given that the data for Melanesia, Micronesia and Polynesia is scarce, in order to avoid imputing these regions with data from only Australia and New Zealand (which are highly developed and thus very different from most other countries in Oceania), the closest five countries to these regions with available data were considered in the calculations, when necessary. This was the case for the calculations of the prevalence of cocaine, “ecstasy”, opiates.

Estimates of the total number of people aged 15-64 who used illicit drugs at least once in the past year

This year's Report used the same approach as in the previous years. Two ranges were produced, and the lowest and highest estimate of each approach was taken to estimate the lower and upper ranges, respectively, of the total drug using population. This estimate is obviously tentative given the limited number of countries upon which the data informing the two approaches were based. The two approaches were as follows:

Approach 1:

The global estimates of the number of people using each of the five drug groups in the past year were added up. Taking into account that people use more than one drug type and that these five populations overlap, the total was adjusted downward. The size of this adjustment was made based upon household surveys conducted in 29 countries globally including countries from North America (Canada, Mexico and the United States of America), Europe (including Italy, Germany, Spain and England and Wales), Latin America (Argentina, Brazil, Plurinational State of Bolivia, Chile, Costa Rica, El Salvador and Uruguay), Asia and the Pacific (Israel, Indonesia, Philippines, Thailand and Australia) and Africa (Algeria, Nigeria), which assessed all five drug types, and reported an estimate of total illicit drug use. Across these studies, the extent to which adding each population of users overestimated the total population was a median factor of 1.16. The summed total was therefore divided by 1.16 to arrive at an estimate of the global number of drug users.

Approach 2:

This approach was based on the average proportion of the total drug using population that used cannabis as a strong positive correlation between cannabis use and overall drug could be identified. The average proportion was obtained from household surveys conducted in the same countries as for Approach 1. Across all of these studies, the median proportion of cannabis users to total drug users was 80.9 per cent. The range of cannabis users at the global level was therefore divided by 0.809 to arrive at an estimate of the global number of drug users.

The global lower estimate was the lower of the two values obtained from the two approaches, while the upper estimates was the upper value derived from the two approaches described. The average of the two values was reported as best estimate.

Calculation of regional and global estimates of cannabis, amphetamines, cocaine and “ecstasy” use among 15-16 years old students

In 2018, UNODC produced in the World Drug Report – for the first time – an estimate of the annual prevalence of cannabis use among 15-16 years old students, based on available data from 130 countries. Starting from 2019, the World Drug Report presents also estimates of any illicit drug use prevalence among 15-16 years old students. In World Drug Report 2025, estimates for amphetamines, cocaine and “ecstasy” were calculated for this age group too. In the World Drug Report 2025, the estimates were based on data from 153, 127, 103 and 102 countries respectively for cannabis, amphetamines, cocaine and “ecstasy”.

The age group “15-16 years” was chosen as this is the “preferred” age group for “youth” that is asked in UNODC’s annual report questionnaire. This age group was also chosen by ESPAD which regularly provides data from some 35 European countries on drug and alcohol use. This age group is also available from the surveys among 10th graders undertaken annually under the Monitoring the Future project in the United States, funded by the National Institute on Drug Abuse (NIDA), and from a number of other countries.

Cannabis use prevalence rates typically increase with age until around 18-20 years before declining again thereafter with age. This also means that for most countries cannabis use prevalence rates among 15-16 years old students turn out to be rather similar to the broader group of students aged 12-18 (with those aged 12-14 showing lower rates and those aged 17-18 showing higher rates). Thus, for the United States the annual cannabis use prevalence rates amongst 10th graders turn out to be very similar to those found amongst 8th, 10th and 12th graders combined. Similarly, in Colombia annual prevalence of cannabis use amongst 12 to 18 years old students was found to have been very similar to the rates found among 15-16 years old students. The same applies to students in Pakistan. Cannabis use prevalence rates among students aged 15-16 are thus reasonably good proxies for cannabis use among the overall student population aged 12-18. They are thus the preferred indicator for measuring student drug use at the international level as is also reflected in the question on student drug use in UNODC’s annual report questionnaire.

The methodology chosen to calculate the global average of drug use among students aged 15-16 years was very similar to the methodology used to calculate drug use among the general population aged 15-64:

1. Listing – on a sub-regional basis – the latest annual prevalence rates of drug use among the population aged 15-16 (which in most cases reflected school surveys) and multiplying such percentages with the average population of those aged 15-16 in those countries in 2020.

2. For the remaining countries that reported prevalence data on drug use (but not the requested age group or not annual prevalence), the following adjustments/extrapolations were done:

    a. Adjusting surveys using different age groups to a likely estimate for the population aged 15-16 years; the age adjustments were done based on detailed data from the United Stated for countries in North America, Europe and the developed countries of the Oceania region (i.e. Australia and New Zealand); for Africa and Asia based on detailed data available from Pakistan and for South America, Central America and the Caribbean based on detailed data available from Colombia.

    A special model was developed for the adjustments. Taking into account considerations of diversity and representativity, the following data served as benchmarks for the calculation of the conversion ratios: the 2013 survey in Colombia among people aged 12-65[3], the 2012 survey carried out in Pakistan jointly by UNODC and the Government of Pakistan targeting the population aged 15-64[4] and the 2015 National Survey on Drug Use and Health of the United States among people aged 12 years and older[5]. After collating or generating prevalence data broken down by age groups, prevalence data were derived for each single-year age group. In cases where robust data were not available at this level of granularity (e.g. prevalence data available only for the age brackets 15-19, 20-24, 25-29, etc.), the prevalence in single-year age groups was estimated by optimizing for smoothness the prevalence data as a function of age - subject to the constraints

3 Gobierno Nacional de la República de Colombia, Estudio Nacional de Consumo de Sustancias Psicoactivas en Colombia – 2013.
4 UNODC, Drug Use in Pakistan 2013.
5 Data query engine at http://pdas.samhsa.gov/ and Substance Abuse and Mental Health Services Administration, Results from the 2015 National Survey on Drug and Health: Detailed Tables.

that the total number of users within each given age bracket remained unchanged (i.e. equal to the prevalence multiplied by the population within the specific age bracket). Where necessary, boundary conditions were imposed, e.g. a prevalence of 0 for ages 10 and below. On the basis of single-year prevalence estimates obtained, the prevalence rates were estimated for each possible age group that could potentially arise (e.g. 10-15, 12-19, 14-22). Finally, the conversion factors were calculated as the ratios of the prevalence data within the respective age groups as compared to the age groups of interest (age 15-16 years). This procedure was repeated for each drug for which prevalence was estimated.

b. Extrapolating available life-time or past month data of drug use from individual countries to (missing) annual prevalence data based on a regression analysis of other countries in the subregion providing both life-time and annual data among youth or both past month and annual data among youth. A 95 per cent confidence interval was then used to calculate, in addition, a minimum and a maximum estimate based on such regression data.

3. For the remaining countries which did not report any prevalence data it was assumed that – on average – they had similar prevalence rates as the population weighted average of the reporting countries in the subregion. In cases where the reporting countries accounted for less than 20 per cent of the total population of the subregion, the (weighted) average of reporting countries in the region as a whole was used instead.

4. For countries not reporting any prevalence data it was assumed that the lower estimate was equivalent to the (population weighted) 10^{th} percentile of the reporting countries in the subregion (or the region if reporting countries in the subregion accounted for less than 20 per cent of total population in the subregion) while the upper estimate was equivalent to the (population weighted) 90^{th} percentile of the reporting countries in the subregion (or the data for the region was used as a proxy if reporting countries in the subregion accounted for less than 20 per cent of the total population in the subregion).

   The reported ranges reflected primarily the coverage of a region by student surveys; in short, the larger the reported error margins, the less countries reported school survey data in a region or sub-region to UNODC. Error margins turned out to be small for Europe and the Americas where a majority of countries undertook such school surveys

in recent years while they were rather large for Africa, Asia or for the Oceania region (with the exception of the economically advanced countries in this region).

5. The totals of the calculated subregional estimates gave the regional estimates and the total of the regional estimates then gave the global estimates.

6. The number of persons who used each drug was shown for a hypothetical average age of 15-16 years; in order to calculate the total number of users of each drug those aged 15 years and 16 years the totals had to be still multiplied by two (in order to be in line with the approach used to show general population estimates for those aged 15-64)

Estimated global cannabis use broken down by sex and age

In the 2022 World Drug Report, an analysis was provided for the first time, aimed at estimating the global breakdown of cannabis users by age and sex. This exercise was repeated for 2023, 2024 and 2025. As a basis for these estimates, the global estimated number of past-year users of cannabis in the age group 15-64, as well as global prevalence of past-year cannabis use among 15-64 year-olds and 15-16 year-olds, described above, was used. The starting point was thus the latest global estimate of past-year cannabis users in the age 15-64. The following sequence of steps was taken:

1. These users were divided into males and females based on an estimate of the percentage of women among past year cannabis users estimated previously, based on the household survey data from 64 countries (see below).

2. Further, the margin total for 15-16 year-olds was added on the basis of an estimate of prevalence of cannabis use among this age group globally and the global population data from the World Population Prospects, United Nations Population Division.

3. These were then subsequently subdivided into boys and girls based on a weighted average of proportions of girls among past-year cannabis users in subregions where data was available. In case of Europe, ESPAD study-based proportion of girls among cannabis users (42%) was used. There were a handful of countries with available school surveys data in Africa and the Middle East and their proportion of girls was at a similar level within these subregions, thus their weighted average was used for African region and the subregion of Middle East. North American studies had also reasonably similar

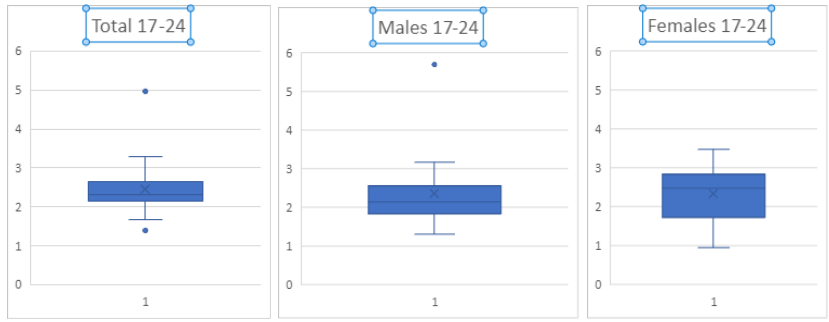
proportions of girls among cannabis users. These proportions were then averaged while weighed by the estimated population of cannabis users living in each region or subregion (estimation procedure is detailed above).

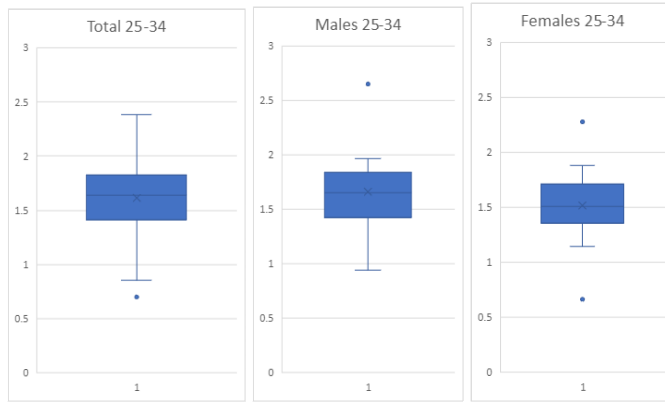
4. The remaining male and female cannabis users aged 17-64 were then further subdivided into more detailed age groups according to age-related coefficients. These coefficients expressed how many times higher is the past-year prevalence of cannabis use among the group aged approximately 17-24 than among those aged 15-64 and how many times higher is the prevalence among 25-34 than among those aged 15-64. The coefficients were gender-specific (calculated separately for males and females), determined as medians of numbers obtained from the data of 18 countries for the age group 17-24 and of 19 countries for the age group 25-34. This step was performed after careful examination that there is not too much variation among the countries (see graphs below). The countries with available data were almost exclusively, with few exceptions from Western and Central Europe and from South and Central America. Tables and graphs below demonstrate the coefficients as well as their distribution in the available data.

Table and Figure. Coefficients of multiplication of cannabis use prevalence among young adults by gender

Coefficients for age group 17-24	
Total	2.3235
Males	2.1452
Females	2.4873

Coefficients for age group 25-34	
Total	1.6420
Males	1.6575
Females	1.5113





5. Applying these coefficients on the global prevalence of cannabis use by gender and the global population size in each age group by sex has led to estimates of male cannabis users in the age group 17-24 and females in the same age group, as well as males and females using cannabis in the past year in the age group 25 to 34 years.

6. Adding up the estimates by gender and subtracting them from the estimate of men and women cannabis users in the age group 17-64 mentioned under step 4 then lead to the estimates for the remaining age group.

Despite the fact that the distribution of age groups in which cannabis use is higher than among the general population is almost universally similar[6], and the same applies to sex to a large extent, there are limitations of the approach taken. Foremost, while sex distribution was obtained as a population-weighted average of data from 64 diverse countries of the world, some subregions were less represented than others (in particular the entire African region). This is even more true about the age distribution which was based on data from 18 - 19 countries, most of which were from subregions of Western and Central Europe and South and Central America.

6 UNODC, World Drug Report 2018, Booklet 4, Drugs and Age: Drugs and Associated Issues among Young People and Older People. (United Nations publication, 2018).

Therefore, there may be differences in the exact age distribution of cannabis use among subregions, which may have led to lack of precision of the present estimated distribution of cannabis use by sex and age. Thus, the estimate of cannabis use prevalence by sex and age needs to be interpreted with caution. Further improvements of the used methodology are likely possible.

Global estimates of the prevalence and number of users by sex and by region and the proportions of people who use selected drugs by sex

National prevalence estimates of the use of cannabis, amphetamines, cocaine, „ecstasy“ and opiates by sex from household surveys were even more scarce than the same estimates for the total population aged 15-64, not disaggregated by sex. Therefore, the approach to obtain them was based on both data sets, total estimates and estimates by sex to maximize the scarce available data.

In the first step, regional estimates by sex were derived using the same methods that were described in the process to obtain total prevalence estimates, separately for males and females (see above). The obtained estimates were then weighted by total regional estimates of the numbers of users. In other words, the male to female ratios obtained in the first step were applied to the total prevalence estimates for each drug and region, under the assumption that the previously obtained total estimates of the numbers of users were methodologically stronger, because they were based on more data. A similar approach was taken to obtain lower and upper bounds of the estimates. In the final step, regional values were summed to obtain global estimates by sex and by drug.

Table. Availability of estimates by sex – number countries with available data points for males and females, by drug and by region

	Cannabis	Cocaine	Amphetamines	„Ecstasy“	Opiates*
Africa	4	5	2	2	3
Americas	20	18	12	13	10
Asia	11	6	9	5	6
Europe	35	34	35	34	28
Oceania	2	2	2	2	1

*Opiates were selected as opposed to total opioids due to the fact that the available studies

These estimates then served as a basis to calculate the proportion of global numbers of people who use drugs who are female and male.

Methodology for the calculation of global prevalence estimate of drug use disorders (DUD)

Data sources

The estimation of the global prevalence of drug use disorders (DUD) relies on multiple sources of data. The data used in the estimation include the number of people in treatment for DUD and the number of people with DUD. These figures are primarily collected through the United Nations Office on Drugs and Crime (UNODC) Annual Report Questionnaire (ARQ). When the data on the number of people with DUD are not available data from national surveys and the estimates produced by the Institute for Health Metrics and Evaluation (IHME), and published through the Global Burden of Disease (GBD) study were used. The data on the number of people in treatment for DUD are complemented with data from European Union Drugs Agency (EUDA) and national and regional reports.

Data Validation

Data on people in treatment for DUD and people with DUD collected through the ARQ and other sources go through a thorough validation process that involves identification of outliers, consistency with previously reported data, consistency with data reported by other countries, direct communication with technical counterparts providing data through the DXP, as well as exploring other sources of data. In addition, once a year, data available through the ARQ and other sources are shared with designated national contacts for the ARQ and Sustainable Development Goals (SDG) – "focal points" for their review. All feedback received by Member States related to these data is then incorporated.

Global estimates

Time series of the rate of DUD, the ratio of the number of people in treatment for DUD and the number of people with DUD for the 2013-2023 period are calculated and the missing values are imputed at the national level, through the following methodology.

1. In the case a country has only one single available data point in the respective series, all missing values are set equal to this single available data point.

2. In the case a country has two to eight available data points in the respective series, the missing values between two data points are estimated by linear interpolation, and if there are missing values that are temporally before (or after) the earliest (or latest) available data point, the values at the beginning (or end) of the series are filled with the earliest (or latest) available data point ("carried over").

3. In the case a country has more than eight available data points in the respective time series, the missing values between two data points are estimated by linear interpolation, and if there are missing values that are temporally before (or after) the earliest (or latest) available data point, the values at the end of the time series are imputed using an exponential smoothing approach.

After this step, the numbers of people with DUD for all countries are estimated as follows

- The number of people with DUD for the countries which have at least one data point is estimated by multiplying the estimated rate of DUD by the population.
- The number of people in treatment for DUD is estimated by multiplying the ratio by the national-level estimate of the number of people with DUD.
- For countries with no available data on DUD, an estimate of DUD is derived by applying the regional ratio of the number of people in treatment to the number of people with DUD to the estimated number of people in treatment.

Finally, the estimates from all relevant countries are aggregated to derive the global estimate of drug use disorders.

Methodology for the calculation of an indicator to evaluate Sustainable Development Goal (SDG) 3.5.1

The general methodology and data sources used are described in the metadata document, available at https://unstats.un.org/sdgs/metadata/files/Metadata-03-05-01.pdf.

The indicator of "treatment coverage" is calculated using the following formula, for the population group of interest in the 15-64 age bracket (i.e., by region and by gender):

$$Coverage_{SUD} = \frac{\text{number of people in treatment for SUD}}{\text{number of people with SUD}} X\ 100$$

Where: SUD – Substance use disorders

Only drug-related substance use disorders are considered in this report.

Regional and sex-disaggregated estimates

Time series of the rate of drug use disorders (DUD), and the ratio of the number of people in treatment for DUD and the number of people with DUD for the 2013-2023 period are calculated and the missing values are imputed at the national level, through the following methodology:

1. In the case a country has only one single available data point in the respective series, all missing values are set equal to this single available data point).
2. In the case a country has two to eight available data points in the respective series, the missing values between two data points are estimated by linear interpolation, and if there are missing values that are temporally before (or after) the earliest (or latest) available data point, the values at the beginning (or end) of the series are filled with the earliest (or latest) available data point ("carried over").
3. In the case a country has more than eight available data points in the respective time series, the missing values between two data points are estimated by linear interpolation, and if there are missing values that are temporally before (or after) the earliest (or latest) available data point, the values at the end of the time series are imputed using an exponential smoothing approach.

After this step, the numerators and denominators for all countries are estimated as follows:

- Estimation of the number of persons with drug use disorders (PDUD) by country (for the countries with at least one available data point), by using the imputed prevalence of PDUD (PDUD/population in 15-64 age group of interest).Estimation of the number of people in drug-related treatment at the national level by multiplying the (imputed or reported) SDG indicator calculated before and multiplying by the estimated number of PDUD this, for all countries that have at least one data point, as described above.

- For countries with no available data on the number of people in treatment, an estimate of this indicator is derived by multiplying number of PDUD with the regional ratio of the number of people in treatment to the number of people with DUD.
- For countries with no available data on DUD/ number of people in treatment , an estimate of DUD is derived by applying the regional ratio of the number of people in treatment to the number of people with DUD to the estimated number of people in treatment.
- The values by region/sex are added up and globally to calculate the global/regional/sex estimates of the SDG indicator and subsequently used to multiply by the estimates of PDUD and obtain a figure for estimated number of people in treatment.

Finally, the numerator (people in treatment) and denominator (PDUD) are separately added over all the relevant countries to obtain regional, global and sex-disaggregated values. The indicator estimates are obtained by computing the ratios of these values.

Proportions of people in drug-related treatment by age group, region, and selected subregions

Treatment registers data reported by age group were used.

In case data were not available for the chosen age brackets based on the annual report questionnaire (less than 18, 18-24, 25-34, 35-64 and 65 and above), the reported age categories were used to estimate the age distribution in the chosen age categories by recalculating of the age groups in a simple linear way. For example, in case of Australia, an age group 30-39 was divided in half to approximately correspond to 30-34 and 35-39 year-olds.

As the USA did not report data by age group, the published results of 'Treatment Episode Data Set-A' (on admissions) for the year 2022 were used. US data is thus based on episodes and not the numbers of treated.

Table. Coverage of reported countries per region and subregion

Region/subregion	Number of included countries
Africa	7
Central America and the Caribbean	9
North America	2
South America	8

Region/subregion	Number of included countries
Central Asia and Transcaucasia	4
East and South-East Asia	6
Near and Middle East, South-West Asia and South Asia	3
Eastern Europe	4
South-Eastern Europe	6
Western and Central Europe	22
Australia and New Zealand	2

Trend in the number of people in drug-related treatment with cannabis as their primary drug of use, Western and Central Europe, 2000-2023

Countries were included in the analysis if their time series did not contain three or more consecutive missing data points with the exceptions of Cyprus (three missing data point in the initial years of the time series) due to the completeness of their remaining data. Following this criterion, it was possible to include 17 countries into the analysis of trend between 2000 and 2023 and 23 countries into the analysis of trend between 2010 and 2023.

The list of the countries included for the period 2000-2009 is as follows: Belgium, Cyprus, Czechia, Denmark, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

The list of the countries included for the period 2010-2022 is as follows: Andorra, Austria, Belgium, Cyprus, Czechia, Denmark, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Norway, Portugal, Slovakia, Slovenia, Spain, Sweden, and United Kingdom.

There still remained some missing data points, which were interpolated in three ways:

1. Interpolation of first one or two data points in a time series was done by using the subsequent existing value to replace the missing value. Three first missing data points were accepted in the analysis for Cyprus due to completeness of the remaining data points.
2. Interpolation of a data point or two data points in-between two existing data points was done using a linear trend function, by applying a geometric mean on the existing data points adjacent to the missing fields.

3. Interpolation of the last data point (in the case of Austria, Cyprus, Czechia, France, Latvia and Spain) in a time series was done by calculating an overall trend between the two last years (2022 and 2023) on the basis of data of the countries which had complete data for both years and multiplying the last existing data point of the respective country (2022 value) by this average trend coefficient.

Altogether, 24% of the data points (120) were interpolated in this way.

Trend in potency and price of cannabis herb (annual average) at the retail level in European Union countries with available data, 2005-2023

Trend of cannabis potency (content of THC in the cannabis herb)

It was possible to include 21 countries into the analysis.

The list of the countries included is as follows: Austria, Belgium, Bulgaria, Croatia, Czechia, Estonia, Finland, France, Hungary, Italy, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Türkiye.

Other countries were excluded from the analysis due to exceeding the selected threshold for missing data points (their time series contained three or more consecutive missing data points).

The remaining missing data points were interpolated in three ways:

1. Interpolation of first one or two data points in a time series was done by using the subsequent existing value to replace the missing value.

2. Interpolation of a data point or two data points in-between two existing data points was done using a linear trend function, by applying a geometric mean on the existing data points next to the missing fields.

3. Interpolation of the last data point in a time series was done by calculating an average trend between the two years (2022 and 2023) on the basis of data of the countries which had complete data for both years and multiplying the last existing data point of the respective country (2022 value) by this average trend coefficient.

Altogether, 5% of the data points (26) were interpolated in this way.

Price of cannabis herb

It was possible to include 13 countries into the analysis of trend for the years 2005-2023.

The list of the included countries was as follows: Belgium, Bulgaria, Croatia, Czechia, Germany, Hungary, Italy, Netherlands, Portugal, Slovakia, Spain, Sweden and Türkiye.

Other countries were excluded due to exceeding the selected threshold for missing data points (their time series contained more than four consecutive missing data points). Only one data set per country – the one with lower number of missing data points was included in the analysis.

The remaining missing data points were interpolated in three ways:

1. Interpolation of first one or two data points in a time series was done by using the subsequent existing value to replace the missing value. In case of two countries (Portugal and Slovakia) the existing value was carried over to the subsequent years with missing data (2010-2012 based on 2009 for Portugal and 2004-2008 based on 2003 for Slovakia).

2. Interpolation of a data point or two data points in-between two existing data points was done using a linear trend function, by applying a geometric mean on the existing data points next to the missing fields.

Altogether, 7% of the data points (16) were interpolated in this way.

Estimates of the number and prevalence of people who inject drugs, HIV and hepatitis (C and B virus) among people who inject drugs (PWID)

Data sources, selection of country estimates and validation process

Population size estimates for PWID, and the prevalence of HIV and hepatitis B and C among PWID, were identified using a comprehensive search of the published peer-reviewed literature, a search of the “grey” literature – essentially national or sub-national reports of size estimation of people who use drugs, and Integrated Biobehavioural Surveillance among key population, from the official United Nations reporting mechanisms of UNODC (ARQ) and UNAIDS (GMP), from regional organizations (particularly the European Drug Agency (EUDA)), civil

society organization and through the global network of UNODC HIV/AIDS team in regional and national office.

The criteria for the selection of country estimates primarily involved the consideration of the methodological soundness of the estimates, determined according to the classification presented in the table below (studies in class A are of higher methodological quality and those in class D of lower quality), with due regard to national geographic coverage, the year of the estimate, and the definition of the target population (global and regional estimates were made for the annual prevalence of injecting among both genders aged 15-64). UNODC, WHO, UNAIDS civil society organizations, a large network of national and international experts reviewed and validated the estimates.

Table. Classification of methodology for people who inject drugs, and those among them living with HIV and hepatitis

Class	*Data on people who inject drugs*
A	Indirect prevalence estimation methods e.g., capture-recapture, network scale-up method, multiplier methods, etc
B1	Mapping/census and enumeration
B2	General population survey
C	Treatment and other national registers of drug users
D1	· Official government estimate with no methodology reported · Experts' judgment with known method of estimation (eg. an estimate obtained through a rapid assessment) · Modelling studies (e.g. Spectrum) · Delphi method or other consensus estimate
D2*	Estimate from non-official source with methodology unknown

Class	*Data on the prevalence of HIV and hepatitis among people who inject drugs*
A	Seroprevalence study
A1	Multi-site seroprevalence study with at least two sample types (e.g. treatment or outreach sample)
A2	Seroprevalence study from a single sample type
B	Registration or notification of cases of HIV infection (e.g. from treatment services)
C	Prevalence study using self-reported HIV
D1	· Official government estimate with no methodology reported · Modelling Studies (e.g. mode of transmission models)
D2*	Estimate from non-official source with methodology unknown

* Data graded D2 are excluded from the dataset

Note: data were categorized here according to a slightly modified classification originally proposed in Mathers et. al. (2008) in a Lancet paper.[7]

As part of a wider review process, every year since 2014, UNODC, WHO and, have reached out to a broad group of experts from academia and regional, international, including civil society, organizations to ensure that a scientific approach to the methodology was used and

7 Mathers, B., L. Degenhardt, et al. (2008). Global epidemiology of injecting drug use and HIV among people who inject drugs: a systematic review. The Lancet 372(9651): 1733-1745

that the greatest number of datasets available worldwide on the subject were included. Data were sent to Member States as part of the prepublication for their validation and potential comments on the selected estimates, or for completion of data if there were national estimates based on surveys or studies that had been conducted and which UNODC was not aware of.

Calculation of regional and global estimates

Regional and global estimates were calculated for the reference year 2023 (as most of the data presented in the World Drug Report 2025 is for the reference year 2023.).

The regional best estimates for the prevalence of injecting drug use, and HIV and hepatitis among PWID, were calculated as the population-weighted means. The global estimates for 2023 were calculated as the population-weighted regional means. In the population-weighting procedure, the population refers to those aged 15-64 years in 2023, in the case of the prevalence of people who inject drugs, or to the estimated number of PWID for the year 2023 in the case of the prevalence of HIV and hepatitis among PWID. For countries where a number (as size estimate) of PWID was reported in the study/survey, a prevalence estimate was subsequently calculated using the population aged 15-64 corresponding to the year of the estimate. For those countries where an estimate of the prevalence of HIV or hepatitis among PWID was available, but a population size estimate for PWID was not, then the regional weighted average prevalence of people who inject drugs was used to produce a population size estimate for PWID that was used in the weighting procedure for the prevalence of HIV and hepatitis among PWID.

Uncertainty intervals for the regional and global best estimates were calculated that reflect both the range in the country prevalence estimates (if these were available) and the regional variability in the available country prevalence estimates. To achieve this, the 10th and 90th percentiles of the known prevalence estimate for countries from within the same region were determined. These were then applied to countries from within the same region for which no estimates were available to give a range of plausible population size estimates. This produced a liberal uncertainty range while excluding the extreme prevalence estimates.

In 2025, the sex disaggregated data points for people who inject drugs and living with HIV were also populated. However, there were not enough data points available of the recent data that would allow estimation of sex-disaggregated regional or global numbers or prevalence of the people who inject drugs and are living with HIV and hepatitis B and C by gender. The sex

disaggregated data points were available for PWID from 23 countries, for HIV among PWID from 63 countries.

These country level data points though have improved since past years. For sex disaggregated estimates, an inclusive approach was adopted to enable the mapping of the availability of reported estimates, their quality, and general trends, for the purpose of informing research, and future reporting.

Data quality of estimates on people who inject drugs and HIV among PWID

- *Interpretation of regional and global estimates*

The global and regional estimates for the prevalence of people who inject drugs and HIV among PWID presented for 2023 in the *World Drug Report* should be viewed as an update to those presented in previous editions of the *World Drug Report* that reflect the latest or the best data available. This year new or updated information on size estimates of PWID was available from 23 countries and on HIV among PWID from 31 countries. The current estimates, changed from the previous year due to new population size estimate of people who inject drugs in the United States and few other small population countries in Africa, but represent the best estimates that can currently be made using the most recent and highest quality data available to UNODC, WHO, UNAIDS, and the World Bank based on data reported by Member States, published or grey literature or through other stakeholders.

- *Quality of national-level data on PWID*

In the current round the data on PWID includes information from 132 countries, of which 18were updated from previous years Overall, of the data from 132 countries on the size estimates or prevalence of PWID, covering 92 of the global population aged 15-64, 61 per cent were of high methodological quality (class A, as defined in the table above) and 84per cent related to recent data from 2015 or later. Nearly one-half (53 per cent) of the countries have information that is from recent, methodologically high-quality surveys. With a low level of coverage of the population aged 15-64 compared to other regions there is limited information on PWID for countries in Oceania (57 per cent) and Africa (64 percent of the data coverage in terms of countries). It is noticeable that there are relatively few recent and methodologically high-quality data from the Americas (20 per cent). However, for the two sub-regions with the highest prevalence of PWID (Eastern and South-Eastern Europe, and Central Asia and

Transcaucasia) there is a very high percentage data coverage of the populations aged 15-64 and approximately one half or more of the estimates are both recent and of high methodological quality.

- *Quality of national-level data on HIV among PWID*

Of the 127 countries with information on the prevalence of HIV among PWID, 24 were updated in the current round. Globally, 72 per cent of the national estimates were of high methodological quality (class A, as defined in the table above) and 71 per cent related to timely data from 2015 or more recently. Information from half of the countries provided was from both recent and methodologically high-quality surveys. The two sub-regions that have by far the highest prevalence of HIV among PWID (South-West Asia, and Eastern and South-Eastern Europe) have prevalence estimates from all countries and from methodologically high-quality surveys from nearly one third of those countries.

Table. Population coverage, timeliness and methodological quality of information from the 132 countries with data on people who inject drugs

Region	Subregion	People who inject drugs		Of countries with available estimates		
		Data coverage of population aged 15-64 in the region	Data coverage in terms of countries	Percentage with recent data (2014 and later)	Percentage with high methodoligcal quality estimes (Class A)	Percentage with both recent and of high methodoligal quality estimates
Africa		**77.9%**	**64%**	**83%**	**53%**	**42%**
	East Africa	61.1%	64%	78%	78%	56%
	West and Central Africa	91.7%	68%	94%	47%	47%
	Southern Africa	62.7%	45%	100%	40%	40%
	North Africa	83.2%	83%	80%	40%	40%
America		**89.9%**	**29%**	**73%**	**27%**	**20%**
	North America	100%	60%	100%	67%	67%
	Caribbean	32.4%	8%	0%	0%	0%
	South America	87.9%	50%	86%	29%	14%
	Central America	56.8%	43%	67%	0%	0%
Asia		**95%**	**71%**	**80%**	**63%**	**51%**
	Central Asia and Transcaucasia	92.4%	88%	71%	86%	57%
	East and South-East Asia	95.4%	74%	79%	57%	50%
	South-West Asia	100%	100%	67%	100%	67%
	Near and Middle East	37.7%	46%	83%	17%	17%
	South Asia	99.9%	83%	100%	80%	80%
Europe		**98.9%**	**84%**	**88%**	**81%**	**69%**
	Eastern Europe	100%	100%	100%	100%	100%
	South-Eastern Europe	100%	100%	78%	89%	67%
	Western and Central Europe	98.2%	78%	90%	76%	66%
Oceania		**70%**	**9%**	**100%**	**100%**	**100%**
Global		**91.8%**	**57%**	**84%**	**61%**	**53%**

Sources for original estimates on PWID: UNODC annual report questionnaire, progress reports of UNAIDS on the global AIDS response (various years), peer-reviewed journal articles, study/survey reports and national government reports.

Table. Population coverage, timeliness and methodological quality of information from the 127 countries with data on the prevalence of HIV among people who inject drugs

Region	Subregion	HIV among PWID		Of countries with available estimates		
		Percentage coverage in terms of number of estimated PWID	Data coverage in terms of countries	Percentage with recent data (2015 and later)	Percentage with high methodoligcal quality estimes (Class A)	Percentage with both recent and of high methodoligal quality estimates
Africa		**84.8%**	**49%**	**71%**	**86%**	**61%**
	East Africa	85.6%	60%	78%	67%	44%
	West and Central Africa	92%	44%	73%	100%	73%
	Southern Africa	61.2%	27%	33%	67%	33%
	North Africa	83.2%	83%	60%	100%	60%
America		**92.3%**	**29%**	**40%**	**67%**	**33%**
	North America	100%	60%	67%	100%	67%
	Caribbean	32.9%	15%	25%	25%	0%
	South America	71.7%	43%	33%	83%	33%
	Central America	33.2%	29%	50%	50%	50%
Asia		**98.2%**	**82%**	**68%**	**78%**	**55%**
	Central Asia and Transcaucasia	92.4%	88%	100%	100%	100%
	East and South-East Asia	98.7%	79%	73%	67%	53%
	South-West Asia	100%	100%	33%	100%	33%
	Near and Middle East	74%	77%	40%	60%	20%
	South Asia	99.9%	83%	80%	100%	80%
Europe		**98.4%**	**82%**	**86%**	**60%**	**45%**
	Eastern Europe	100%	100%	100%	75%	75%
	South-Eastern Europe	100%	100%	78%	78%	56%
	Western and Central Europe	95.7%	76%	86%	52%	38%
Oceania		**70%**	**9%**	**50%**	**100%**	**50%**
Global		**94.8%**	**55%**	**71%**	**72%**	**50%**

Sources for original estimates on HIV among PWID: UNODC annual report questionnaire, progress reports of UNAIDS on the global AIDS response (various years), peer-reviewed journal articles, study/survey reports and national government reports.

Global overview of the proportions of people in drug-related treatment according to the primary drug of concern by subregion and by sex

The presented proportions are based on summary counts by primary drug among persons treated due to drug use in regions and subregions.

Although the coverage of drug treatment data reporting may vary from country to country and thus result in more weight of countries with better coverage of data reporting, the coverage of countries per region was relatively high with few exceptions. The proportions of represented population aged 15-64 by the included countries is tabulated below:

Table. Proportions of represented population aged 15-64 by countries

Africa	68.7%
East Africa	39.5%
North Africa	96.8%
Southern Africa	78.6%
West and Central Africa	70.5%
Americas	97.1%
Caribbean	62.5%
Central America	100%
North America	99.9%
South America	99.8%
Asia	58.1%
Central Asia and Transcaucasia	100.0%
East and South-East Asia	31.9%
Near and Middle East/ South-West Asia	19.9%
South Asia	99.9%
Europe	99.5%
Eastern Europe	100%
South-Eastern Europe	97.4%
Western and Central Europe	99.8%
Oceania	70%
Global population aged 15-64	70%

Not all countries' data were suitable to calculate sex proportions by drug (due to missing data but often also certain drug or drug group not used in a particular country or subregion), therefore, an arbitrary decision was taken to only calculate sub-regional male/female proportions by drug in case half or more countries provided non-zero data for the particular drug.

Some data came from 2019 or earlier (2010 was chosen as a cut-off point beyond which data were considered outdated). In this case, the reporting was done by means of older version of ARQ (Excel files) and the number of male and female clients was not directly reported. However, proportion of females per drug or drug group was given. These proportions were used to derive best estimates of males and females in drug treatment per drug and in total. Therefore, some numbers in the data set were estimates and thus not integers.

Analysis of drug consumption based on the analysis of wastewater

The development of analytical tools and methods for the wastewater analysis took place in recent years in Europe by wastewater research institutes under the umbrella of the SCORE initiative (Sewage Analysis CORe group Europe under the European Cooperation in Science and Technology initiative), originally supported by the European Union under the EU Framework Programme Horizon 2020 and as of 2024 under the auspices of the European Union Drugs Agency. Both EU and non-EU countries, including non-European countries located in South America and Oceania in recent years, participate in this cooperation.

In order to obtain – as far as possible – comparable data, wastewater in various cities has been analysed by the research institutes participating in the SCORE exercise over a one-week period each year in spring. The analysis was done for the main cocaine metabolite (benzoylecgonine) as well as for amphetamine, methamphetamine, cannabis, ketamine and MDMA.

Such wastewater analyses to determine the extent of drug consumption took place in overall more than 240 waste-water treatment sites over the period 2011-2024 participating in the SCORE exercise across the globe, located in more than 175 cities in 41 countries[8].

There is, however, a problem of how to deal with sites which used to report in the past but did not report any longer in recent years. In order to reduce a potential bias in the calculation of recent trends due to missing data, only a subset of these data was used for such a trend analysis of the various drugs in Europe. Only sites which, in principle, agreed to participate in the SCORE exercise of 2024 were included in the trend calculations; such cities happened to be equivalent to cities which reported at least one result over the 2020-2022 period (a similar approach as taken in last year's World Drug Report).

The trend analysis in the 2025 World Drug Report was thus conducted on a subsample of 135 waste-water treatment sites, located in 119 cities in 26 countries of Western, Central and South-Eastern Europe (i.e. in cities of Austria, Belgium, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Italy, Latvia, Lithuania, Netherlands (Kingdom of

8 UNODC calculations based on wastewater data provided by Sewage Analysis CORe group Europe (SCORE).

the), Norway, Poland, Portugal, Slovenia, Slovakia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom).

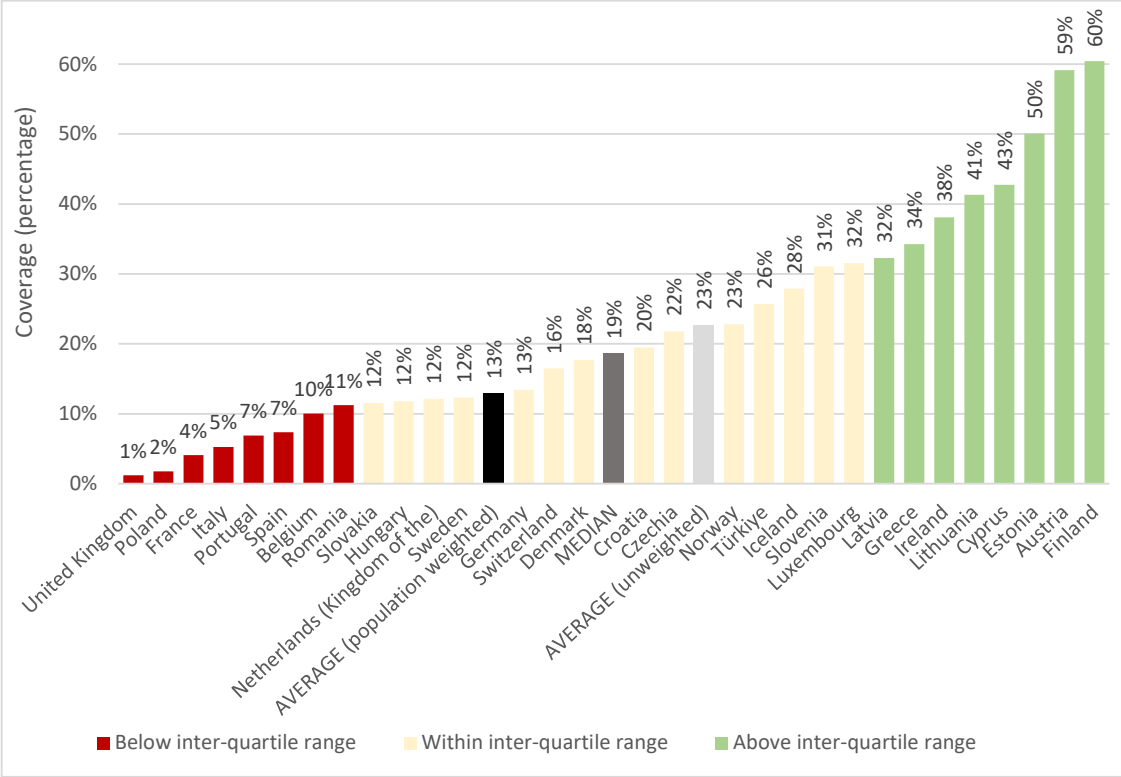
The waste-water sites in the cities participating in this exercise had an aggregate population of 71 million people in 2024; including cities participating in previous years, the total number increases to 79 million people, accounting overall for 13 per cent of the total population of the 30 European countries participating in SCORE in recent years. Nonetheless, the participation in the analysis of drugs in waste-water was in Europe, overall, lower than in the Republic of Korea (>50 per cent of the total population in 2023)[9], Australia (56 per cent of the total population in April 2024)[10] or New Zealand (75 per cent of the total population in 2024).[11]

Participation varied, however, strongly across the European countries, ranging from 1 per cent of the country's total population in the United Kingdom to close to 60 per cent in Finland and Austria, followed by Estonia (50 per cent). The median in Europe amounted to 19 per cent with an inter-quartile range from 13 to 32 per cent.[12]

There was, however, a general increase in the number of waste-water treatment sites providing data over the last decade. The number of waste-water treatment sites providing data on benzoylecgonine in Europe rose, for instance, in recent years from 13 in 2011 to 70 in 2020, 96 in 2023 and 146 in 2024.

9 Ministry of Food and Drug Safety of the Republic of Korea, Estimating drug consumption rates; wastewater-based epidemiology, press release (29 May 2024).
10 Australian Criminal Intelligence Commission, The University of Queensland, University of South Wales, National Wastewater Drug Monitoring Program, (based on data collected in April and June 2024), Report 23 (November 2024).
11 New Zealand Police, National Drugs in Wastewater Testing Programme – Quarter 1, 2024 (June 2024).
12 UNODC calculations based on wastewater data provided by Sewage Analysis CORe group Europe (SCORE) and United Nations, Department of Economic and Social Affairs, Population Division (2024). World Population Prospects 2024, Online Edition.

Figure. Proportion of population covered by waste-water analysis in Europe, 2024 (or latest year available)



Source: UNODC calculations based on wastewater data provided by Sewage Analysis CORe group Europe (SCORE).

The approach used is further exemplified for the case of benzoylecgonine, the main cocaine metabolite found in wastewater. The amount of benzoylecgonine found each day in the waste-water was determined and a daily average was calculated. This is important as cocaine use (similar to the use of MDMA or amphetamine) is typically more widespread during the weekend than during normal weak days. In a subsequent step the size of the population responsible for the wastewater in the respective wastewater catchment areas was determined and the results were shown in terms of average milligrams of benzoylecgonine (a main cocaine metabolite) per day found in waste-water per 1000 inhabitants[13].

Even though the results from the analysis of wastewater have been obtained applying high levels of scientific rigour, the subsequent analysis of the trends at the European level has remained a challenge due to the fact that different cities across Europe took part in this exercise

13 More information about the methodology used to obtain the population-standardized values can be found at: https://score-network.eu/monitoring/ and the graphical presentation of data by city is published under https://www.emcdda.europa.eu/publications/html/pods/waste-water-analysis_en

in different years over the period 2011−2024 and differences of cocaine consumption across European cities continue to be quite significant. This means that the inclusion or the exclusion of a specific city can have a significant impact on the overall average.

Even though the problem in arriving at (reasonable) trend data was alleviated by basing the analysis on a subsample of cities reporting waste-water results in recent years (2022–2024), the problem of missing data did not fully disappear.

In theory, this problem could be overcome by analysing the results of the cities which participated each year in this exercise. However, such results would be based on the results of just a handful of cities and the data from such a limited number of cities are not necessarily a reliable indicator for overall cocaine consumption trends in Europe.

An alternative approach used and shown in the report was to expand the analysis to 152 European cities, having participated in studies analysing bencoylecgonine in wastewater over the period 2022−2024; UNODC included in its calculations only such cities that were geographically located within Europe, i.e., not included were cities being part of European countries located outside of Europe.

Interpolation techniques were used to account for missing data. First, data from the 152 cities were entered as reported from individual cities. In case of data gaps between years it was assumed that there was a gradual increase or decline in per capita results between the two data points (using the Excel function Series, Trend, Growth). In case of missing data at the beginning or at the end of the data series, the latest reported data (from other years) was used to fill the data gaps. This method helped to reduce the bias due to the reporting of additional cities (or the non-reporting of other cities) in specific years while making better use of reported data, thus reducing potential trend distortions.

In order to calculate a European average, first an **unweighted average** was calculated.

Second, the city results were **weighted** by the respective **population living in the respective waste-water catchment areas**. The calculation of an average, weighted by the population living in the various cities (i.e., the population served by the respective sewage system, to be precise) provides a better estimate for the overall cocaine consumption of the population served by the sewage systems of the participating cities. Whether this is, however, a better proxy for overall cocaine consumption among the European population at large is less clear. This would

have been the case if all of Europe had participated in this exercise or if a random selection of sites had taken place. However, the cities participating in the waste-water exercise were not randomly selected, but are based on a convenience sample of European cities expressing their willingness to participate in this exercise. Results at the European level must thus be interpreted with caution.

In the original model used by UNODC, information from all cities was collected. One limitation of this method used was that the more cities not reporting in the latest year(s), the flatter became the resulting curve, potentially under-estimating overall growth (and/or in years of decline, under-estimating the net decline). In order to reduce this bias, trends in the World Drug Reports of recent years, were calculated based on cities which had signalled their readiness to participate in the 2022-2024 SCORE exercises. This limited the number of non-participating cities in recent years.

The method of interpolations used for calculting the **weighted averages** is shown below based on a hypothetical example of data from four cities:

Table. Hypothetical sample - data of benzoylecgonine per 1000 inhabitants in four cities

City	2016	2017	2018	2019	2020	2021	2022	2023	2024
City A	80	78	75	80	92		95	97	100
City B		55	60			85	90		102
City C	150	154			174	180			
City D	140			115	120	125	127	130	135

Table. Interpolation method* used for dealing with missing data for calculating the averages

City	2016	2017	2018	2019	2020	2021	2022	2023	2024
City A	80	78	75	80	92	93	95	97	100
City B	55	55	60	67	76	85	90	90	102
City C	150	154	160	167	174	180	180	180	180
City D	140	131	123	115	120	125	127	130	135

*using Excel Series Growth function for filling in data within a time series and assuming no change after latest year available.

Table. Reported population living in waste-water catchment areas in cities A, B, C, D

City	2016	2017	2018	2019	2020	2021	2022	2023	2024
City A	120,000	125,000	126,000	128,000	130,000				135,000
City B		210,000	215,000			220,000	225,000	225,000	
City C	60,000	65,000			75,000	77,000		80,000	
City D	150,000			170,000	175,000	177,000	180,000	182,000	185,000

Table. Interpolation method* used for estimating population living in waste-water catchment areas in cities A, B, C, D

City	2016	2017	2018	2019	2020	2021	2022	2023	2024
City A	120,000	125,000	126,000	128,000	130,000	131,232	132,476	133,732	135,000
City B	210,000	210,000	215,000	216,654	218,321	220,000	225,000	225,000	225,000
City C	60,000	65,000	68,176	71,506	75,000	77,000	77,000	77,000	77,000
City D	150,000	156,391	163,053	170,000	175,000	177,000	180,000	182,000	185,000

*using Excel growth function for filling in data within a time series and assuming no change after latest year available

Based on these data the population weighted averages can be calculated for the four cities. (i.e. for 2024: (100*135,000+102*225000+180*77,000+135*185,000) / sum (135,000, 225,000, 77,000, 185,000) = 121).

The actual calculation was done in Excel, using for each year the “sumproduct” function for benzoylecgonine found in the four cities and the population in the four catchment areas; the resulting total was then divided by the total population in the four waste-water catchment areas in the respective year to arrive at the average for the respective year.

Table. Calculation of average of benzoylecgonine per 1000 inhabitants in four hypothetical cities

	2016	2017	2018	2019	2020	2011	2022	2023	2024
Average for cities A, B, C, D	95	93	93	96	105	111	113	115	121

Finally, a **paired/chained index** was established which took all city results into account once a city reported data in two subsequent years. i.e., reporting in year x followed by reporting in year x+1. The advantage of this method is that it is based entirely on reported data and does not require any explicit assumptions to be made about missing data. The disadvantage is that it is based on fewer datapoints as it does not cover trends once there has not been any immediately following reporting. Emerging trends from reporting in year x and again in year x+2, or in year x+3, etc. are ignored in this model.

A hypothetical sample is shown below, calculating paired averages to arrive at growth rates and combine the results into a chained index:

Table. Hypothetical sample: data of benzoylecgonine per 1000 inhabitants in four cities

	2016	2017	2018	2019	2020	2021	2022	2023	2024
City A	80	78	75	80	92		95	97	100
City B		55	60			85	90		102
City C	150	154			174	180			
City D	140			115	120	125	127	130	135

Table. Hypothetical sample: calculation of growth rates of paired averages

	City A	City B	City C	City D	Averages (of data in reporting and subsequent year)	Growth rates
2016	80		150	140	115.0	
2017	78	55	154		116.0	1.009
2017	78	55	154		66.5	
2018	75	60			67.5	1.015
2018	75	60			75.0	
2019	80			115	80.0	1.067
2019	80			115	97.5	
2020	92		174	120	106.0	1.087
2020	92		174	120	147.0	
2021		85	180	125	152.5	1.037
2021		85	180	125	105.0	
2022	95	90		127	108.5	1.033
2022	95	90		127	111.0	
2023	97			130	113.5	1.023
2023	97			130	113.5	
2024	100	102		135	117.5	1.035

Table. **Hypothetical sample: Calculation of chained index**

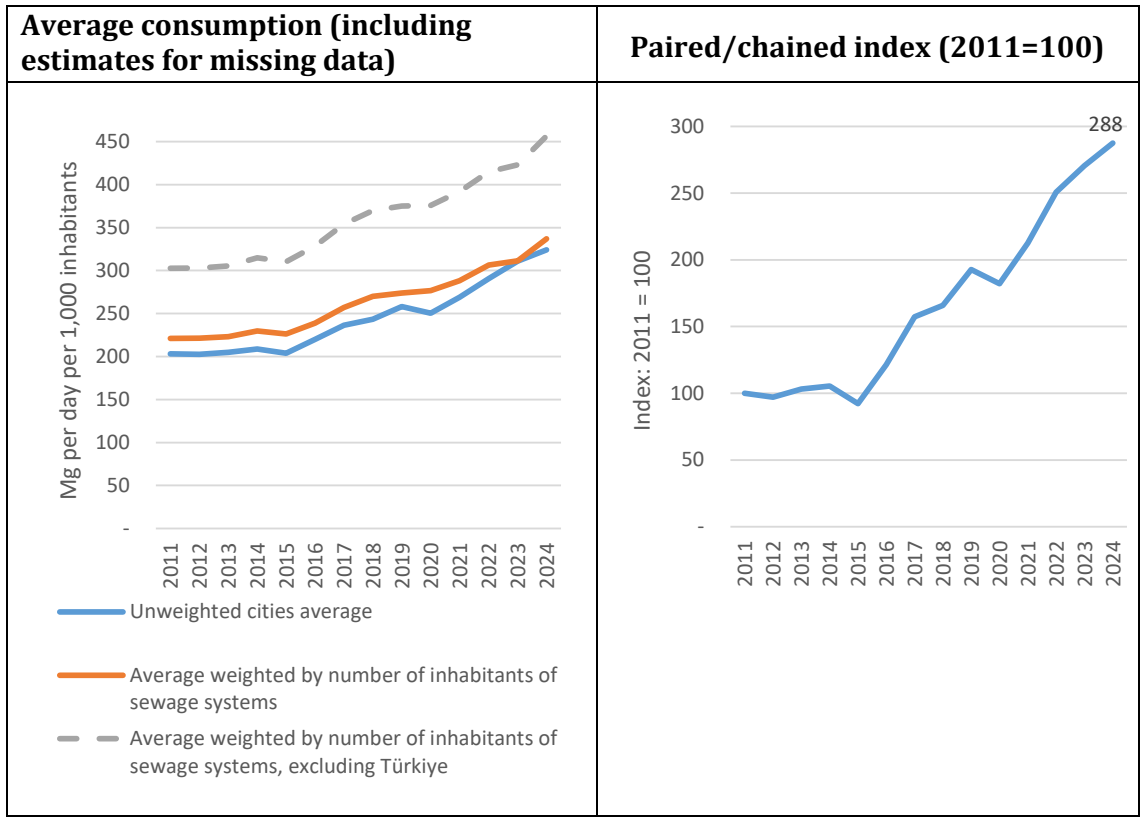
	2016	2017	2018	2019	2020	2021	2022	2023	2024
	100	100*1.009	100.9*1.015	102.4*1.067	109.2*1.087	118.7*1.037	123.2*1.033	127.3*1.023	130.1*1.035
Index	100.0	100.9	102.4	109.2	118.7	123.2	127.3	130.1	134.7

While each of the methods used to identify consumption trends has its merits and its shortcomings, it may be still interesting to note that all calculations of benzoylecgonine in

wastewater in Europe resulted in strong increases. Calculations of a chained index showed even stronger increases.

While cocaine consumption appears to have temporarily stabilized or even declined in 2020, the year of the COVID-19 outbreak in Europe, cocaine consumption increased again strongly in 2021, 2022, 2023 and 2024. It may be also interesting to note that reported quantities of cocaine seized even quintupled in Europe over the period 2011-2021, suggesting that Europe's cocaine consumption might have increased even stronger without the intensification of law enforcement interventions in recent years.

Figure. Benzoylecgonine found in waste-water in Europe, 2011-2024



Source: UNODC calculations based on wastewater data provided by Sewage Analysis CORe group Europe (SCORE).

Wastewater data were also used for the calculation of amphetamine, methamphetamine and MDMA standardized loads (in milligrams per day per 1000 inhabitants) in Europe.

Trend in the treatment for cocaine use disorders (2011-2023)

The trend in the treatment for cocaine use disorders was calculated on the basis of reported numbers of treated persons due to the use of cocaine as their primary drug. Data were available from 36 countries: 23 countries in Western and Central Europe, 6 in Eastern and South-Eastern Europe, and 7 in the Americas. The full list of countries is as follows: Andorra, Austria, Belgium, Bulgaria, Chile, Colombia, Costa Rica, Croatia, Cyprus, Czechia, Denmark, El Salvador, France, Germany, Greece, Hungary, Indonesia, Ireland, Italy, Lebanon, Lithuania, Luxembourg, Malta, Mexico, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Türkiye, Ukraine, United Kingdom of Great Britain and Northern Ireland (the), Uruguay, Venezuela (Bolivarian Republic of). Between approximately 80 000 and 152 000 treated persons in total were included in the analysis each year.

Countries were included solely on the basis of available data with a rule that a maximum of two adjacent data points were allowed to be missing from time series. In other words, countries with three or more adjacent data points missing in their time series were excluded from the analysis with the sole exception of El Salvador (data from years 2011-2013 were missing). Interpolation was used for the missing data points. If one or two data points were missing between other data points, the method used to fill in the data gaps was a geometric mean. If this was the case for the first one or two points in the time series, the first available value was used to fill this gap assuming the numbers were constant between 2011 and 2012 or 2013. The 2023 data points were interpolated on the basis of holding the trend calculated from countries with available data for 2022 and 2023, constant. Altogether, 81 out of 468, or 17.3% of data points were interpolated in this way.

Graph "Trends in indicators of cocaine availability and use, Western and Central Europe and South-Eastern Europe, 2015–2023"

The indices displayed on the graph were calculated on the basis of three data sets published by the European Union Drugs Agency: the treatment demand data set (all persons treated due to cocaine as their primary drug, Table TDI-2022 in EUDA Statistical Bulletin 2025), number of cocaine seizures (Table SZR 1-3-1) and mean retail-level cocaine HCL purity (Table PPP- 01-1-1-1-5-3).

Data on countries were only included if less than three data points in a row were missing. These time series were available for 27 countries in the case of cocaine purity and seizures and 30 countries in the case of cocaine treatment. The missing data were replaced by UNODC data after confirming that the data come from the same time-series or interpolated. Interpolation of first one or two data points in a time series was carried out by using the subsequent existing value to replace the missing value ("carry backwards"). Interpolation of a data point or exceptionally two data points in-between two existing data points was done using a linear trend function, by applying a geometric mean on the existing adjacent data points. Interpolation of the last data point in a time series was done by calculating a pooled trend between the two years (2022 and 2023) on the basis of data of the countries which had complete data for both years and applying the trend factor to the 2023 data point of the respective country to obtain an estimate for 2022. In the cocaine purity data set, 2.9% of the data points were interpolated in this way (7 data points; 2 in the beginning of the data series, 5 in the middle of existing data points and none for the latest year (2023). In the number of cocaine seizures data set, 4.9% of the data points were interpolated in this way (11 data points; 8 in the beginning of the data series, 4 in the middle of existing data points and none for the latest year (2023). In the number of persons in cocaine-related treatment data set, 4.4% of the data points were interpolated in this way (12 data points; 8 in the middle of existing data points and 4 for the latest year (2023).

3. Drug cultivation, production and manufacture

Data on cultivation of opium poppy and coca bush and production of opium and coca leaf for the main producing countries (Afghanistan, Myanmar, Mexico and the Lao People's Democratic Republic, for opium; and Colombia, Peru and the Plurinational State of Bolivia for coca) are mainly derived from national monitoring systems supported by UNODC in the framework of the Global Illicit Crop Monitoring Programme (ICMP). The detailed country reports can be found on the UNODC website https://www.unodc.org/unodc/en/crop-monitoring/index.html

UNODC supported monitoring systems in most of these countries following UNGASS 1998, which became operational over the 2000-2002 period. Opium cultivation and production estimates are basically available up to the year 2024.

The preliminary opium poppy cultivation data for 2023, published in last year's World Drug Report 2024, were revised as new information became available and some country results were revised. Nonetheless, these are still preliminary figures as data from a number of countries have not as yet been available. Preliminary opium poppy cultivation estimates for 2024 – 100,010 hectars at the global level – must thus still be interpreted with caution.

These estimates are based on new information received from Afghanistan and Myanmar, the two countries responsible for the bulk of the global area in recent years and on the assumption that the overall area under poppy cultivation in the other countries may not have changed significantly. The latest official data from the next largest opium producer, Mexico, are those for 2019/2020; preliminary unofficial data for Mexico for 2020/21 and 2021/22 are used for the establishment of the global totals in subsequent years, including the global estimates for 2024; they will, of course, change once the Mexican estimates for 2023/24 will have been received. Opium poppy cultivation data for the Lao PDR for 2024 are also still missing; 2023 data have been used – for the time being – as a proxy.

Opium poppy cultivation in countries which do not conduct area surveys, was estimated with an indirect method (see below).

Preliminary estimates suggest that global opium production in 2024 amounted to some 1,980 tons, thus remaining de-facto unchanged from a year earlier (1,960 tons), reflecting increases in Afghanistan which were largely compensated by declines reported from Myanmar. In any case, they were clearly down from opium production estimates for 2022 (7,590 tons) or 2021 (7,850 tons).

It may be also interesting to compare these estimates to earlier estimates though a comparison of opium poppy cultivation and opium production with estimates from previous decades, notably those reported for periods prior to World War II are rendered difficult as the methodologies then used differ from the methodologies used nowadays. Opium production estimates are nowadays mainly derived from an analysis of satellite photos for the analysis of the area under cultivation which is then multiplied with the respective yields of opium per hectare found in specific regions, as derived from detailed yield surveys. In contrast, opium production estimates at the turn of the 19th to the 20th century were mainly derived from a detailed analysis of tax payments and other levies of opium poppy farmers to the authorities.

Such global opium production estimates reported in the proceedings of the Shanghai Opium Commission, 1909, revealed e.g. a global opium production of 41,600 tons of opium for the period 1906/07.[14] For the year 1934 official reports by the League of Nations saw a global opium production of some 16,600 tons [15] falling – based on preliminary estimates by the International Narcotics Control Board (INCB) to 253 tons by 2024.

A direct comparison, however, may be misleading. Comparisons are complicated by the fact that the legal status of opium production was not always clear in the 19th century and the early decades of the 20th century, i.e. data reported usually comprised both legal and illegal production of opium. Thus, long-term comparisons should be made with estimates for legal and illegal opium production combined.

The calculations must also take into account that much of the licit source of morphine production nowadays is in the form of poppy straw rather than in the form of opium as such.

Preliminary estimates suggest that a total of 118,267 ha may have been under (licit) poppy straw cultivation in 2024, far more than under licit opium cultivation (5,880 ha). Such licit cultivation together totalled some 124,100 ha and thus turned out to have been higher than current illicit cultivation of some 100,100 ha in 2024. This suggests that the illicit opium poppy cultivation accounted for some 45 per cent of the total area under illicit and licit cultivation of opium and poppy straw in 2024, down from around two thirds (or more) of the total in 2022 and previous years.

Alternatively, production of harvested opium straw may be converted into an estimate of opium equivalents. One possibility is to calculate the morphine produced out of the poppy straw (published in the INCB Narcotics Reports) and then to find out how much opium would have been needed to produce such amounts of morphine. This can be done based on the reported ratios of the actual morphine manufactured out of opium at the global level, again reported in the INCB Narcotics Report.

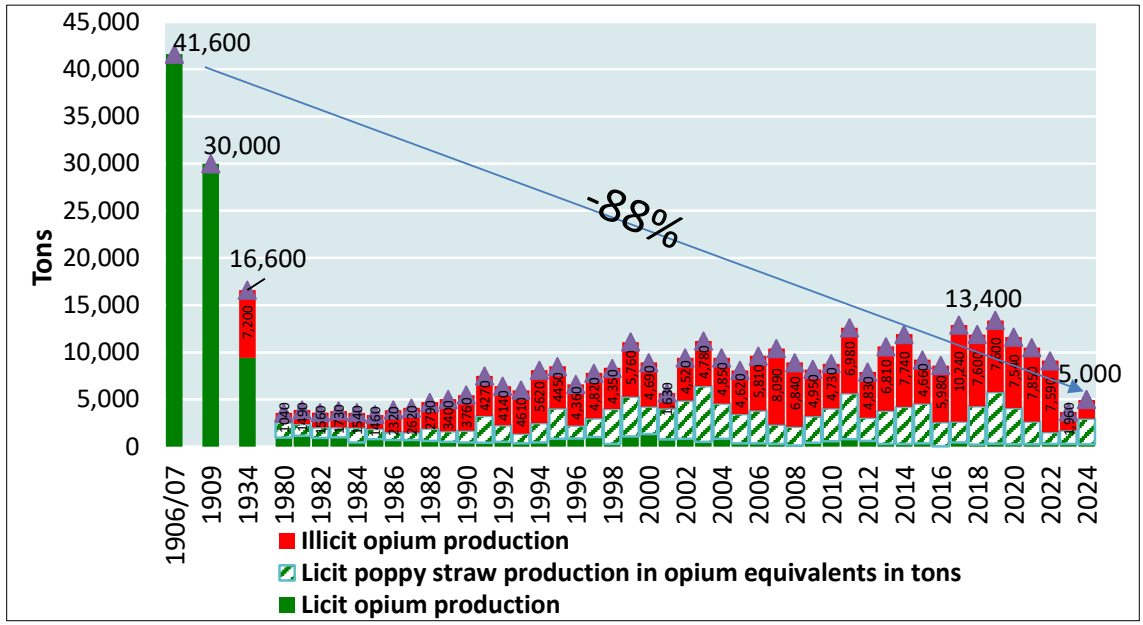
14 UNODC, A Century of International Drug Control, 2009), based on data reported by the International Opium Commission (Report of the International Opium Commission, Shanghai, China), Feb. 1909.
15 UNODC, A Century of International Drug Control, 2009.

Calculations suggest that such global production of harvested opium straw (used for the manufacture of heroin (based on preliminary estimates) may have amounted to 2,726 tons, expressed in opium equivalents in 2024.

This means that the total licit production of (morphine related) opiates (production of opium plus production of poppy straw intended for morphine manufacture), was equivalent to some 3,000 tons in 2024 (2,726+253 tons = 2,979 tons, rounded 3,000 tons) expressed in opium equivalents. Illicit opium production (some 1,980 tons) would have been thus equivalent to some 40 per cent of all illicit and licit opium production (opium and poppy straw production, expressed in opium equivalents) in 2024 (some 5,000 tons), the second lowest figure over the last two decades. An even lower figure was only reported for 2023 (some 3,700 tons).

Figures for 2024 are, nonetheless, significantly lower than the opium production estimates reported for the year 1906/07 (41,600 tons of opium) and clearly lower than the licit and illicit opium production estimates reported for the year 1934 (16,600 tons) or for the most recent peak in 2019 (13,400 tons).

Figure. Global opium production, 1906-2024



Sources: UNODC calculations based on Report of the International Opium Commission, Shanghai, China, Feb. 1909, Vol. II, INCB, *Narcotic Drugs 2024 - Estimated World Requirements for 2025 – Statistics for 2023* (and previous years), UNODC, A Century of International Drug Control (2009), UNODC, *World Drug Report 2024 (and* previous years).

Coca cultivation estimates in the three main Andean coca producing countries were available – at the time of drafting the World Drug Report - up to the year 2023 for Colombia, Peru and

the Plurinational State of Bolivia. Results for the year 2024 will be published on UNODC's website as soon as the new reports will have been released.

There are no new cultivation or production estimates for cannabis. Estimates of **cannabis cultivation** in 2009, 2010, 2011 and 2012 in Afghanistan, as well as cannabis cultivation in 2003, 2004 and 2005 in Morocco, were produced by the UNODC-supported national monitoring systems and can be found on the UNODC website. In addition, UNODC published in 2022 estimates of 6 major cannabis producing states in Nigeria for the year 2019. These estimates showed a total of 8,900 ha under cannabis cultivation. These estimates were thus lower than previous estimates for Morocco (72,000 ha for 2005), though within the range of the estimates published for Afghanistan (7,000-14,000 ha for 2012). Estimates for other countries were drawn from ARQ replies and various other sources, including reports from Governments, UNODC field offices and the United States Department of State's Bureau for International Narcotics and Law Enforcement Affairs.

All of these reports are, however, not sufficient to provide any reasonable current global estimates of cannabis cultivation and production. They are, however, sufficient to state – in combination with other indirect indicators (such as eradication, seizures of cannabis plant, reports on the origin of cannabis, etc.) - that the cultivation of cannabis is almost universal and that it took place in at least 150 countries over the last decade, ie. in more countries than the cultivation of opium poppy (52 countries) or of the coca leaf (9 countries).

A full technical description of the methods used by UNODC-supported national monitoring systems can be found in the respective national survey reports available at https://www.unodc.org/unodc/en/crop-monitoring/index.html

Net cultivation

Not all the fields on which illicit crops are planted are actually harvested and contribute to drug production. For Afghanistan, a system of monitoring opium poppy eradication was in place until 2021 which provided all necessary information to calculate the net cultivation area. Given the political changes this country, the calculation of a net area under cultivation, however, was no longer possible for 2022, though actually reported eradications in that year as well as year earlier (some 42 ha out of 177,000 ha cultivation in 2021 and a similarly small proportion in 2022) were so small that they did not really affect comparability with previous years cultivation estimates.

In Myanmar and the Lao People's Democratic Republic, only the area of opium poppy eradicated before the annual opium survey is taken into account for the estimation of the cultivation area. Not enough information is available to consider eradication carried out after the time of the annual opium survey. The overall area eradicated, however, tends to be rather small and so is the potential impact on the overall calculations of eradication for the latter two countries. The identified area under opium poppy cultivation in Myanmar was 45,200 ha for 2024 while the area eradicated amounted to 2,502 ha in that year. The net cultivation area – depending on the time eradication was actually taken place – could have been thus 0 to 1,502 ha or 0 to 5.5 per cent less than the area reported for opium poppy cultivation. Such a figure, however, would still fall well within the overall error margins of the reported area under opium poppy for Myanmar (30,900 – 73,700 ha in 2024).

The situation is different for Mexico. No new data on Mexico are presented here as no new estimates have been, so-far, authorized by the authorities to be published. Data presented here related to the area sown with opium poppy (24,100 ha) in the season 2019/20. Based on official data provided by the authorities, 11,747 ha of the area under opium poppy cultivation were destroyed in Mexico in 2020 (and a figure of similar magnitude over the 2019/20 period), and thus a far higher proportion than in Afghanistan or Myanmar.

A major difference between coca and other narcotic plants such as opium poppy and cannabis is that the coca bush is a perennial plant which can be harvested several times per year. This longevity of the coca plant should, in principle, make it easier to measure the area under coca cultivation. In reality, the area under coca cultivation is dynamic, making it difficult to determine the exact amount of land under coca cultivation at any specific point in time or within a given year. There are several reasons why coca cultivation is so dynamic, including new plantation, abandonment, reactivation of previously abandoned fields, manual eradication and aerial spraying.[16]

The issue of different area concepts and data sources used to monitor illicit coca bush cultivation was repeatedly investigated by UNODC.[17] To improve the comparability of estimates between countries and years, since 2011 net coca cultivation area at 31 of December

16 Plant disease and pests are not considered here as their impact is likely to be captured in the coca leaf yield estimates.
17 See World Drug Report 2011, p. 262.

is presented not only for Colombia but also for Peru. For technical reasons, the initial area measurement of coca fields takes place on satellite images acquired at different dates of the year and sometimes having different technical specifications. For the Plurinational State of Bolivia, in contrast, most satellite images are taken close to the 31 of December in order to reduce potential errors linked to subsequent eradication. In any case, for the Bolivian and Peruvian estimate, these differences are considered to have a limited effect only, whereas the dynamic situation in Colombia requires more adjustments to maintain year-on-year comparability. For more details, please see the country specific reports.

Indirect estimation of illicit opium poppy cultivation

For a number of countries no systematic opium poppy cultivation surveys exist; still there is evidence of some opium poppy cultivation taking place in these countries. Eradication and plant seizure reports, e.g. indicate that illicit opium poppy cultivation exists in such countries. Therefore, starting 2008, a methodology was established and introduced to estimate the likely extent of this illicit cultivation with an indirect method based on two indicators available in UNODC's databases: eradicated poppy area and opium poppy (plant, capsule) seizures reported as units or weight.

Prioritization of data sources: Whenever possible, the eradicated poppy area was used as this indicator is conceptually closest. If this indicator was not available, poppy plant seizure data was used, which requires an additional conversion of the seized amount into area eradicated. It can be assumed that plant seizures are often a different way of recording eradication. e.g. in cases where area measurements are technically difficult or because the law requires all seized material to be weighed even if the seizure consists actually of eradicated plants on a field. Large-scale or long-distance illicit trade with opium poppy plants is unlikely as the plants are bulky, perishable and of low value.

Eradication factor: Evidence from countries which provide both illicit cultivation and eradication data indicates that illicit cultivation is typically a multiple of the area eradicated. This relationship, averaged over the last five years for which information is available, was used to calculate a factor which allowed to estimate illicit cultivation in countries from eradication figures. Since 2008, this factor is based on opium poppy cultivation and eradication data from Colombia, Lao People's Republic, Mexico, Myanmar, Pakistan, Thailand and Guatemala. Over

the years, the average over these five countries ranged between 2.1 and 3.7 (eradicated area * factor = net cultivation area). (Afghanistan was not considered for the calculation of the factor as the objective was to estimate low to mid-levels of illicit cultivation. Afghanistan, representing two thirds or more of global illicit poppy cultivation, clearly fell outside this range).

Plant seizures: seizures of poppy plant material usually happen close to the source, i.e. in vicinity of the cultivated area. The data available to UNODC does not allow to accurately and systematically differentiate between the various parts (capsules, bulbs, entire plants) of the plant seized as for plant seizures. Most (roots, stem, leaves, capsules) or only some parts (poppy straw, capsules only) of the plant may be seized. While this does not influence seizure data given in plant units, it plays a role when interpreting seizure data given as weight

Plant seizure data in units represent plant numbers, which can be converted into area (ha) using an average number of opium poppy plants per hectare. Yield measurements from Afghanistan and Myanmar, where UNODC has conducted yield surveys over several years, indicate an average figure of about 190,000 plants per hectare. Dividing poppy plant seizure numbers by this factor results in estimate of the area on which the seized material was cultivated. This is equivalent to eradicated area, as the seized material was taken out of the production cycle. Eradicated area multiplied with the eradication factor described above yields then cultivation area.

Plant seizure data reported as weight: In order to convert the weight of seized poppy plants into area, a typical biomass per hectare of poppy was estimated based on the evaluation of various sources. The biomass yield in oven-dry equivalent including stem, leaves, capsule and seeds reported by a commercial licit opium poppy grower in Spain[18] was 2,800 kg/ha for rain-fed and 7,800 kg/ha for irrigated fields respectively. Information on the weight of roots was not available. Loewe[19] found biomass yields between 3,921 kg/ha to 5,438 kg/ha in trial cultivation under greenhouse conditions. Acock et al.[20] found oven-dry plant weights of about 37 grams including roots in trials under controlled conditions corresponding to a biomass yield

18 Personal communication, 2010, from Alcaliber company.
19 Personal communication, 2010, see also Loewe, A. (2010). Remote Sensing based Monitoring of Opium Cultivation in Afghanistan. Philosophische Fakultaet. Bonn, Rheinische Friedrich-Wilhelms-Universitaet: 106.
20 Acock, M. C., R. C. Pausch, et al. (1997). "Growth and development of opium poppy (Papaver Somniferum L.) as a function of temperature." Biotronics 26: 47-57.

of around 7,000 kg/ha with the assumed plant density of 190,000/ha. Among the available biomass measurements only the figures from Spain referred to poppy grown under field conditions. All other results fell into the range between the non-irrigated and irrigated biomass yields (2,800 – 7,800 kg/ha) reported. For purposes of this calculation the simple average of these two values was taken.

Two caveats have to be made: a) As the reporting format does not differentiate between capsules and plants or between the different growth stages of a poppy plant, it was assumed that the reported weight refers to whole, mature plants. This leads to a conservative estimate as many plant seizures are actually carried out on fields before the poppy plants reach maturity. b) The reference biomass measurements from scientific studies are expressed in oven-dried equivalents, whereas the reported weights could refer to fresh weight or air-dry weight; both of which are higher than the oven-dry equivalent weight equivalent. This would lead to an over-estimation of the illicit cultivation area. In the case of young plants, which are typically fresh but not yet fully grown, both errors could balance off, whereas in the case of mature or harvested plants, which tend to be drier, both errors would be smaller.

In order to avoid the fluctuations typically present in seizure and eradication data, the above calculations were based on plant seizures averaged over the most recent five-year period, rather than datapoints relative to the specific year. If no eradication or plant seizure was reported in that period, no value was calculated.

Yield and production

To estimate potential production of opium, coca leaf and cannabis (herb and resin), the number of harvests per year and the total yield of primary plant material has to be established. The UNODC-supported national surveys take measurements in the field and conduct interviews with farmers, using results from both to produce the final data on yield. [21]

Opium yield surveys are complex. Harvesting opium with the traditional lancing method can take up to two weeks as the opium latex that oozes out of the poppy capsule has to dry before harvesters can scrape it off and several lancings take place until the plant has dried. To avoid

21 Further information on the methodology of opium and coca leaf yield surveys conducted by UNODC can be found in United Nations (2001): Guidelines for Yield Assessment of Opium Gum and Coca Leaf from Brief Field Visits, New York (ST/NAR/33).

this lengthy process, yield surveyors measure the number of poppy capsules and their size in sample plots. Using a scientifically developed formula, the measured poppy capsule volume indicates how much opium gum each plant potentially yields. Thus, the per hectare opium yield can be estimated. Different formulas were developed for South-East and South-West Asia. In Afghanistan, yield surveys are carried out annually; in Myanmar regularly.

For coca bush, the number of harvests varies, as does the yield per harvest. In the Plurinational State of Bolivia and Peru, UNODC supports monitoring systems that conduct coca leaf yield surveys in several regions, by harvesting sample plots of coca fields over the course of a year, at points in time indicated by the coca farmer. In these two countries, yield surveys are carried out only occasionally, due to the difficult security situation in many coca regions and because of funding constraints. In Colombia, coca leaf yield estimates are updated yearly through a rotational monitoring system introduced in 2005 that ensures that every yield region is revisited about every three years. However, as the security situation does not allow for surveyors to return to the sample fields, only one harvest is measured, and the others are estimated based on information from the farmer. In 2013 for the first time the concept of productive area was applied to calculate the coca leaf yields in Colombia, taking into account the dynamics of the fields due to spraying and eradication for which some fields are only partly productive during the year. This way of calculating was retroactively applied to the results of 2005-2012, giving slightly different results than published in previous years [22]. In Peru and the Plurinational State of Bolivia the additional production of partly productive areas is not considered for the coca leaf yield estimates.[23]

Conversion factors

The primary plant material harvested - opium in the form of gum or latex from opium poppy, coca leaves from coca bush, and the cannabis plant - undergo a sequence of extraction and transformation processes, some of which are done by farmers onsite, others by traffickers in clandestine laboratories. Some of these processes involve precursor chemicals and may be done

22 More information on the results of the methodology used can be found in the report on coca cultivation in Colombia for 2013 (UNODC/ Government of Colombia, June 2014) available on the internet at http://www.unodc.org/unodc/en/crop-monitoring/index.html.
23 In 2013 a correction factor was applied for the time that fields in Peru were productive during the year, however this approach was abolished as of 2014 due to incomplete eradication data. More information about the 2013 calculation to be found at page 73 of the Peru coca cultivation survey report for 2013 available on the internet at http://www.unodc.org/unodc/en/crop-monitoring/index.html.

by different people in different places under a variety of conditions, which are not always known. In the case of opium gum, for example, traffickers extract the morphine contained in the gum in one process, transform the morphine into heroin base in a second process, and finally produce heroin hydrochloride. In the case of cocaine, coca paste is produced from either sun-dried (in the Plurinational State of Bolivia and Peru) or fresh coca leaves (in Colombia), which is later transformed into cocaine base, from where cocaine hydrochloride is produced.

The results of each step, for example from coca leaf to coca paste, can be estimated with a conversion factor. Such conversion factors are based on interviews with the people involved in the process, such as farmers in Colombia, who report how much coca leaf they need to produce 1 kg of coca paste or cocaine base. Tests have also been conducted where so-called ‘cooks’ or ‘chemists’ demonstrate how they do the processing under local conditions. A number of studies conducted by enforcement agencies in the main drug-producing countries have provided the orders of magnitude for the transformation from the raw material to the end product. This information is usually based on just a few case studies which are not necessarily representative of the entire production process. Farmer interviews are not always possible due to the sensitivity of the topic, especially if the processing is done by specialists and not by the farmers themselves. Establishing conversion ratios is complicated by the fact that traffickers may not know the quality of the raw material and chemicals they use, which may vary considerably; they may have to use a range of chemicals for the same purpose depending on their availability and costs; and the conditions under which the processing takes place (temperature, humidity, et cetera) differ.

It is important to take into account the fact that the margins of error of these conversion ratios – used to calculate the potential cocaine production from coca leaf or the heroin production from opium - are not known. To be precise, these calculations would require detailed information on the morphine content of opium or the cocaine content of the coca leaf, as well as detailed information on the efficiency of clandestine laboratories. Such information is limited. This also applies to the question of the psychoactive content of the narcotic plants.

UNODC, in cooperation with Member States, continues to review coca leaf to cocaine conversion ratios as well as coca leaf yields and net productive area estimates.[24] More research, however, is needed to establish comparable data for all components of the cocaine production estimate.

Many cannabis farmers in Afghanistan and Morocco conduct the first processing steps themselves, either by removing the upper leaves and flowers of the plant to produce cannabis herb or by threshing and sieving the plant material to extract the cannabis resin. The herb and resin yield per hectare can be obtained by multiplying the plant material yield with an extraction factor. The complex area of cannabis resin yield in Afghanistan was investigated in 2009, 2010, 2011 and 2012. The yield study included observation of the actual production of resin, which is a process of threshing and sieving the dried cannabis plants. In Morocco, this factor was established by using information from farmers on the methods used and on results from scientific laboratories. Information on the yield was obtained from interviews with cannabis farmers.[25] Given the high level of uncertainty and the continuing lack of information for the large majority of cannabis-cultivating countries, estimates of global cannabis herb and resin production are not calculated.

"Potential" production versus "actual production"

'Potential' heroin or cocaine production refers to total production of heroin or cocaine if all the cultivated opium or coca leaf, less the opium and coca leaf consumed as such, were transformed into the end products in the respective producer country in the same year. Direct consumption of opium or the coca leaves being taken into account. Thus, for example, consumption of coca leaf considered licit in the Plurinational State of Bolivia and Peru is deducted from the amounts of coca available for the transformation into cocaine. Similarly, opium consumed in Afghanistan and neighbouring countries is deducted from the amounts of opium available for heroin production.

In contrast, opium stocked or opium used from stocks accumulated over previous years is not considered in the calculation of 'potential' heroin manufacture though it may have a significant

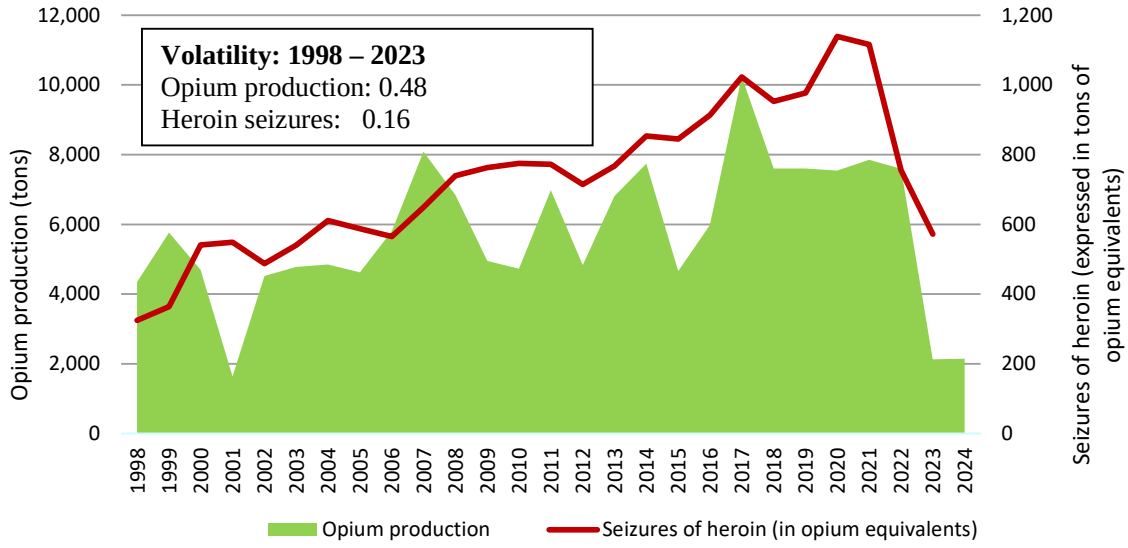
24 More detailed information on the ongoing review of conversion factors was presented in the 2010 World Drug Report, p.251 ff.
25 For greater detail on studies with cannabis farmers, see: UNODC, Enquête sur le cannabis au Maroc 2005, Vienna, 2007.

impact on ‘actual’ heroin manufacture. Similarly, none of the coca leaf harvested in a previous year is taken into consideration when it comes to the manufacture of cocaine. This is less of a problem for the coca leaf, but it should be noted that opium can be stored for extended periods of time and converted into intermediate or final products long after the harvest year. Thus ‘actual’ heroin manufacture, making use of accumulated stocks of opium from previous years, can deviate significantly from ‘potential’ heroin manufacture out of the opium produced in a specific year.

While global opium production shows strong year-on-year fluctuations (standard deviation of percentage changes on a year earlier: 0.48 over period 1998-2023), global heroin seizures tend to remain rather smooth (standard deviation of percentage changes on a year earlier: 0.16 over period 1998-2023). This suggests that there may be a rather constant year-on-year output in the manufacture of heroin, i.e. the development of ‘actual’ heroin manufacture (in contrast to the calculation of ‘potential’ global heroin manufacture, derived from opium production in a specific year) is probably rather smooth.

This also means that an average number of calculated ‘potential’ heroin manufacture over a few years (e.g. over a period of 5 years) may turn out to provide a more realistic estimate of the ‘actual’ amounts of heroin manufactured in a specific year than the calculated ‘potential’ heroin manufacturing estimate for a specific year.

Figure. Global opium production and heroin seizures, 1998–2023/24



Sources: UNODC, opium surveys; UNODC, responses to the annual report questionnaire; and other Government sources

This is of significance in years when opium production is either rather high or rather low as compared to other years (as was the case in 2016, 2023 or 2024) while the differences are far less pronounced in years when opium production has been close to average (such as in 2020, 2021 or 2022).

It should be also noted that opium and coca leaf seizures are not taken into account in the calculation of potential global heroin or cocaine manufacture. This tends to be more of an issue for opium than for the coca leaf. It tends to over-estimate the actual amount of opium available for the manufacture of heroin as opium seized (close to the areas of its production) is, in fact, no longer available for the manufacture of heroin. In 2023 global opium production amounted to 2,130 tons while opium seizures amounted to 471 tons. This is far from being negligible (equivalent to 22 per cent of global opium production).

As discussed above, an estimate of potential manufacture of heroin also does not take into account previous years' opium being used for the manufacture of heroin or the stockpiling or clearance of stocks of opium in a specific year. Given rather stable opium production levels over the period 2018–2022, changes in stocks are unlikely to have affected, to any significant extent, heroin manufacture in these years. Estimated 'potential' manufacture of heroin in those years seems to have been a rather good proxy for "actual" manufacture of heroin (estimated at 460-690 tons in 2022, or, on average, 471-717 tons over the 2018-2022 period). In contrast, potential heroin estimates for 2017 (677-1,017 tons) have been - most likely - significant "over-estimates" and those for 2023 (193-207 tons) and for 2024 (193-211 tons) significant "under-estimates" of "actual" heroin manufacture in these years as opium stocks were either built up (case of 2017) or depleted (cases of 2023 and 2024) to smooth "actual" manufacture of heroin in these years.

UNODC estimates suggest that by the end of 2022 opium stocks accumulated in Afghanistan came up to some 13,200 tons (11,600-14,800 tons), equivalent to 1.8-2.3 times the pre-ban annual harvests. Taking into account plausible ranges in annual consumption of Afghan opiates, it is possible that stocks in Afghanistan could have been enough for at least until the end of 2025 or 2026[26] to allow global heroin manufacture to clearly exceed the calculated "potential" totals of heroin manufacture for 2023 (193-207 tons) and 2024 (193-211 tons),

26 UNODC, Afghanistan Drug Insights Volume 4, Drug Trafficking and Opiate Stocks, (January 2025).

derived from actual opium production in these years, though probably still turning out less heroin than what was reported for 2022 (460-690 tons) or previous years.

Purity of potential production estimates

For cocaine, potential production of 100 per cent pure cocaine is estimated. In reality, clandestine laboratories do not produce 100 per cent pure cocaine but cocaine of lower purity which is often referred to as ‘export quality’.

For **heroin**, in contrast, estimates at the global level are based on ‘export quality’ purity. Apart from Afghanistan, not enough information is available to estimate the production of heroin at 100 per cent purity. Instead, potential production of export quality heroin is estimated, whose exact purity is not known and may vary. For Afghanistan, the calculations are more detailed. Here the share of all opium converted to heroin is estimated and a specific conversion ratio is applied, which uses an estimated purity for heroin of export quality, derived from wholesale purities found in other countries in the neighbourhood.

Although it is based on current knowledge on the alkaloid content of narcotic plants and the efficiency of clandestine laboratories, it should be noted that ‘potential production’ remains a hypothetical concept and is – except under specific circumstances – not a reliable estimate of “actual” heroin or cocaine production at the country or at the global level.

The concept of potential production is also different from the theoretical maximum amount of drug that could be produced if all alkaloids were extracted from opium and coca leaf. The difference between the theoretical maximum and the potential production is expressed by the so-called laboratory efficiency, which describes which proportion of alkaloids present in plant material clandestine laboratories are actually able to extract.

Country-specific estimates

Colombia

From 2013 onwards, the yearly ‘productive’ areas were estimated, instead of using the average area under coca cultivation of the reporting year and the previous year (the approach used in previous reports). In addition, a different conversion factor for estimating cocaine base was

applied. Both the adjustment of the productive area estimate and the estimation of the conversion factor for cocaine base were retroactively applied to the results of 2006-2012.[27]

In 2019, the overall conversion ratios from coca leaf production to the manufacture of cocaine hydrochloride in Colombia were again reviewed and the results of this review were retroactively applied to the results from Colombia for the years 2014 to 2018. This review became necessary as due to changes in the overall political context of the country, farmers – often without in-depth knowledge of chemistry – got increasingly involved in the manufacture of coca paste and cocaine base, resulting in overall efficiency losses. At the same time, several of the larger cocaine manufacturing facilities operated by professional chemists showed efficiency gains.

The net result was still a loss in the overall efficiency as compared to a decade ago (and thus a downward revision of cocaine manufacturing estimates for Colombia over the period 2014-2018), going hand in hand with rising levels of efficiency in the manufacturing of cocaine identified over the period 2014-2019. The older estimates prior to the review in 2019 for years after 2013 are no longer shown in this World Drug Report.

Peru

Potential cocaine production in Peru is estimated from potential coca leaf production and after deducting the amount of coca leaf estimated to be used for traditional purposes according to Government sources (9,000 mt of sun-dry coca leaf).

The Plurinational State of Bolivia

Potential cocaine production in the Plurinational State of Bolivia is estimated from potential coca leaf production after deducting the amount of coca leaf produced on 12,000 ha in the Yungas of La Paz where coca cultivation has been for years authorized under national law.

27 More information on the results of the two approaches and the methodology used can be found in annex 3 of the report on coca cultivation in Colombia for 2013 (UNODC/ Government of Colombia, June 2014) available on the internet at http://www.unodc.org/unodc/en/crop-monitoring/index.html and in UNODC and Gobierno de Colombia, Colombia, Monitoreo de territorios afectados por cultivos ilícitos 2015, July 2016, available at: CENSO 2105mx.pdf (unodc.org)

“Old” versus “new” conversion ratios for cocaine

Cocaine estimates based on the “old” and the “new” conversion ratios are shown. Results based on the “old” conversion ratios are shown for the years in which no estimates based on the “new” conversion ratios have been available. Only for a short period, 2005–2009, estimates based on both the “old” and the “new” conversion ratios are shown, indicating an overall higher level though similar trends for the cocaine estimates based on the “new” conversion ratios.

In order to estimate cocaine production from the area under coca cultivation, the coca leaf yield per region is estimated based on yield studies as well as – based on experiments in the field - – he coca-leaf to coca-paste conversion, the coca-paste to cocaine base conversion and the cocaine-base to cocaine hydrochloride conversion. The results are then adjusted to show an overall conversion ratio from coca leaf to (a potential) 100 per cent pure cocaine hydrochloride.

The ‘old’ conversion ratios from coca leaf to cocaine hydrochloride are based on studies conducted by the United States Drug Enforcement Administration (DEA) in the Andean region in the 1990s. The ratios for Colombia – in close cooperation with the Colombian authorities - –ere updated in 2004 and are part of the ‘old’ conversion ratio series.

In subsequent years the DEA undertook 'new’studies in Peru (2005) and in the Plurinational State of Bolivia (2007-2008), following indications that the laboratory efficiency in these countries may have improved.

The ‘new’ conversion rates used in this report – for the years 2007-2021 – however, have not been reconfirmed so far in national studies as funds for such studies have not been forthcoming. For this reason, cocaine production data are not shown separately for Peru and the Plurinational State of Bolivia; only the global total based on the “new” conversion ratio is shown. The calculations of cocaine production based on the “new” conversion ratios refer to the “new” coca leaf to cocaine hydrochloride transformation ratios found by the DEA for Colombia, Peru and the Plurinational State of Bolivia and the updated ratios for Colombia. It should be noted though that the ”new” conversion ratios are still temporary; they will be updated as soon as new data, jointly established between the respective Member States and UNODC will become available (for more details, see World Drug Report 2010 (United Nations publication, Sales No. E.10.XI.13, pp. 251 and 252).

Impact of drugs on the environment in Europe

Synthetic drugs

Most European countries also serve as manufacturing sites for the clandestine manufacture of drugs. Based on information provided by member states in response to the annual report questionnaire, a total of 36 countries could be identified to have had been subject to clandestine manufacture of drugs (excluding the processing of cannabis) over the last decade.

Table. Main drug manufactured in clandestine drug laboratories dismantled in Europe, 2019–2023

Country	Main drug	followed by			
Czechia	methampheta mine	heroin			
Russian Federation	synthetic cathinones	amphetamine	"ecstasy"	Meth-amphetamine	
Netherlands (Kingdom of the)	amphetamine	"ecstasy"	methampheta mine	synthetic cathinones	cocaine
Ukraine	amphetamine	synthetic cathinones	methadone	NPS	"ecstasy"
Belgium	amphetamine	"ecstasy"	methampheta mine	cocaine	
Poland	amphetamine	synthetic cathinones	methampheta mine	"ecstasy"	NPS
Germany	amphetamine	methampheta mine	NPS	"ecstasy"	
Spain	cocaine	amphetamine	"ecstasy"	methampheta mine	NPS
Bulgaria	methampheta mine	amphetamine			
Austria	amphetamine	methampheta mine	synthetic cathinones		
Greece	heroin	cocaine	methampheta mine	NPS	
Slovakia	methampheta mine	NPS			
Sweden	amphetamine	"ecstasy"	cocaine	methampheta mine	
Belarus	amphetamine	synthetic cathinones	NPS	methampheta mine	
Romania	NPS				
France	heroin	methampheta mine	"ecstasy"	cocaine	
Hungary	amphetamine	methampheta mine			
Estonia	amphetamine	fentanyl	hallucinogens		
Slovenia	cocaine	amphetamine	methampheta mine		
Portugal	methampheta mine	cocaine			

Source: UNODC, responses to the annual report questionnaire.
Note: Countries are ordered in terms of number of clandestine laboratories seized.

Using the latest available data of the annual report questionnaire, the following two tables show the main synthetic drug manufactured in each country for the last five years (2019-2023). In the first table, all European countries were included that reported at least 10 clandestine laboratories over the past decade. In the second table, European countries were included with less than 10 laboratories dismantled over the last ten years.

Table. Main drug manufactured in clandestine drug laboratories dismantled in Europe, 2019–2023

	Main threat in terms of domestic clandestine drug manufacture over the last 5 years (2019-2023)	**followed by**			
Latvia	methadone	nitazene	NPS	amphetamine	
Lithuania	methamphetamine	amphetamine			
Ireland	methamphetamine				
Malta	heroin	cocaine			
Türkiye	synthetic drugs*				
Switzerland	synthetic cannabinoids	methamphetamine*			
Italy	methamphetamine	amphetamine			
Albania	heroin*	cocaine*			
Serbia	hallucinogens	"ecstasy"	amphetamine		
North Macedonia	amphetamine*				
Cyprus	methamphetamine				
Denmark	amphetamine	NPS			
Finland	amphetamine	NPS			
Norway	amphetamine				
Moldova (Rep. of)	NPS				
United Kingdom	amphetamine	methamphetamine	NPS	Benzo-diazepines	cocaine
Bosnia and Herzegovina	amphetamine				

Source: UNODC, responses to the annual report questionnaire.
Note: Countries are ordered in terms of number of clandestine laboratories seized.

The largest numbers of clandestine laboratories over the last decade were reported to have been dismantled by Czechia, followed by the Russian Federation, the Kingdom of the Netherlands, Ukraine, Belgium, Poland and Germany. The size varies significantly, with small-scale “kitchen laboratories” dominating in Czechia and larger size, often industrial-scale laboratories found in countries like Belgium, Germany and the Kingdom of the Netherlands.

Only Iceland as well as a few Western Balkan countries reported that no clandestine laboratories were operating on their territories. Information on main countries of "origin" and "departure", provided by other European countries, seem to confirm this.

Table. Dismantled clandestine drug laboratories in Europe, 2013-2023

	Dismantled laboratories in Europe, reported to UNODC in response to the annual report questionnaire											
Countries	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Laboratories, dismantled 2013-2023**
Czechia	261	275	265	262	264	244	242	162	191	202	189	2,557
Russian Federation	31	38	40		35	68	174	229	222	437	390	1,664
Netherlands (Kingdom of the)		51	118	10	103	20	105	129	93	105	151	885
Ukraine			143	95			14	76	78	54	94	554
Belgium	16	17	18	10	39	60	60	43	37	42	68	410
Poland	19		10	23	19	35	33	52	59	63	88	401
Germany	20	16	12	15	14	19	31	29	11	9	16	192
Spain	5	6	3	5		14	7	6	30	46	26	148
Bulgaria	35	12		3			2		4		53	109
Austria	5	12	10	9	7		5	13	12	2	6	81
Greece	10	5	5	5	12	12	10	8	4	5	5	81
Slovakia	8				11		13	3	6	17	6	64
Sweden			2		9	9	4	12	5	12	3	56
Belarus	6			6	6	7	4	3	4	2		38
Romania	12		12							1		25
France	2					1	2	5	3	7	2	22
Hungary	3	1	2	2	2	2	1	2		1	1	17
Estonia	1						2		4	2	3	12
Slovenia					9			1		1		11
Portugal			1		2	2	1				4	10
Latvia			2	1	3	1		2				9
Lithuania	2		2		1			1	1		1	8
Ireland				1	3	1						5
Malta											4	4
Türkiye	1		3									4
Switzerland	3											3
Italy								1		1		2
Albania			2									2
Serbia								1				1
North Macedonia					1							1
Finland											1	1
Republic of Moldova								1				1

	Dismantled laboratories in Europe, reported to UNODC in response to the annual report questionnaire											
Countries	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Laboratories, dismantled 2013-2023**
Denmark											1	1
Cyprus								1				1
Bosnia and Herzegovina												0
Norway												0
United Kingdom												0
Grand Total	**440**	**433**	**650**	**447**	**540**	**495**	**710**	**780**	**764**	**1,009**	**1,112**	**7,380**

Source: UNODC, responses to the annual report questionnaire.
Note: Data for the Netherlands are taken from: Politie Nederland, Nationaal Overzicht Drugslocaties 2023 (version 1.5 – 1 May 2024).

In the period 2019–2023, 1,194 drug manufacture waste dumping sites were reported to UNODC by seven countries in Europe. In the longer period 2013–2023, most dumping sites that were linked to specific drug manufacture were related to amphetamine (43 per cent), MDMA (35 per cent) and cocaine (8 per cent). During the latter period, the number of countries reporting dumping sites was slightly higher, at nine, with the addition of Spain (14 sites) and North Macedonia (1 site).

This means that there is a significant disconnect between the number of countries reporting dismantled clandestine laboratories, at 36 in the period 2013–2023, and the number of dumping sites reported. Indeed, 99 per cent of all the dumping sites reported in that period were reported by just three countries: Belgium, Netherlands (Kingdom of the) and Ukraine. Although this partly reflects their significance as synthetic drug manufacture hotspots, it does not tell the whole story.

Table. Dumping sites of chemicals related to clandestine drug manufacture in Europe (2019-2023)

	2019	2020	2021	2022	2023	2019-2023	Ranking 2019-2023	
Belgium	33	20	28	41	28	150	Netherlands (Kingdom of the)	923
Germany		4				4	Belgium	150
Hungary							Ukraine	102
Latvia		1				1	Slovakia	12
Lithuania		1	1			2	Germany	4
Netherlands (Kingdom of the)	191	178	208	155	191	923	Lithuania	2
North Macedonia							Latvia	1
Poland	0							
Slovakia	4	2	6			12		
Slovenia								
Spain	0							
Ukraine					102	102		
Grand Total	**37**	**206**	**243**	**196**	**321**			**1,194**

Source: UNODC, responses to the annual report questionnaire.

Table. Countries with most dumping sites of chemicals related to clandestine drug manufacture in Europe, 2013-2023

Country	2013-2023
Netherlands (Kingdom of the)	2,022
Belgium	261
Ukraine	102
Spain	14
Slovakia	12
Germany	4
Lithuania	2
Latvia	1
North Macedonia	1

Source: UNODC, responses to the annual report questionnaire.

There seems to have been a general trend towards an increase in the clandestine manufacture of drugs in Europe as reflected in a rising number of such laboratories dismantled over the 2013-2023 period.

Data show that throughout this period methamphetamine continued to account for most laboratories seized in Europe though the number of such dismantled laboratories declined while the number dismantled amphetamine laboratories increased, and even more so the number of laboratories producing various cathinones, thus exceeding the number of amphetamine laboratories in recent years. The number of dismantled “ecstasy” laboratories fluctuated though with no clear discernible trends. There was also an increase in cocaine extraction or cocaine-

base to cocaine hydrochloride conversion laboratories. An even stronger increase, however, was related to the “other” category, which includes clandestine manufacture of precursors out of pre-precursors for the manufacture of various synthetic drugs.

Table. Dismantled amphetamine laboratories, 2019-2023

Countries	2019	2020	2021	2022	2023	2019-2023
Netherlands (Kingdom of the)		48	32	39	38	157
Russian Federation	35	26	21	13	20	115
Ukraine	5	67	69	45	34	220
Poland	15	26	27	24	31	123
Belgium	23	14	4	15	20	76
Germany	15	16	6	5	8	50
Sweden	4	8	5	6	2	25
Spain	2	2	6	14	4	28
Austria	2	2	3	1	3	11
Belarus	1	1				2
Estonia		1	4	2	2	9
Hungary		2		1		3
Latvia						0
Bulgaria	1		2			3
Slovenia		1				1
Czechia						0
Finland					1	1
North Macedonia						0
Lithuania					1	1
Greece						0
Italy		1				1
Grand Total	103	215	179	165	164	826

Source: UNODC, responses to the annual report questionnaire.

Table. Dismantled methamphetamine laboratories, 2019-2023

Countries	2019	2020	2021	2022	2023	2019-2023
Czechia	234	160	188	199	187	968
Bulgaria	1		2		53	56
Netherlands (Kingdom of the)		32	15	15	29	91
Germany	13	7	5	3	5	33
Poland	12	11	14	3	8	48
Slovakia	7	3	5	17	6	38
Austria	3	11	8	1	1	24
Belgium	5	6	6	2	6	25
Ukraine	1	3	5	5	14	28
Spain		1	2	2	4	9
Russian Federation	2	1			3	6

Countries	2019	2020	2021	2022	2023	2019-2023
Lithuania		1	1			2
Portugal	1				3	4
France	2	1	1	1		5
Ireland						0
Greece		1	1	1	1	4
Switzerland						0
Belarus		2	1			3
Sweden		1		1		2
Slovenia				1		1
Cyprus		1				1
Hungary					1	1
Italy				1		1
Grand Total	281	242	254	252	321	1,350

Source: UNODC, responses to the annual report questionnaire.

Table. Dismantled “ecstasy” laboratories, 2019-2023

Country	2019	2020	2021	2022	2023	2019-2023
Netherlands (Kingdom of the)	19	24	13	15	32	103
Belgium	19	3	4	5	11	42
Spain			2	10	2	14
Russian Federation	2	4	1			7
Poland		2	1	1		4
Sweden		1		1		2
Germany	1	3				4
Greece						0
France			1			1
Ukraine		1				1
Belarus				1		1
Grand Total	41	38	22	33	45	179

Source: UNODC, responses to the annual report questionnaire.

Table. Dismantled cathinone laboratories, 2019-2023

Country	2019	2020	2021	2022	2023	2019-2023
Russian Federation			167	190	158	515
Ukraine	2	2			6	10
Poland	5					5
Austria			1		1	2
Belarus	2					2
Grand Total	9	2	168	190	165	534

Source: UNODC, responses to the annual report questionnaire.

Life cycle assessment of MDMA

This section outlines the methodological framework employed in the Life Cycle Assessment (LCA) for the production of MDMA-HCl salts, which is included in the chapter *The Impact of Drugs on the Environment: The Case of Europe*. The study is presented as a "screening-level" LCA study which, to the extent possible, was conducted in accordance with the principles and framework provided by the ISO 14040 standard (Environmental Management – Life Cycle Assessment – Principles and Framework) (ISO, 2006).

Goal and Scope Definition

Goal of the Study

The overarching goal of the LCA is to quantify and assess the potential environmental impacts associated with the cradle-to-gate production of MDMA-HCl in the Netherlands. This assessment aims to identify environmental hotspots within the production chain, inform decision-making regarding mitigation measures, and provide recommendations for further study.

Given that the MDMA-HCl synthesis modelled in the study is an illicit process, the scope of the study is inherently limited by highly variable and often unavailable data due to strict controls and regulations. Many assumptions were based on best available estimates, consequently the uncertainties associated with the quantitative results are substantial. The quantities of inputs, outputs, and energy consumption as well as the impact scores provided in the report are intended to serve solely as order-of-magnitude indications rather than precise figures. **The primary value of the study lies in its qualitative definition of the system boundaries and processes involved, and in offering a preliminary identification of potential environmental hotspots and contributing to a better understanding of the often-overlooked consequences of an illicit MDMA production chain.**

Functional Unit

The functional unit, which serves as the reference flow to which all input and output data are related, was defined as 1 kg of MDMA-HCl salt, at the gate of the production facility, produced in the Netherlands. This unit ensured a consistent basis for the quantification of environmental burdens and allowed for a direct comparison of environmental performance vs. other benchmarks

System Boundary

The system boundary for the study was defined as "cradle-to-gate." This encompassed all relevant processes from the extraction and processing of raw materials (the "cradle") through to the manufacturing of MDMA-HCl and its packaging, up to the point it leaves the production facility (the "gate"). This included:

- Acquisition and transport of all necessary chemicals and auxiliary materials.
- Energy consumption associated with chemical synthesis and auxiliary processes.
- Water consumption and wastewater treatment.
- Emissions to air, water, and soil arising from all included unit processes.
- Waste generation and management.

Due to the unavailability of data for some of the illicit synthesis steps modelled, not all of the above elements could be represented for the full supply chain. These and other limitations are discussed in further below.

Geographical coverage for the foreground system was set for the Netherlands, while background processes extend globally with most of the supply of precursors originating in Asia.

Allocation Procedures

Where multi-functional processes (e.g., co-production of useful by-products, or waste streams that are subsequently valorized) were encountered, allocation by substitution was applied. This approach aims to avoid the need for allocation at multi-output processes by expanding the system boundary to include the alternative production of the co-product or the displaced treatment of the waste stream. This approach is consistent with the hierarchy of allocation procedures outlined in ISO 14044 (ISO, 2006) and was specifically applied to the production of catechol which has hydroquinone as a commercial byproduct (see further below).

Life Cycle Inventory (LCI) Analysis

The Life Cycle Inventory phase involved the compilation of an inventory of relevant energy and material inputs and environmental releases associated with the defined functional unit.

Data Collection and Sources

Background inventory data, representing the environmental burdens of generic processes such as electricity generation, transport, and the production of bulk chemicals and materials, were sourced from the ecoinvent v3.10.1 cutoff database (Wernet et al., 2016). The "cutoff" system model was chosen, meaning that the burdens and credits of waste treatment are generally

allocated to the processes generating the waste, and secondary materials are considered burden-free at the point of their entry into a new production system.

Primary foreground data, reflecting the specific production processes for MDMA-HCl, were collected from relevant secondary literature sources (e.g., peer-reviewed scientific articles and patents). These data encompass all direct inputs (e.g., raw materials, energy, water) and outputs (e.g., products, co-products, emissions, waste) for the unit processes within the defined system boundary. In many cases, the data were produced from our own calculations following stoichiometric calculations, thermodynamics and process engineering principles (Piccinno et al., 2016). When none of these strategies were sufficient to fill data gaps and additional assumptions were required, these were based on best available estimates of similar processes which the study obtained via interviews with forensic scientists and organic chemists, and complemented with focused internet searches. A detailed account is provided further below.

Upscaling of Chemical Processes

The study used the framework of (Piccinno et al., 2016) to estimate industrial-scale production data from laboratory-scale experimental data when only the latter was available. The framework simplifies important calculations for energy use in heated liquid phase batch reactions, as well as for purification and isolation steps. In line with the screening scope of this study, this allows for simplified LCA calculations without requiring a full process simulation study and/or extensive data collection for each of the unknown processes. The study applied the approach mostly to commercially available pre-precursors and precursors, given that the final steps are assumed to be taken in conditions resembling an (informal) laboratory.

Energy consumption. The framework of Piccinno et al. (2016) calculates energy consumption during reactions by considering several key factors and simplifying complex chemical engineering principles, as detailed below. In all cases the study took the default values and constants suggested by the framework for a reactor tank size of 1000L.

- Heating Energy (Q_{react}): The total heating energy required for a reaction accounts for the energy to raise the reaction mixture's temperature and compensate for heat loss from the reactor surface. This is divided by the heating device's efficiency (η_{heat}).

$$Q_{react} = \frac{Q_{heat} + Q_{loss}}{\eta_{heat}}$$

In the equation above, energy to reach reaction temperature (Q_{heat}) is primarily determined by the specific heat capacity (C_p) of the main solvent, the mass of the reaction mixture (m_{mix}), and the temperature difference between the reaction temperature (T_r) and the starting temperature (T_0) (usually ambient temperature at 25°C or 298.15 K).

$$Q_{heat} = C_p \times m_{mix} \times (T_r - T_0)$$

The energy to compensate for heat loss (Q_{loss}) accounts for heat lost through the reactor's insulated surface. It depends on the surface area of the reactor (A), the thermal conductivity of the insulation material (k_a), the thickness of the insulation (s), the temperature difference between the inside and outside of the reactor (ΔT or $T_r - T_{out}$), and the reaction time (t).

$$Q_{loss} = A \times \frac{k_a}{s} \times (T_r - T_{out}) \times t$$

The efficiency of the heating element (η_{heat}) is standardized at 75% for a 1,000 L reactor and scales with a factor of 0.02.

- Stirring energy (E_{stir}): The stirring energy consumed during a reaction depends on factors such as the type and diameter (d) of the impeller, the rotational velocity of stirring (N), the density of the reaction mixture (ρ_{mix}), and the reaction time (t), along with an efficiency value (η_{stir}).

$$E_{stir} = \frac{N_P * \rho_{mix} * N^3 * d^5 * t}{\eta_{stir}}$$

In the equation above, the power number (N_P) is a dimensionless number specific to the impeller type, constant at turbulent flow (e.g., 0.79 for an axial flow impeller). The impeller diameter (d) is calculated as one-third of the reactor diameter. The rotational speed of agitator (N) is assumed to be 85 rpm (1.417 1/s) for a 1,000 L reactor and scaled for other sizes based on equal tip speed. The efficiency of agitator (η_{stir}) is standardized at 90%.

- Pumping energy (E_{pump}): The energy consumption of a pump is primarily dictated by the change in the hydraulic head (Δh).

$$E_{pump} = \frac{m * g * \Delta h}{\eta_{pump}}$$

This hydraulic head change is a sum of several components: gravitational head (Δh_g) which is the height difference between the starting and ending points of the transfer; dynamic head (Δh_{dyn}) which is influenced by the average speed of the fluid (v); static head (Δh_{st}) which is formed by the pressure differences; and frictional head (Δh_{fr}) which represents pressure loss due to friction, depending on factors like the friction factor (λ), pipe length (l), pipe diameter (d), and average fluid speed (v).

$$\Delta h = \Delta h_g + \Delta h_{dy} + \Delta h_{st} + h_{fr} = \Delta h_g + \frac{(v - v_0)^2}{2 * g} + \frac{\Delta p_{st}}{\rho * g} + \lambda * \frac{l}{d} * \frac{v^2}{2 * g}$$

In the framework, several parameters for pumping are standardized for simplicity. The pipe diameter is set to 0.2 m, the length to 30 m, and steel is assumed as the material. The gravitational head difference (Δh_g) is standardized to 4 m, which is sufficient to overcome the height of the suggested reactor sizes. With an average speed of 1 m/s at turbulent flow, the hydraulic head is calculated to be 4.2 m. Assuming a reciprocating pump efficiency between 0.7 and 0.85 (a value of 0.75 is used for standardization).

- Cooling energy. While no formula is provided in the framework of Piccino et al. for cooling energy requirements, the study included it for highly exothermic reactions using a typical coefficient of performance (COP) for cooling systems of 3.5, where:

$$COP = \frac{|Q|}{W}$$

In this case, Q is the heat removed from the system, and W is the net work put into the system.

Chemicals consumption. A key difference between lab scale and industrial scale chemical production is the use of recycling to reduce the use of chemicals where feasible and advantageous. If not accounted for, this could substantially and incorrectly amplify the impacts calculated. The rules of thumb provided by the framework suggest using stoichiometric amounts for reactants and reduce solvent use by 20% compared to lab scale, plus additional

reductions if recycling is included. For simplicity, in line with the scope of the study and in lieu of recycling data, the study assumed a recycling rate of 90% where the study had sufficient indications in literature of such recycling taking place at industrial scale. The study did not include energy consumption of the recycling processes, which would mean an underestimation of the final results (see further below).

Life Cycle Impact Assessment (LCIA)

The LCIA phase aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts of the MDMA-HCl production system.

Impact Assessment Method

The environmental impacts were assessed using the Environmental Footprint (EF) 3.1 method developed by the European Commission (Damiani et al., 2022). This method provides a harmonized and robust approach for evaluating environmental performance across a comprehensive range of impact categories.

Impact Categories Reported

Aiming to provide a holistic environmental assessment, results for all impact categories included within the EFv3.1 method (Damiani et al., 2022) were calculated and reported. These categories cover various environmental concerns, including but not limited to climate change, ozone depletion, human toxicity (cancer and non-cancer effects), particulate matter formation, ionizing radiation, photochemical ozone formation, acidification, eutrophication (terrestrial, freshwater, and marine), land use, water scarcity, resource depletion (minerals and fossil), and ecotoxicity (freshwater).

Life Cycle Interpretation

The interpretation phase involved the identification of potential environmental hotspots (via a contribution analysis), completeness and consistency checks, uncertainty analysis. This phase ensured that the findings of the LCI and LCIA were consistent with the goal and scope, and that the limitations of the study were transparently communicated.

Contribution (hotspot) analysis

The contribution analysis was conducted using the built-in function of the OpenLCA software v2.3 (GreenDelta, 2018). The findings are presented in the chapter that is part of the World Drug Report.

Completeness check

Coverage of Life Cycle Stages: All stages defined in the scope (e.g., raw material acquisition, (pre)precursor synthesis and synthesis up to lab gate) have been included.

Inclusion of Process Steps: Most relevant unit processes within each life cycle stage were accounted for, albeit with some important exceptions:

- Transportation between precursor suppliers and labs responsible for the final synthesis.
- Electricity for pumping of cooling water in cooling systems.
- Waste treatment from the synthesis of (pre)precursors the study modelled in the foreground system
- Infrastructure (e.g. factories) and ancillary services (e.g. lighting) for (pre)precursors the study modelled and which are synthesized at commercial scale. In such cases, the study assumed these aspects to be negligible due to the large quantities produced and the optimizations possible at this scale.

Environmental Flows: Key inputs and outputs of materials, energy and water for each unit process were considered. Due to data unavailability and insufficient elements to make modelling assumptions, the study did not include:

- Additional waste flows during dumping of illegal production, e.g., MDMA and direct precursors such as PMK, other than direct solvents such as acetone and methylamine.
- Emissions to air during burning of products and precursors which often take place in lab seizures.
- Direct emissions from the synthesis of (pre)precursors the study modelled in the foreground system

Data Sufficiency: Despite the numerous data gaps and uncertainties reported, the study ensured that the goal of the scope was aligned with what was feasible for this screening-level study, and that the conclusions regarding the potentially relevant environmental aspects of illicit MDMA production can be sufficiently substantiated.

Consistency check

Data Sources and Quality: This was a strong limitation for the study; thus it was not possible to ensure that the data used for different parts of the production system were comparable in terms of technology, geography, and time. These aspects are further discussed further below.

Allocation Methods: By selecting the cutoff version of the ecoinvent database, the study applied the same rules for allocating environmental burdens between co-products or in recycling systems across the entire background product system. However, for the single multifunctional process in the foreground system (catechol production), the study applied a substitution principle given the large quantities and high commercial value of both products thus avoiding a large bias towards catechol only (which would have resulted from a cut-off approach).

System Boundaries: For most processes the criteria for including or excluding inputs and processes were applied uniformly. A key exception is the inclusion of ventilation in small scale / informal lab production and the exclusion of it in large scale.

Impact Assessment Models: The same characterization factors and models were used for all assessed systems within the study (illicit and GMPc production). This however does not apply to some of the broader comparisons made in the chapter that is included in the World Drug Report vs. coffee beans, cannabis and chocolate bars (see the data in the table below).

Table. Carbon footprint comparison of MDMA with a cannabis joint, a cup of coffee and a chocolate bar

Substance	Foot print kg CO_2e	Source
MDMA pill (7,150 pills per kilo; high 1,500 kg CO_2e)	0.26	UNODC, World Drug Report 2025
MDMA pill (6,000 pills per kilo; high 1,500 kg CO_2e)	0.31	UNODC, World Drug Report 2025
MDMA pill (7,150 pills per kilo; low 400 kg CO_2e)	0.07	UNODC, World Drug Report 2025
MDMA pill (6,000 pills per kilo; high 400 kg CO_2e)	0.08	UNODC, World Drug Report 2025
Chocolate (100 g) - Dark (Italian dark chocolate "cradle-to-grave")	0.31	Recanati et al., 2018
Chocolate (100 g) - White (Consumed in the UK)	0.54	Konstantas et al., 2018
Chocolate (100 g) - Milk (Italian chocolate "cradle-to-grave" from Ecuador, Ghana and Indonesia)	0.59	Bianchi et al., 2021
Espresso	0.28	Nab and Maslin, 2020
Latte	0.55	Nab and Maslin, 2020
Cappuccino	0.41	Nab and Maslin, 2020
Flat white	0.34	Nab and Maslin, 2020
Joint (0.32 g dose - high estimate indoor cultivation (5,200 kg CO_2e))	1.66	Summers et al., 2021
Joint (0.32 g dose - low estimate indoor cultivation (2,300 kg CO_2e))	0.74	Summers et al., 2021
Joint (0.32 g dose - low estimate indoor cultivation (2,150 kg CO_2e))	0.69	Mills, 2025
Joint (0.5 g dose - high estimate indoor cultivation (5,200 kg CO_2e))	2.60	Summers et al., 2021
Joint (0.5 g dose - low estimate indoor cultivation (2,300 kg CO_2e))	1.15	Summers et al., 2021
Joint (0.5 g dose - low estimate indoor cultivation (2,150 kg CO_2e))	1.08	Mills, 2025
Joint (0.32 g dose - high estimate outdoor cultivation (700 kg CO_2e))	0.22	Mills, 2025
Joint (0.32 g dose - high estimate outdoor cultivation (110.7 kg CO_2e))	0.035	Desaulniers-Brousseau et al., 2024
Joint (0.32 g dose - low estimate outdoor cultivation (61.8 kg CO_2e))	0.020	Desaulniers-Brousseau et al., 2024
Joint (0.5 g dose - high estimate outdoor cultivation (700 kg CO_2e))	0.35	Mills, 2025
Joint (0.5 g dose - high estimate outdoor cultivation (110.7 kg CO_2e))	0.055	Desaulniers-Brousseau et al., 2024
Joint (0.5 g dose - low estimate outdoor cultivation (61.8 kg CO_2e))	0.03	Desaulniers-Brousseau et al., 2024

Sources: Bianchi et al., "Environmental analysis along the supply chain of dark, milk and white chocolate: a life cycle comparison", International Journal of Life Cycle Assessment, vol. 26, No. 4 (2021), pp. 807–821; Konstantas et al., "Environmental impacts of chocolate production and consumption in the UK", Food Research International, vol. 106 (2018), pp. 1012–1025; Recanati et al., "From beans to bar: a life cycle assessment towards sustainable chocolate supply chain", Science of The Total Environment, vol. 613–614 (2018), pp. 1013–1023; Nab and Maslin, "Life cycle assessment synthesis of the carbon footprint of Arabica coffee: case study of Brazil and Vietnam conventional and sustainable coffee production and export to the United Kingdom," Geo: Geography and Environment 7, No. 2 (July 2020).

The coffee data are based on carbon footprint estimates related to coffee produced in Brazil and Viet Nam and exported to the United Kingdom of Great Britain and Northern Ireland. For chocolate, the lowest figures relate to dark chocolate, while the highest figures relate to milk chocolate, in both cases consumed in Italy. The indoor and outdoor cannabis cultivation data are based on studies undertaken in the United States of America and do not include exportation. For cannabis, 1 kg equals 1000 g, which equals 3.125 joints (0.32 g servings) or 2.000 joints (0.5 g servings). The 0.32 g estimate is derived from Ridgeway and Kilmer, 2016. The 0.5 g estimate is the higher end of a 0.3-0.5 g range that has been reported in Kilmer and Pacula, 2009, which is also mentioned in Ridgeway and Kilmer, 2016. The highest estimate for MDMA is based on 1,500 kg of CO_2e per kg and 6,000 pills per kg. The lowest estimate is based on 400 kg of CO_2e per kg and 7,150 pills per kg.

Uncertainty and sensitivity analysis

Due to the screening nature of the study and the large but unquantifiable uncertainties and variabilities involved, a detailed assessment of uncertainty was unfeasible. The study instead conducted a high-level estimation of uncertainty in the LCA results by taking the higher ranges for some key assumptions, namely:

- The energy consumption of the final MDMA synthesis step.
- The reported yields in the final MDMA synthesis steps using uncertainty distributions suggested by ter Laak et al. (2025).

The combined application of these changes to the corresponding parameters in the model allowed us to approximate the upper ranges for the impact score results presented in the main report.

Data collection, calculations and assumptions

Pre-precursors

Sodium ethoxide

Calculations for the (industrial) production of sodium ethoxide in Asia are based on the reaction:

$$2Na + 2EtOH \rightarrow 2NaOEt + H_2$$

For electricity and heat consumption the study assumed a batch reaction time (t) of 4 hours and a solution mix density (ρ_{mix}) of 818.5 kg/m³. The reaction requires negligible heating and, on the contrary, is highly exothermic, thus the electricity provided is mostly for the cooling system. The heat generated by the reaction (which has to be removed by the cooling system) is calculated from the enthalpy of reaction which is the sum of the enthalpies of the products minus the sum of the enthalpies of the reactants.

INFLOWS	AMOUNT	UNIT
ELECTRICITY, MEDIUM VOLTAGE	104.77	kWh
ETHANOL, WITHOUT WATER, IN 99.7% SOLUTION STATE, FROM ETHYLENE	546.05	kg
SODIUM	272.49	kg

OUTFLOWS	AMOUNT	UNIT
SODIUM ETHOXIDE	766.35	kg

Hexamine

Calculations for the (industrial) production of hexamine in Asia are based on the reaction:

$$6HCHO + 4NH_3 \rightarrow (CH_2)_6N_4 + 6H_2O$$

For electricity and heat consumption, the study assumed a batch reaction time (t) of 30 minutes, a reaction temperature (T_r) of 50°C and a solution mix density (ρ_{mix}) of 818.5 kg/m³.

INFLOWS	AMOUNT	UNIT
AMMONIA, ANHYDROUS, LIQUID	68.65	kg
ELECTRICITY, MEDIUM VOLTAGE	3.07	kWh
FORMALDEHYDE	181.59	kg
HEAT, FROM STEAM, IN CHEMICAL INDUSTRY	11.24	kWh
WATER, DEIONISED	15.13	kg

OUTFLOWS	AMOUNT	UNIT
HEXAMINE	134.22	kg

Paraformaldehyde

Paraformaldehyde is produced by polymerizing formaldehyde (CH_2O) under acidic conditions with heating. In practice, an aqueous formaldehyde solution (often called formalin) is used. Formalin is typically about 37% by weight formaldehyde with the balance being water. An acid (such as acetic acid or sulfuric acid) is added as a catalyst. The study disregarded this, as

it is usually added only in trace amounts. Heating drives the polymerization and helps remove water so that the solid polymer (paraformaldehyde) precipitates. For electricity and heat consumption (see section 1.2.2) the study assumed a batch reaction time (t) of 1 hour, a reaction temperature (T_r) of 90°C and a solution mix density (ρ_{mix}) of 804.9 kg/m³.

INFLOWS	AMOUNT	UNIT
ELECTRICITY, MEDIUM VOLTAGE	6.11	kWh
FORMALDEHYDE	268.31	kg
HEAT, FROM STEAM, IN CHEMICAL INDUSTRY	23.15	kWh
WATER, DEIONISED	16.77	kg

OUTFLOWS	AMOUNT	UNIT
PARAFORMALDEHYDE	262.91	kg

Ethyl a-bromoproprionate

Calculations for the (industrial) production of ethyl α-bromoproprionate in Asia are based on the reaction:

$$CH_3CH_2COOH + CH_3CH_2OH + Br_2 \rightarrow CH_3CHBrCOOCH_2CH_3 + H_2O + HBr$$

For electricity and heat consumption the study assumed a batch reaction time (t) of 4 hours, a reaction temperature (T_r) of 78°C and a solution mix density (ρ_{mix}) of 774.3 kg/m³.

INFLOWS	AMOUNT	UNIT
BROMINE	149.71	kg
ELECTRICITY, MEDIUM VOLTAGE	9.56	kWh
ETHANOL, WITHOUT WATER, IN 99.7% SOLUTION STATE, FROM ETHYLENE	693.99	kg
HEAT, FROM STEAM, IN CHEMICAL INDUSTRY	35.24	kWh
PROPIONIC ACID	69.40	kg

OUTFLOWS	AMOUNT	UNIT
ETHYL A-BROMOPROPRIONATE	144.16	kg

Precursors

Catechol (+ hydroquinone)

Calculations for the (industrial) production of catechol in Asia are based on an industrial process reported in Japan by (Fiege et al., 2000), according to which catechol is produced together with hydroquinone by hydroxylation of phenol with ketone peroxides formed in situ from a ketone and hydrogen peroxide in the presence of an acid catalyst. A trace amount of acid is added (disregarded in this study), together with a small volume of ketone (also

disregarded), and 60 % aqueous hydrogen peroxide to phenol at 70°C. The ketone peroxide that is formed in situ reacts rapidly and electrophilically with phenol, and catechol and hydroquinone are obtained in a molar ratio of about 3:2 in more than 90% yield (the study takes 95%).

For electricity and heat consumption (see section 1.2.2) the study assumed a batch reaction time (t) of 2 hours, with a reaction temperature (T_r) of 70°C and a solution mix density (ρ_{mix}) of 1134 kg/m³.

INFLOWS	AMOUNT	UNIT
ELECTRICITY, MEDIUM VOLTAGE	7.15	kWh
HEAT, FROM STEAM, IN CHEMICAL INDUSTRY	45.44	kWh
HYDROGEN PEROXIDE, WITHOUT WATER, IN 50% SOLUTION STATE	360.60	kg
PHENOL	997.50	kg

OUTFLOWS	AMOUNT	UNIT
CATECHOL	700.30	kg
HYDROQUINONE	466.80	kg

1,3-benzodioxole

Calculations are based on the synthesis method described in (Bonthrone & Cornforth, 1969). The study notes however, that the temporal representativeness of this process is very low, adding substantially to the uncertainty in the final results.

INFLOWS	AMOUNT	UNIT
CATECHOL	0.11	kg
DICHLOROMETHANE	0.004	kg
DIETHYL ETHER, WITHOUT WATER, IN 99.95% SOLUTION STATE	0.003	kg
DIMETHYL SULFOXIDE	0.01	kg
ELECTRICITY, MEDIUM VOLTAGE	0.04	kWh
HEAT, FROM STEAM, IN CHEMICAL INDUSTRY	2.67	MJ
SODIUM HYDROXIDE, WITHOUT WATER, IN 50% SOLUTION STATE	0.17	kg

OUTFLOWS	AMOUNT	UNIT
1,3-BENZODIOXOLE	0.11	kg

Piperonal

Calculations are based on the synthesis method described in patent CN107108425B from Anthea Aromatics Pvt Ltd (Mohapatra et al., 2021). The method requires several steps involving both cooling and heating. The energy estimations are conducted as described above, using the reaction times, temperatures and masses provided in the patent's description.

INFLOWS	AMOUNT	UNIT
1,3-BENZODIOXOLE	0.49	kg
ACETIC ACID, WITHOUT WATER, IN 98% SOLUTION STATE	1.30	kg
ELECTRICITY, MEDIUM VOLTAGE	0.04	kWh
HEAT, FROM STEAM, IN CHEMICAL INDUSTRY	2.76	MJ
HEXAMINE	0.56	kg
HYDROCHLORIC ACID, WITHOUT WATER, IN 30% SOLUTION STATE	0.73	kg
PARAFORMALDEHYDE	0.18	kg
TOLUENE, LIQUID	0.10	kg

OUTFLOWS	AMOUNT	UNIT
PIPERONAL	0.31	kg

PMK methyl glycidate

While reports reviewed and interviews conducted indicate that the most likely direct precursor currently used for PMK oil production is PMK *ethyl* glycidate, the study was only able to obtain process data for PMK *methyl* glycidate which is also used frequently and thus the study used as a proxy. The calculations are based on the synthesis steps described in Collins et al., (2007) which refers to an older reference from Elks & Hey (1943). As the production of PMK glycidates is highly regulated the study assumed this part of the process to be conducted in an informal lab-scale setting. The following assumptions were made based on this process description, subject to very large uncertainties due to the difficulties in obtaining more representative data which is subject to strict controls. In addition to this, the study had to make numerous assumptions (underlined below) for non-reported processing times, which the study based on consultation with organic chemists but for very generic processes that may not necessarily represent the specific steps listed below.

- *Stirring (Initial Addition):* 4 hours using a magnetic stirrer for which the study assumed 20W power consumption.
- *Stirring (Overnight):* The process description reports approximately 12-16 hours (the study takes 14 hours) at room temp using a magnetic stirrer for which the study assumed 20W power consumption.

- *Stirring & Heating (Water Bath):* Process description reports 6 hours using a heated water bath for which the study assumed an average draw of 400W.
- *Ether Removal:* The study assumed this step would be done using a rotary evaporator with a motor for rotation, a heated bath, and a vacuum pump. The study assumed a power consumption of 25W (rotator) + 150W (vacuum pump) + 150W (heating bath) = 325W total, for an assumed processing time of 1 hour.
- *Distillation 1:* Heating the residue to 70-200°C (likely using a heating mantle or oil bath) under vacuum (requiring a vacuum pump). Assume the heating mantle consumes 350W and the vacuum pump 150W for a total of 500W. The study assumed 3 hours for this process.
- *Redistillation 2:* Heating the collected fraction to 184-186°C (heating mantle/oil bath) under vacuum (vacuum pump). The study assumed similar equipment is used as in the previous step, with 500W power consumption in total. The study assumed 3 hours for this step.

The process produces fumes of a highly hazardous nature, thus active ventilation is required, even in an informal lab setup. Here the uncertainty becomes larger, as the energy spent on ventilation per kg of synthesized chemicals directly depends on the size and number of batches that are run simultaneously. For a base case, the study assumed a commercial fume hood of 150W was operating continuously throughout the process (~30 hours), while 2 batches of the reported size were being run simultaneously.

INFLOWS	AMOUNT	UNIT
ELECTRICITY, MEDIUM VOLTAGE	8.65	kWh
ETHYL A-BROMOPROPRIONATE	0.06	kg
PIPERONAL	0.05	kg
SODIUM ETOXIDE	0.02	kg

OUTFLOWS	AMOUNT	UNIT
PMK METHYL GLYCIDATE	0.04	kg

MDMA synthesis from PMK

PMK oil

The calculations for this process are based on the quantities in steps 1b and 2 reported in ter Laak et al., (2025), Table 1.

INFLOWS	AMOUNT	UNIT
HYDROCHLORIC ACID, WITHOUT WATER, IN 30% SOLUTION STATE	1.19	kg
HYDROCHLORIC ACID, WITHOUT WATER, IN 30% SOLUTION STATE	5.60	kg
PMK METHYL GLYCIDATE (*AS A PROXY FOR PMK ETHYL GLYCIDATE*)	1.00	kg
SODIUM HYDROXIDE, WITHOUT WATER, IN 50% SOLUTION STATE	0.78	kg

OUTFLOWS	AMOUNT	UNIT
PMK OIL	0.46	kg

MDMA-HCL SALT

The calculations for this process are based on the quantities in steps 3a and 4 reported in ter Laak et al., (2025), Table 1. Here the study added the estimated energy consumption of the previous process as well (section 2.3.1). For producing a 1–2 kg batch of MDMA via reductive amination the study placed energy consumption at roughly 10–35 kWh (36–126 MJ): 1–5 kWh for mechanical operations like stirring and pumps; 2–10 kWh for heating and controlling the reaction temperature; and 5–20 kWh for the most energy-intensive stage, which is the final distillation. These figures are meant to provide a ballpark estimate, as actual energy use will largely depend on the specific equipment, reaction scale, and duration. In addition to energy for the reaction, the study included the operation of a ventilation fume hood operating over a period of 24 hours. Taking mid-point values and scaling down to the production of 0.77 kg of MCMA-HCl salt, this gives a total energy consumption of ~60 MJ which the study assumed to be provided by a diesel generator set.

To estimate the hydrogen gas consumption, the study considered that each mole of ketone consumes 1 mole of H_2 (2 g of H_2) in the hydrogenation step. For a typical reductive amination solution containing ~20 wt% ketone, the study would expect ~2 g of H_2 consumed per 1 kg of reaction mixture.

To estimate the generation of waste emitted directly to the natural environment (acetone, methanol, methylamine), the study assumed a corresponding 40:40:20 distribution, a rough estimation based on consultations the study conducted with forensic scientists and the total waste (volume) reported by ter Laak (2025). The study assumed all goes to surface water, and noted that the characterization database for Life Cycle Impact assessment the study used (Environmental Footprint v3.1) does not contain information to characterize the impacts of direct release of these substances into soil).

INFLOWS	AMOUNT	UNIT
ACETONE, LIQUID	4.56	kg
DIESEL, BURNED IN DIESEL-ELECTRIC GENERATING SET, 18.5KW	60	MJ
HYDROCHLORIC ACID, WITHOUT WATER, IN 30% SOLUTION STATE	0.82	kg
HYDROGEN, GASEOUS, LOW PRESSURE	0.01	kg
METHANOL	0.22	kg
METHYLAMINE	0.35	kg
PMK OIL	1	kg

OUTFLOWS	AMOUNT	UNIT
MDMA-HCL SALT	0.77	kg
ACETONE	5.51	kg
METHANOL	5.56	kg
METHYLAMINE	2.30	kg

Limitations and recommendations

The fundamental limitation of the LCA study stems from its definition as a "screening-level" study conducted on an illicit process, which inherently restricts data availability and quality. This context results in substantial uncertainties, meaning the quantitative results should be interpreted solely as order-of-magnitude indications rather than precise figures. The study's primary value is therefore qualitative, aimed at identifying potential environmental hotspots and shining light on previously unseen environmental issues with illicit synthetic drug production. A significant limitation is the inconsistent quality and representativeness of data; for instance, some foreground data relies on very old literature, such as a 1969 source for 1,3-benzodioxole synthesis, which has very low temporal relevance. Furthermore, the analysis models a single synthesis pathway, using PMK methyl glycidate as a proxy for the more common PMK ethyl glycidate, which may not fully represent the most prevalent processes.

The study also contains several specific data gaps and exclusions that impact its completeness. The system boundary, while defined as "cradle-to-gate", omits the transportation between precursor suppliers and the final synthesis labs, the energy for pumping cooling water, and the infrastructure and ancillary services for commercial pre-precursor production. It also does not include the energy consumption for solvent recycling, despite assuming a 90% recycling rate for certain chemicals, leading to a likely underestimation of total energy impacts. Additionally, key environmental flows are missing due to data unavailability, including waste streams from the synthesis of precursors, emissions from the burning of seized products, and other waste flows associated with the dumping of production materials.

Finally, the assessment of uncertainty and consistency has important limitations. A detailed, quantitative uncertainty analysis, such as a Monte Carlo simulation, was deemed unfeasible. Instead, the study performed a high-level estimation by modeling the upper ranges for a few select parameters, which provides only a limited perspective on the potential range of outcomes. While the study applies a consistent impact assessment method (EF 3.1), this

method itself has inherent model uncertainties and may not fully characterize the severe, localized impacts of dumping concentrated chemical waste, particularly for substances not fully characterized in the database.

Despite these limitations, the study's primary strength lies in its structured and systematic application of an LCA framework to such a clandestine process. By adhering to the principles of the ISO 14040 standard where possible, the study was able to establish a clear goal, a cradle-to-gate system boundary, and a defined functional unit of 1 kg of MDMA-HCl, which provided a consistent basis for analysis. The study's methodological rigor was enhanced by applying the Piccinno et al. (2016) framework to systematically upscale laboratory data as well as the application of the comprehensive Environmental Footprint 3.1 method for impact assessment. This robust approach allowed us to draw valid conclusions despite a difficult data landscape and successfully meet the study's goal: to provide a qualitative definition of the production system, preliminarily identify environmental hotspots, and contribute to an improved understanding of the unforeseen consequences of this supply chain.

Building on this foundational work, future studies should focus on systematically addressing the key uncertainties and methodological gaps. A key improvement would be to model both the PMK methyl and ethyl glycidate pathways to understand the sensitivity of the results to this crucial proxy assumption. Future research should also prioritize quantifying the excluded flows by modeling the energy demand for solvent recycling and estimating the impacts of precursor transport from their origin in Asia. To move beyond the current study's high-level estimation, implementing a formal quantitative uncertainty analysis, such as a Monte Carlo simulation, is recommended. This would involve defining probability distributions elicited from experts for key parameters like yields and reaction times to provide a more robust understanding of the full range of potential impacts.

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Cannabis

Out of 45 European countries which provided information to UNODC over the last decade (2013-2023), 40 European countries reported the cultivation of cannabis or provided a ranking of the drugs which showed cannabis as the most widely produced drug, or reported trends on cannabis cultivation in their country and 42 countries (including 4 countries in addition to those identified before) reported the seizures of "cannabis plants" - which is another strong indication for the domestic cultivation/production of cannabis. This brings the total to 44 countries. No cannabis cultivation in Europe was only reported from one country (Vatican).

Practically all European countries reported cannabis as the main illicit crop found on their respective territory, i.e. in all countries that provided a ranking over the period 2020-2023 (38 European countries), cannabis was the most widely cultivated illicit crop.

Indoor versus outdoor cultivation in Europe

Most European countries report both outdoor and indoor cultivation for the period 2020-2023. A clear majority of European countries (22) reported more indoor than outdoor cannabis cultivation (the opposite was true for 13 countries for the period 2020-2023).

This analysis is based on answers provided by Member States to a question about the "ranking of illicit cultivation of crops" and was complemented, where necessary, with the answers to other relevant questions, including those related to the "area under cannabis cultivation", "cannabis produced", "cannabis area eradicated", "cannabis plants eradicated" and "cannabis sites eradicated". While Spain has reported a similar amount of indoor and outdoor cultivation during this period, authorities report that the latest available data suggest increased indoor cultivation.

Bosnia and Herzegovina and Montenegro were the few countries which reported only outdoor cannabis cultivation; in contrast, Norway, Sweden and Lithuania reported only cannabis indoor cultivation.

There is a geographical divide: most South-European and East European reported predominantly outdoor cannabis cultivation while indoor cannabis cultivation dominates most of Western, Central and Northern Europe. The only country where results differ from year to year is Spain, resulting in an average score that is exactly the same for indoor and outdoor cultivation over the period 2020-2023. Eradication of cannabis plants in Spain also shows similar patterns and differs from year to year.

Table. Main forms of cannabis cultivation in Europe, 2019-2023

Country	Dominant form of cannabis cultivation reported
Albania	More outdoor cannabis cultivation
Andorra	Cannabis cultivation (directly or indirectly) reported
Austria	More indoor cannabis cultivation
Belarus	More outdoor cannabis cultivation
Belgium	More indoor cannabis cultivation
Bosnia and Herzegovina	More outdoor cannabis cultivation
Bulgaria	Similar extent of indoor and outdoor cannabis cultivation
Croatia	More outdoor cannabis cultivation
Cyprus	More indoor cannabis cultivation
Czechia	More indoor cannabis cultivation
Denmark	More indoor cannabis cultivation
Estonia	More indoor cannabis cultivation
Finland	More indoor cannabis cultivation
France	More indoor cannabis cultivation
Germany	More indoor cannabis cultivation
Greece	More outdoor cannabis cultivation
Hungary	More indoor cannabis cultivation
Iceland	Cannabis cultivation (directly or indirectly) reported

Country	Dominant form of cannabis cultivation reported
Ireland	More indoor cannabis cultivation
Italy	More outdoor cannabis cultivation
Kosovo	Cannabis main illicit crop, but no further ranking provided
Latvia	More indoor cannabis cultivation
Luxembourg	Cannabis cultivation (directly or indirectly) reported
Lithuania	More indoor cannabis cultivation
Malta	More outdoor cannabis cultivation
Montenegro	More outdoor cannabis cultivation
Netherlands	More indoor cannabis cultivation
North Macedonia	Cannabis cultivation (directly or indirectly) reported
Norway	More indoor cannabis cultivation
Poland	More indoor cannabis cultivation
Portugal	Cannabis main illicit crop, but no further ranking provided
Republic of Moldova	More outdoor cannabis cultivation
Romania	More outdoor cannabis cultivation
Russian Federation	More outdoor cannabis cultivation
Serbia	More outdoor cannabis cultivation
Slovakia	More indoor cannabis cultivation
Slovenia	More indoor cannabis cultivation
Spain	Similar extent of indoor and outdoor cannabis cultivation
Sweden	More indoor cannabis cultivation
Switzerland	More indoor cannabis cultivation
Türkiye	More outdoor cannabis cultivation
Ukraine	More outdoor cannabis cultivation
United Kingdom	More indoor cannabis cultivation

Source: UNODC, responses to the annual report questionnaire.

The analysis of indoor versus outdoor cultivation was included in the Chapter as this has a considerable impact on the overall the carbon footprint of cannabis cultivation. For example, the available estimates from Canada show that the carbon footprint of indoor cannabis cultivation is significantly higher than cannabis cultivated outdoors.

Table. Comparison of the estimated carbon footprint of indoor and outdoor cannabis cultivation in Canada (kg of CO2e produced per kg of dry flower)

Indoor estimate	Kg of CO_2e per kg of dry flower	Outdoor estimate	Kg of CO_2e per kg of dry flower	Difference in the carbon footprint
Indoor high estimate	5,400	Outdoor high estimate	110.7	Indoor 49 times more than outdoor
Indoor high estimate	5,400	Outdoor low estimate	61.8	Indoor 87 times more than outdoor

Indoor estimate	Kg of CO_2e per kg of dry flower	Outdoor estimate	Kg of CO_2e per kg of dry flower	Difference in the carbon footprint
Indoor low estimate	3,200	Outdoor high estimate	110.7	Indoor 29 times more than outdoor
Indoor low estimate	3,200	Outdoor low estimate	61.8	Indoor 52 times more than outdoor

Carbon footprint of indoor and outdoor cannabis

No studies were identified that estimate the carbon footprint of cannabis production in Europe. That means the Chapter had to rely on studies conducted in Northern America, which are related to jurisdictions where cannabis production has been legalized. As such, the estimates included in the Chapter should only be regarded as rough indications or approximations of what the carbon footprint of cannabis in Europe could be.

Table. Carbon footprint of indoor cannabis cultivation (kg of CO_2e produced per kg of dry flower)

Study	Carbon footprint (kg of CO_2e produced per kg of dry flower) – Single value or lower range	Carbon footprint (kg of CO_2e produced per kg of dry flower) – Higher range	Scope
Mills, 2012, energy use (United States)	4,600		"Cultivation and transportation"
Summers et al., 2021 (United States)	2,300	2900	"Cradle-to-gate"
Desaulniers-Brousseau et al., 2024, (Canada)	3,200	2200	"Cradle-to-gate"
Mills, 2025, intensive commercial production (United States)	4,500		"Cradle-to-grave"
Mills, 2025, less intensive home cultivation (United States)	2,150		"cradle-to-grave"

Sources: Desaulniers Brousseau et al., “Greener green: the environmental impacts of the Canadian cannabis industry”, *Resources, Conservation and Recycling*, vol. 208 (2024); Summers, Sproul and Quinn, “The greenhouse gas emissions of indoor cannabis production in the United States”, *Nature* Sustainability, vol. 4, No. 7 (July 2021), pp. 644–50; Mills, “Energy-intensive indoor cultivation drives the cannabis industry’s expanding carbon footprint’, *One Earth*, vol. 8, No. 3 (February 2025); Mills, “The carbon footprint of indoor cannabis production”, *Energy Policy*, vol. 46 (July 2012), pp. 58–67.

Table. Carbon footprint of outdoor cannabis cultivation (kg of CO_2e produced per kg of dry flower)

Study	Carbon footprint (kg of CO_2e produced per kg of dry flower) – Single value or lower range	Carbon footprint (kg of CO_2e produced per kg of dry flower) – Higher range	Scope
Desaulniers-Brousseau et al., 2024, open-field cultivation (Canada)	61.8	110.7	"Cradle-to-gate"
Mills, 2025, greenhouse cultivation (United States)	2,500		"Cradle-to-grave"
Mills, 2025, open-field cultivation (United States)	700		"Cradle-to-grave"

Sources: Desaulniers Brousseau et al., "Environmental impact of outdoor cannabis production", *ACS Agricultural Science & Technology*, vol. 4, No. 7 (15 July 2024), pp. 690–99; Mills, "Energy-intensive indoor cultivation drives the cannabis industry's expanding carbon footprint', *One Earth*, vol. 8, No. 3 (February 2025); Mills, "The carbon footprint of indoor cannabis production", *Energy Policy*, vol. 46 (July 2012), pp. 58–67.

4. Drug trafficking

Seizures

Overview

The analysis presented in this report is mainly derived from the ARQ responses from Member States up to the 2023 reporting year. Seizures are reported in volume terms ("quantities seized") as well as in terms of the number of seizure cases.

Including information from other sources, UNODC was able to obtain data on quantities of drugs seized from 140 countries and territories for 2023, up from 133 in 2022. Seizures are thus the most comprehensive indicator of the drug situation and its evolution at the global level. Although seizures may not always reflect trafficking trends correctly at the national level, they tend to show reasonable representations of trends at the regional and global levels, unless affected by major policy changes (such as legalization of cannabis herb in several jurisdictions in the Americas).

The analysis of seizure cases enables a direct comparison of data across drug categories. Reporting of seizure cases is, however, less comprehensive. A total of 63 countries and territories reported seizure cases to UNODC in 2023, or 81 countries and territories if the period 2022-2023 is considered. The latter period was used for the determination of the distribution of such seizure cases by drug categories at the global level, with the total amounting to 5.5 million seizure cases or close to 2.8 million per year.

Conversion into kilogram equivalents

Countries reporting seizures of drugs in volume terms may report seizures using a variety of units, primarily by weight (kg) but also in litres, tablets, doses, blotters, capsules, ampoules, et cetera. When reporting about individual countries in individual years, UNODC endeavours to be as faithful as possible to the reports received, but often it is necessary to aggregate data of different types for the purposes of comparison. For the aggregation, conversion factors are used to convert the quantities into 'kilogram equivalents' (or 'ton equivalents'). UNODC continues to record and report the disaggregated raw data, which are available in the seizure listings published at: https://www.unodc.org/unodc/en/data-and-analysis/wdr2023_annex.html. In these tables, seizure quantities are reproduced as reported. In the rest of the Report, seizure data are often aggregated and transformed into a unique unit of measurement (such as "kilogram equivalents" or "ton equivalents"). Moreover, at some points in the analysis, purity adjustments are made where relevant and where the availability of data allows.

The conversion factors affect seizure totals of amphetamine-type stimulants (ATS), as a significant share of seizures of these drug types is reported in terms of the number of tablets. Apart from seizures of ATS tablets, drug seizures are mainly reported to UNODC by weight, and sometimes by volume. This includes seizures of ATS which are not seized in tablet form (for example, ATS in powder, crystalline or liquid form) as well as seizures of other drug types, such as heroin and cocaine. Moreover, ATS seizures made in tablet form are also sometimes reported by weight, and in some cases, the reported total aggregated weight possibly includes ATS seized in different forms. Reports of seizures by weight usually refer to the bulk weight of seizures, including adulterants and diluents, rather than the amount of controlled substance only. Moreover, given the availability of data, accurate purity adjustments for bulk seizure totals in individual countries are feasible in only a minority of cases, as they would require

information on purity on a case by case basis or statistically calibrated data, such as a weighted average or a distribution. The bulk weight of tablets is easier to obtain and less variable.

To ensure the comparability of seizure totals across different years and countries, UNODC uses conversion factors for ATS tablets intended to reflect the bulk weight of the tablets rather than the amount of controlled substance. The factors used in this edition of the *World Drug Report* are based on available forensic studies and range between 90 mg and 300 mg, depending on the region and the drug type, and also apply to other units which are presumed to represent a single consumption unit (dose). The table below lists the factors used for ATS, by type and region. The conversion factors remain subject to revision as the information available to UNODC improves.

Table: Weight of tablets in milligrams

	Ecstasy (MDMA or analogue)	Amphetamine	Methamphetamine	Prescription stimulants	Other stimulants	Non-specified amphetamines
Africa	271	250	250	250	250	250
Asia (excluding Near and Middle East/ South-West Asia)	300	250	90	250	250	250
Europe	271	253	225	250	250	250
Central and South America and Caribbean	271	250	250	250	250	250
Near and Middle East/ South-West Asia	237	170	250	250	250	250
North America	250	250	250	250	250	250
Oceania	276	250	250	250	250	250

For the other drug types, the weight of a ‘typical consumption unit’ was assumed to be: for cannabis herb, 500 mg; for cannabis resin, 135 mg; cocaine and morphine, 100 mg; heroin, 30 mg; LSD, 0.05 mg (50 micrograms); and opium, 300 mg. For opiate seizures (unless specified differently in the text), it was assumed that 10 kg of opium were equivalent to 1 kg of morphine or heroin. As in previous editions of the World Drug Report, seizures quantified by volume (litres) are aggregated using a conversion ratio of 1 kilogram per litre, which applies to all drug types. Cannabis plants are assumed to have an average weight – in terms of cannabis herb equivalents - of 100 grams.

Though these transformation ratios can be disputed, they provide a means of combining the different seizure reports into one comprehensive measure. The transformation ratios have been derived from those normally used by law enforcement agencies, in the scientific literature and

by the International Narcotics Control Board, and were established in consultation with UNODC's Laboratory and Scientific Section.

Conversion into S-DDDs

A special challenge has been the emergence of **pharmaceutical opioids** in recent years. For the year 2023 total seizures of 208 tons of codeine, 49 tons of tramadol, 20 tons of fentanyl and 26 tons of other pharmaceutical opioids were reported, if transformed into weight equivalents. Such seizure figures, without any further adjustments, however, may be still misleading as doses across pharmaceutical opioids vary significantly.

Directly comparable doses are, however, difficult to identify. One of the most comprehensive datasets in this regard are the defined daily doses for statistical purposes (S-DDD), established – with the help of experts - by the INCB. For the transformation of seizures of pharmaceutical opioids into doses such S-DDD, shown in milligrams of various substances per day, were used:

Substance	S-DDD in mg
Acetyldihydrocodeine	40
Alphaprodine	120
Anileridine	65
Bezitramide	15
Codeine (analgesic)	240
Codeine (cough suppressant)	100
Dextromoramide	20
Dextropropoxyphene hydrochloride	200
Dextropropoxyphene napsylate	300
Difenoxin	3
Dihydrocodeine (analgesic)	150
Dihydrocodeine (cough suppressant)	100
Diphenoxylate	15

Dipipanone	75
Ethylmorphine	50
Fentanyl	0.6
Heroin	30
Hydrocodone	15
Hydromorphone	20
Ketobemidone	50
Levorphanol	6
Methadone	25
Morphine	100
Nicomorphine	30
Normethadone	10
Norpipanone	18
Opium	100
Oxycodone	75
Oxymorphone	10
Pethidine	400
Phenazocine	20
Phenoperidine	4
Pholcodine	50
Piminodine	100
Piritramide	45
Propiram	100
Thebacon	15
Tilidine	200
Trimeperidine	200

Source: INCB, Narcotic Drugs 2024 (New York 2025).

For buprenorphine, a S-DDD of 8 mg - as reported by the INCB in its annual report on Psychotgropic Substances[28] - was used.

No such conversion ratios, however, have been established by the INCB for tramadol as this substance is not under international control. In this case, a review of doses provided in the literature ranged from 50 to 400 mg per day with a median of around 250 mg per day. (Tramadol tablets typically contain between 50 and 250 mg, i.e. the median daily dose would be equivalent to between 1 and 5 tablets, depending on the strength of the tablet). This ratio can be used as the best estimate for converting reported seizures into daily doses of seized drugs.

Moreover, reports suggest that most of the codeine seized in recent years has been in South Asia in the form of cough syrup while most of the fentanyl was seized in the United States and was heavily diluted.

28 INCB, Psychotropic Substances 2024 (New York 2025).

For the purposes of this report, the quantities seized were first transformed into S-DDDs (defined daily doses for statistical purposes) as provided by the INCB. Thus, for codeine a conversion ratio of 100 mg for one daily dose was used (as found for the use of codeine as a cough suppressant); for oxycodone 75 mg were used; for methadone 25 mg; for buprenorphine 8 mg and for fentanyl 0.6 mg were used.

For substances which are not under international control (and for which no official S-DDDs were established), such as tramadol, a review of the literature (including grey literature), as discussed above, gave as a best estimate, some 250 mg per day [starting from 25 mg to a maximum of typically 400 mg though in some cases also larger quantities of up to 600 mg have been reportedly prescribed); of course, such estimates of S-DDDs may change once better and more authoritative data on the daily use of tramadol become available.

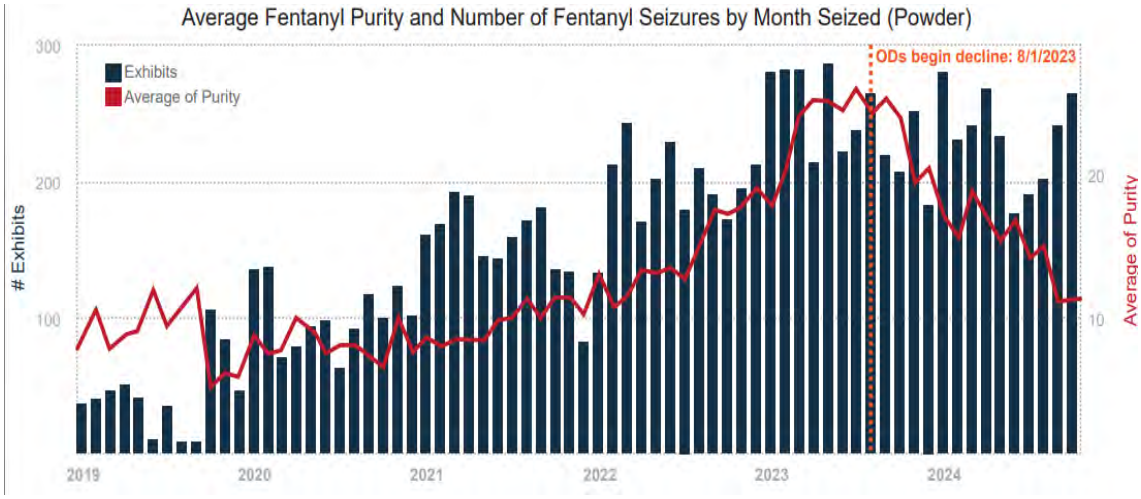
For the large group non-specified pharmaceuticals a ratio of 83 mg was assumed; this was the value of the unweighted average of all the opioids for which S-DDDs exist.

Subsequently, purity reported from the geographical areas where most seizures take place, was also taken into account.

The purity level of legal, pharmaceutical-grade fentanyl tends to be extremely high (98-99 per cent) while the purity of fentanyl on the black markets is usually far lower. Information from the United States, where global fentanyl seizures are concentrated, shows that purity of fentanyl on the black market varies strongly (0.07 per cent to 81.5 per cent of samples analysed in 2022) as well as over time. Purity averaged at 19.2 per cent in 2022, a clear increase on a year earlier and as compared to 2020.[29] This purity ratio was subsequently also used for the purity adjustments of fentanyl seizures reported to UNODC in 2022 and 2023. For the year 2024, the average purity of black-market fentanyl in the United States, however, fell again back to 11.4 per cent, the lowest level since 2022.[30] This – possibly – also contributed to the strong fall in the number of fentanyl related deaths in the United States in 2024 (-37 per cent) which fell even more than drug deaths in general (-27 per cent).[31]

[29] U.S. Department of Justice, Drug Enforcement Administration, National Drug Threat Assessment 2024 (May 2024, p.22).
[30] U.S. Department of Justice, Drug Enforcement Administration, National Drug Threat Assessment 2025 (May 2025, p.22).
[31] National Center for Health Statistics, US. Overdose Deaths Decrease almost 27 per cent in 2024 (14 May 2025).

Results from the DEA's Fentanl Profiling Program, 2019-2024



Source: DEA, Drug Enforcement Administration 2025 National Drug Threat Assessment (May 2025, p. 23).

Codeine is frequently seized in preparations such as cough syrups. Based on information obtained from South Asia, the content of codeine in such preparations varies though, on average, it seems to be equivalent to a codeine content of close to 20 per cent. This ratio was taken for the "purity adjustment" of codeine.

For other pharmaceutical opioids, in contrast, no substantial dilutions have been reported so-far; thus, no specific purity adjustment for these products were made.

Missing data

Usually, the total seizures of the individual countries are calculated to give the global total for a specific year. This approach tends to provide reasonable results as long as no data from countries reporting large seizures are missing. There are plenty of possibilities proposed in the literature to deal with missing data. Two distinct approaches have been used in the World Drug Report: 1. assumption that seizures of non-reporting countries remained unchanged; 2. Use of a paired index. This will be now exemplified, based on the case of amphetamine.

Table. Seizures of amphetamine, in kilogram equivalents, 2020-2023

	as reported					with estimates for countries with missing data	
	2020	2021	2022	2023	Total	2022	2023
Saudi Arabia	29,027	72,627			101,654	72,627	72,627
United Arab Emirates	25,135	4,989	3,569		33,693	3,569	3,569
Jordan	2,052	5,277	11,800	3,216	22,346	11,800	3,216
Italy	14,213	9	9	7	14,239	9	7
Türkiye	746	3,561	6,066	3,500	13,873	6,066	3,500
Syrian Arab Republic		2,615	6,950	1,674	11,240	6,950	1,674
United States		8,128	1,893		10,021	1,893	1,893
Poland	1,921	2,127	1,823	2,055	7,926	1,823	2,055
Sweden	1,282	1,619	1,913	2,766	7,581	1,913	2,766
Egypt	3,765	453	1,118	1,959	7,295	1,118	1,959
Pakistan	407	2,467	1,724	2,007	6,606	1,724	2,007
Lebanon	215	5,598	693		6,506	693	693
Burkina Faso		4,494		680	5,174	4,494	680
Germany			1,631	2,983	4,614	1,631	2,983
Iraq	368	617	2,011		2,996	2,011	2,011
Myanmar	2,145	111	280		2,536	280	280
Norway	530	756	237	597	2,120	237	597
Finland	256	393	304	838	1,791	304	838
Romania	1,572	8	16		1,596	16	16
Lao People's Democratic Republic	1,534				1,534	0	0
Belgium	1,133	306	4	0	1,444	4	0
Denmark	539	160	365	314	1,378	365	314
United Kingdom	308	308	243	331	1,190	243	331
Russian Federation	341	276	328	198	1,142	328	198
India	99	61	496	177	833	496	177
Mozambique		596			596	596	596
Spain	48	36	14	457	555	14	457
Serbia	168		73	271	511	73	271
Morocco			505		505	505	505
Qatar	0		499		499	499	499
Croatia	46	110	96	242	493	96	242
Australia	149	63	181	94	487	181	94
South Africa		480			480	480	480
Mali		107	1	300	408	1	300
Bulgaria	39	263	29	49	380	29	49
Ukraine	25	169	44	64	302	44	64
Lithuania	112	66	101	21	301	101	21

	as reported					with estimates for countries with missing data	
	2020	2021	2022	2023	Total	2022	2023
Canada	65	46	64	108	284	64	108
Slovenia	109	98	1	63	271	1	63
Estonia	128	26	40	65	259	40	65
Hungary	81	74	31	63	249	31	63
Austria	37	83	29	94	244	29	94
Niger	0	23		211	235	23	211
Switzerland	44	49	17	26	135	17	26
Netherlands	34	19	32	25	110	32	25
Greece	4	0	93	1	98	93	1
Ireland	20	6	21	0	47	21	0
Zambia				40	40	0	40
Brazil	5	11	1	19	35	1	19
Bosnia and Herzegovina		14	13	8	35	13	8
Latvia	8	13	11		32	11	11
Iceland		15		15	30	15	15
Ghana			14	16	30	14	16
New Zealand	3	3	7	13	26	7	13
Argentina	1	15	5	3	25	5	3
Gibraltar	0	1	21	0	21	21	0
Venezuela (Bolivarian Republic of)	12	0	1	2	15	1	2
Ecuador	2	10			12	10	10
North Macedonia			9		9	9	9
Czechia	2	1	3	1	7	3	1
Portugal	0	1	1	4	7	1	4
Montenegro	0	1	3	2	6	3	2
Israel	0	5			5	5	5
Kazakhstan	0		5		5	5	5
Republic of Moldova	0	1	1	2	5	1	2
China			4	0	4	4	0
Belarus	0	2	2	0	4	2	0
State of Palestine	0	3		0	3	3	0
Côte d'Ivoire	2				2	0	0
Luxembourg	0	2	0	0	2	0	0
Uzbekistan		2		0	2	2	0
Nigeria	1				1	0	0
Cameroon				1	1	0	1
Bahrain	0				0	0	0
Philippines		0			0	0	0

	as reported					with estimates for countries with missing data	
	2020	2021	2022	2023	Total	2022	2023
Mexico	0				0	0	0
Cyprus			0	0	0	0	0
China, Hong Kong SAR	0				0	0	0
Central African Republic			0	0	0	0	0
Malta		0	0	0	0	0	0
Albania			0		0	0	0
Chile	0				0	0	0
Slovakia	0	0	0	0	0	0	0
Guatemala	0			0	0	0	0
Andorra	0		0	0	0	0	0
Bahamas	0				0	0	0
Georgia		0	0		0	0	0
Madagascar				0	0	0	0
Armenia	0	0	0		0	0	0
Kyrgyzstan	0				0	0	0
Panama		0			0	0	0
Uruguay	0		0		0	0	0
Sub-total	**88,736**	**119,378**	**45,444**	**25,587**	**279,144**	123,699	108,794

If there are reasons to believe that seizures of countries follow more general or country-specific trends, such trend data can be used to estimate the missing data instead of the latest available data. The approach can be further fine-tuned by filling in missing data within a time series. In other cases, the Excel fill-in trend function was used for such purposes.

The second approach only adds up data from countries if such countries reported seizures in two subsequent years, i.e. in 2020 and 2021, in 2021 and 2022 and in 2022 and 2023. The growth rates are then calculated and an index is created.

Table. Calculation of paired index (based on a paired sample analysis)

Country	X Y_{-1} 2020	X_{+1} Y 2021	2022	2023
A	B	C	D	E
Saudi Arabia	29,027	72,627		
United Arab Emirates	25,135	4,989	3,569	
Jordan	2,052	5,277	11,800	3,216
Italy	14,213	9	9	7
Türkiye	746	3,561	6,066	3,500
Syrian Arab Republic		2,615	6,950	1,674
United States of America		8,128	1,893	
Poland	1,921	2,127	1,823	2,055
Sweden	1,282	1,619	1,913	2,766
Egypt	3,765	453	1,118	1,959
Pakistan	407	2,467	1,724	2,007
Lebanon	215	5,598	693	
Burkina Faso		4,494		680
Germany			1,631	2,983
Iraq	368	617	2,011	
Myanmar	2,145	111	280	
Norway	530	756	237	597
Finland	256	393	304	838
Romania	1,572	8	16	
Lao People's Democratic Republic	1,534			
Belgium	1,133	306	4	0
Denmark	539	160	365	314
United Kingdom	308	308	243	331
Russian Federation	341	276	328	198
India	99	61	496	177
Mozambique		596		
Spain	48	36	14	457
Serbia	168		73	271
Morocco			505	
Qatar	0		499	
Croatia	46	110	96	242
Australia	149	63	181	94
South Africa		480		
Mali		107	1	300
Bulgaria	39	263	29	49
Ukraine	25	169	44	64
Lithuania	112	66	101	21
Canada	65	46	64	108
Slovenia	109	98	1	63

Country	X Y_{-1} 2020	X_{+1} Y 2021	2022	2023
A	B	C	D	E
Estonia	128	26	40	65
Hungary	81	74	31	63
Austria	37	83	29	94
Niger	0	23		211
Switzerland	44	49	17	26
Netherlands	34	19	32	25
Greece	4	0	93	1
Ireland	20	6	21	0
Zambia				40
Brazil	5	11	1	19
Bosnia and Herzegovina		14	13	8
Latvia	8	13	11	
Iceland		15		15
Ghana			14	16
New Zealand	3	3	7	13
Argentina	1	15	5	3
Gibraltar	0	1	21	0
Venezuela (Bolivarian Republic of)	12	0	1	2
Ecuador	2	10		
North Macedonia			9	
Czechia	2	1	3	1
Portugal	0	1	1	4
Montenegro	0	1	3	2
Israel	0	5		
Kazakhstan	0		5	
Republic of Moldova	0	1	1	2
China			4	0
Belarus	0	2	2	0
State of Palestine	0	3		0
Côte d'Ivoire	2			
Luxembourg	0	2	0	0
Uzbekistan		2		0
Nigeria	1			
Cameroon				1
Bahrain	0			
Philippines		0		
Mexico	0			
Cyprus			0	0
China, Hong Kong SAR	0			
Central African Republic			0	0

Country	X Y_{-1} 2020	X_{+1} Y 2021	2022	2023
A	B	C	D	E
Malta		0	0	0
Albania			0	
Chile	0			
Slovakia	0	0	0	0
Guatemala	0			0
Andorra	0		0	0
Bahamas	0			
Georgia		0	0	
Madagascar				0
Armenia	0	0	0	
Kyrgyzstan	0			
Panama		0		
Uruguay	0		0	
Subtotal	**88,736**	**119,378**	**45,444**	**25,587**
	=+SUMIF(C5:C96, “>0”, B5:B96)	=+SUMIF(D5:D96, ">0", C5:C96)	=+SUMIF(E5:E96, ">0", D5:D96)	
Subtotal with seizures reported in year X if X_{+1} >0	87,029	41,122	35,955	
		=+SUMIF(B5:B96, ">0", C5:C96)	=+SUMIF(C5:C96, ">0", D5:D96)	=+SUMIF(D5:D96, ">0", E5:E96)
Subtotal with seizures reported in year Y if Y_{-1} >0		102,903	42,704	24,639
Change (Y/X)		1.18	1.04	0.69
Paired index (2020 = 100)	100	118	123	84

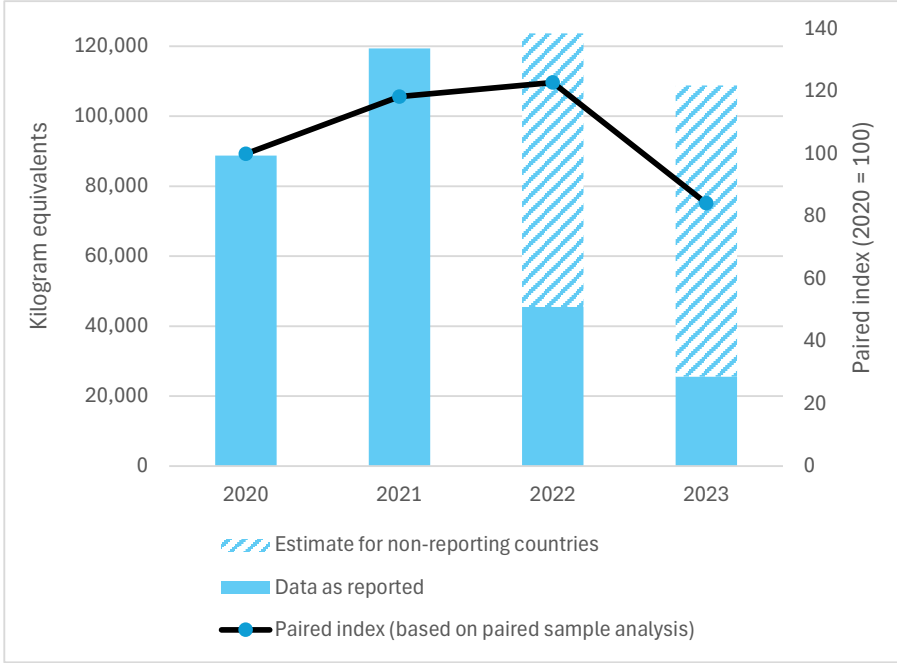
Amphetamine-seizures, as reported by member states, would have shown – overall - dramatic declines of such seizures in 2022 (-62 per cent), basically resulting from the non-reporting of such seizures by one country in that specific year, as well as further declines in 2023 (-44 per cent). However, there are indications such a massive decline in 2022 would not have reflected reality. It was – most probably - a mere statistical artefact. There are no indications that overall trafficking in amphetamine showed any massive declines in 2022.

In contrast, assuming unchanged seizures of non-reporting countries in 2022 would have led to a small increase (4 per cent) of such seizures in 2022, followed by a far more moderate decline in 2023 (-12 per cent).

Using a paired index (based on a paired sample analysis), i.e. analysing only seizures of countries reporting in 2021 and 2022, would have shown again a small increase in 2022 (4 per cent) while analysing data from countries reporting in 2022 and in 2023 would have shown a more pronounced decline of such seizures (-31 per cent), though still less than the decline shown in the original statistics (-44 per cent).

While it is difficult, if not impossible, to come to a definite conclusion of whether the calculation of a paired index or the provision of data including estimates for non-reporting countries (based in this case on the last available data) are, in the end, providing more reliable estimates on seizures and trafficking trends, it is very likely such attempts to deal with the problem of missing data heads-on will eventually show better results than if the issue of missing data is simply ignored.

Figure. Global seizures of amphetamine, 2020-2023



Source: UNODC, responses to the annual report questionnaire

Trafficking routes and volumes

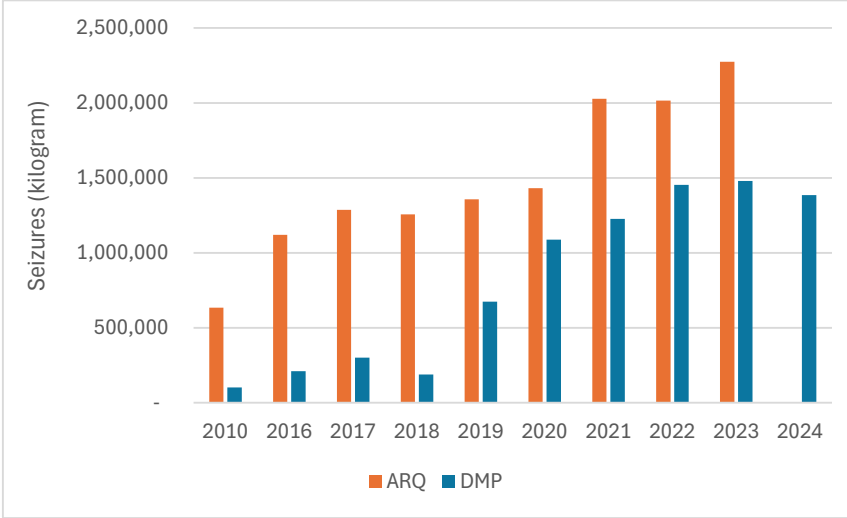
Information of trafficking routes was mainly obtained from analyses of reports by Member States in the annual report questionnaire, complemented by individual drug seizures reported to UNODC, as well as analyses of trafficking routes reported by Member States.

Individual drug seizures (IDS) would be the ideal data source for any in-depth analysis of drug flows. Unfortunately, reporting of individual drug seizure cases is still rather uneven though overall coverage has clearly improved in recent years (though not really due to Member States reporting).

The total number of countries and territories submitting IDS increased from 67 in 2020 to 87 in 2024. This information provided by member states was significantly expanded further by active searches for such data by UNODC on Government sites, partner organisations and the harvesting of such seizure reports in the mass media. The number of overall individual drug seizures collected rose from 116 countries and territories in 2016 to 129 by 2021 and more than 160 annually over the 2022-2024 period. Thus, the overall coverage, has clearly improved in recent years.

In the case of cocaine, e.g. the weight of aggregate individual seizures reported through UNODC's Drugs Monitoring Platform, expressed as a proportion of the total weight of annually seized cocaine, as reported by Member States in the annual report questionnaire, rose from just 16 per cent of the total in 2010 to 23 per cent by 2017 and to, on average, 68 per cent over the period 2020-2023. Seizure data collected through UNODC's Drugs Monitoring Platform has thus clearly gained in importance in recent years.

Figure. Aggregate individual cocaine seizures (DMP) and annual seizures of cocaine (ARQ), 2010 -2023/2024



Sources: UNODC, responses to the annual report questionnaire and UNODC, Drugs Monitoring Platform.

Information for the maps has been – primarily – based on information contained in the annual report questionnaire, while individual drug seizures reports and official national documents were used to fill data gaps.

Some of the maps, however, have been fully based on UNODC's Drugs Monitoring Platform. The number of collected individual drug seizures increased from less than 10,000 cases in 2010 to some 20,000 cases in 2018, 29,000 in 2019, some 33,000 cases per year over the period 2020-2022 and 138,000 cases in 2024.

Nonetheless, the latter numbers remain still small compared to the overall number of annual seizure cases reported by Member States to UNODC in the annual report questionnaire, amounting to, on average, around 2.8 million drug seizure cases per year over the period 2022-2023 period.

Main trafficking routes as described by reported seizures

Seizures made in the various regions over the 2020-2023 period were used as a proxy for the importance of drug trafficking activities. Such seizures were distributed according to the countries of departure and transit mentioned by countries in the various regions for the period 2020-2023 (outside of the regions analysed), as weighted by the total reported seizures at the national level. This served as a basis for the calculation of (likely) importance of the various trafficking flows, taking into account that drugs could be seized at different stages along the trafficking route and drugs may need to travel across several sub-regions to reach the seizing country.

A similar approach was implemented using the countries of intended destination reported by the seizing Member States. Afterwards, the flows obtained from using reported departure/transit and destination information separately were put together to estimate the final relative size of the flow. This procedure was implemented at the sub-regional level to produce a matrix of flows across sub-regions. Afterwards, the main countries of departure or transit (and destination) were identified based on the weighted amounts that were seized while being trafficked from (to) them, according to reported seizures by Member States.

Drug price and purity data

Price and purity data, if properly collected and reported, can be powerful indicators of market trends. Trends in supply can change over a shorter period of time when compared with changes in demand and shifts in prices and purities are relatively good indicators for increases or declines of market supply. Research has shown that short-term changes in the consumer markets are first reflected in purity changes while prices tend to be rather stable over longer periods of time. UNODC collects its price data from the ARQ, and supplements this data with other sources such as DAINAP, EMCDDA and Government reports. Prices are collected at farm-gate level, wholesale level ('kilogram prices') and at retail level ('gram prices'). Countries are asked to provide minimum, maximum and typical prices and purities. When countries do not provide typical prices/purities, for the purposes of certain estimates, the mid-point of these estimates is calculated as a proxy for the 'typical' prices/purities (unless scientific studies are available which provide better estimates). What is generally not known is how price data and purity data were collected and how reliable the provided data are. Although improvements have been made in some countries over the years, a number of law enforcement bodies have still not established a regular system for systematically collecting purity and price data.

Prices are collected in local currency or in the currency in which the transactions take place and are then converted by UNODC into US dollars for the purposes of comparability among countries. The conversion into US dollars is based on official UN rates of exchange for the year. If comparisons of prices, expressed in US dollars are made over different years it should be noted that changes in such prices may be also influenced by changes in the exchange rates and may not necessarily reflect changes in the local markets.

Standardized prices of cocaine and heroin in the United States and Western Europe

The price and purity data used for the various figures found in the report are available under 8. Prices and purities of illicit Drugs (Tables) in the statical annex of the 2025 World Drug Report. https://www.unodc.org/unodc/en/data-and-analysis/world-drug-report-2025-annex.html

For the time series data for heroin and cocaine of Western Europe and the United States, the following methodology was used: For the case of heroin and cocaine prices in the 17 European

countries in this Table, the published prices correspond an average of the available prices for the specific year (e.g., “crack” and cocaine salts, or white and brown heroin), if more than one type of drug is reported, or the typical value if only one price is reported by the country. In order to properly calculate the weighted averages across the 17 European countries, in those countries for which no data is available, a “best estimate” is reported. This “best estimate” is based on: a) the latest reported value, b) an interpolation between two reported values, or c) the midpoint between the reported low and high observed prices (when a typical value is not available).

In order to properly reflect the prices faced by the population within these 17 countries, the average prices are weighted by the population 15-64 years old. A reported average price per gram in Euro is also published based on the average exchange rates for the corresponding year, and the reported units (gram for retail, kilogram for wholesale). Finally, the inflation-adjusted weighted average is expressed in 2023 Euros, by deflating the prices using the Consumer Price Index (CPI) published by Eurostat.

For the case of heroin and cocaine average prices at the retail level in the United States of America, both series were reviewed in 2021 as the revised data up to 2018 was made available. Authorities from the United States of America provided UNODC with newly available quarterly data on the price and purity of cocaine and heroin at the retail level for the 2005-2018 period. The average quarterly price for each of these years is reported. For the year 2019, cocaine price data reported in reply to UNODC’s annual report questionnaire were used while same typical price for heroin in 2019 as in 2018 was used as reported price ranges for heroin did not change between the two years. Since no data on prices was available for 2020 in the United States, the same values used for 2019 were used as reference for this year. In the case of years prior to 2005, the yearly trends from the previously published series are used to retropolate the price available for 2005. These trends are based on ARQ data and data from ONDCP, *2015 National Drug Control Strategy - 2015 Data Supplement*.

In the calculation of purity adjusted average heroin prices, the purity provided by national authorities at the quarterly level are used for 2005-2018, while data available through the ARQ or published in ONDCP, *2015 National Drug Control Strategy - 2015 Data Supplement* are used for previous years. In the calculation of purity adjusted cocaine prices, data from ONDCP is also used up to the year 2004. No data are available from 2019 onwards.

Inflation adjusted prices in the United States were deflated using the CPI, published by the Bureau of Labor Statistics. For inflation adjusted average drug prices in Western Europe drug prices were deflated using the Harmonised Indices of Consumer Prices (HICP) published by Eurostat for the Euro area.

Trafficking of drugs on the dark-web

Over the last few years, UNODC has also regularly analyzed – based on available information – changes and patterns of drug trafficking via the darkweb.

The UNODC analysis of sales on darknet markets has been based on (i) original data from Hikari Labs which uses web-crawling techniques to identify and collect data from darknet markets, "scraping" relevant information from such sites, (ii) data collected by Chainanalysis, analysing licit and illicit flows based on major crypto-currencies as well as, in the past, on (iii) information gathered through the Global Drug Survey, a non-representative convenience sample of roughly 100,000 self-selected people from more than 50 countries each year, which basically confirmed the findings obtained from Hikari Labs and Chainanalysis.

Hikari Labs is a spin-out from Carnegie Mellon University's CyLab Security and Privacy institute, located in Pittsburgh, Pennsylvania. Hikari Labs has regularly scraped major darknet markets. The raw data obtained from such monitoring was then used by UNODC for further calculations and analyses.

Data from Hikari Labs provided detailed information on 39 major global darknet markets analyzed over the period 2011-2022, thus providing insights into a number of dimensions of global darknet market activities. Data provided include information on individual transactions, the minimum sales generated by vendors on the various markets, the length of time markets were operating and/or vendors have been active on such darknet markets, the type of substances or services offered and sold, the likely origin of the vendors (i.e. from where the substances were shipped) or the distribution of darknet sales.

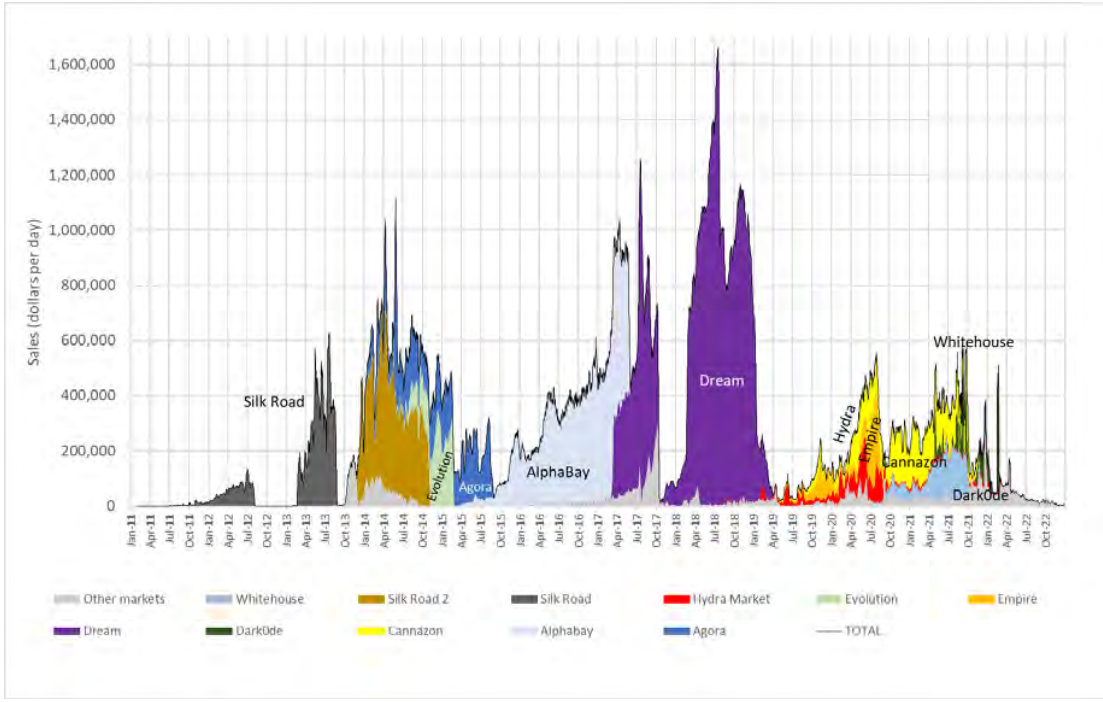
As of June 2022, more than 1.4 million listings of drugs and other substances and services were identified on the monitored darknet markets over the period 2011-June 2022; more than 87,000 vendors were identified, leading to more than $19 million transactions via the darkweb and total sales of more than $1.29 billion of which more than 90 per cent were drug related in recent years (91 per cent in 2021).

Drugs and other goods and services are usually offered by vendors on a darknet market, providing information on the quantities of items offered and the price requested. Once a transaction has taken place and the item delivered, the customer usually leaves feedback under the listed item. While the effective money flows are usually not known, feedback can be used as a proxy for actual transactions. Sales calculations then assume that "one" item at the offered price was purchased. Calculating the total sales made on a darknet market on the basis of the number of individual feedback comments thus generates a "conservative" (i.e. a very low) estimate because:

a) not all customers leave feedback though on some markets customers are actually compelled to comment because vendors consider positive feedback to be one of the most important marketing tools on the dark web;
b) a customer can purchase more than the minimum unit quantity offered on a darknet market.
c) not all sites from a darknet market can be fully scraped within a short period of time without arousing suspicion by site administrators. Thus, the actual proportion scraped can differ substantially from market to market and over time (ranging initially (i.e. prior to mid–2015) from 60 per cent to more than 90 per cent of market sites). In recent years, this bias seems to have gained further in importance, possibly as a result of administrators being better equipped to combat unwanted monitoring. On average 50 per cent of darknet market sites could be scraped in the period mid-2017–2020, compared with close to 87 per cent in the period 2011–mid-2017. Assuming items offered and sold on non-scraped darknet sites are similar to those on scraped darknet sites (which is not certain), this could mean that actual darknet sales, for several years, may have been twice as high as the calculated minimum darknet sales though this ratio clearly increased in more recent years, notably after the emergence of Hydra market, i.e. after 2018, when the proportion of existing sites scraped fell drastically.

Of particular interest has been the development of major darknet markets between 2011 and 2021, clearly showing the emergence of new markets as others were either dismantled by the authorities, were subject to successful attacks by competitors or were subject to some exit scams by the operators.

Table. Observed minimum daily sales (mostly drugs) on 39 major darknet markets, 2011-2022



Source: UNODC calculations based on Hikari Labs data.

Note: Data refer to minimum stacked market sales of different products and services, of which drugs accounted for some 90 per cent, and are presented as seven-day averages. All data shown reflect minimum sales as the current web-crawler techniques do not cover all sites on a specific market and because not all customers leave feedback, information which is used to arrive at total sales figures. Recent data shown are grossly under-represented (due to low coverage ratios), notably for Hydra market, the world's largest darknet market prior to its dismantling in April 2022.

Data collected and analysed also enabled the identification of the main departure countries of drug shipments. Though not all vendors may have truthfully reported from where the drugs were shipped, there are still indications that by and large the information was basically correct as countries which would have been farther away from the final consumers would have led to negative feedback of customers complaining about the unexpectedly long shipping period.

It should be, however, noted that the coverage of individual markets through scraping attempts may significantly differ. There are, e.g. indications that the actual coverage of information collected from Hydra market, for instance, until 2022 the world's largest darknet market operating in the Russian language, may have been particularly low (less than 1 per cent), suggesting that actual sales done on this market may well have been substantially higher than indicated by the minimum sales figures in Hikari Labs data.

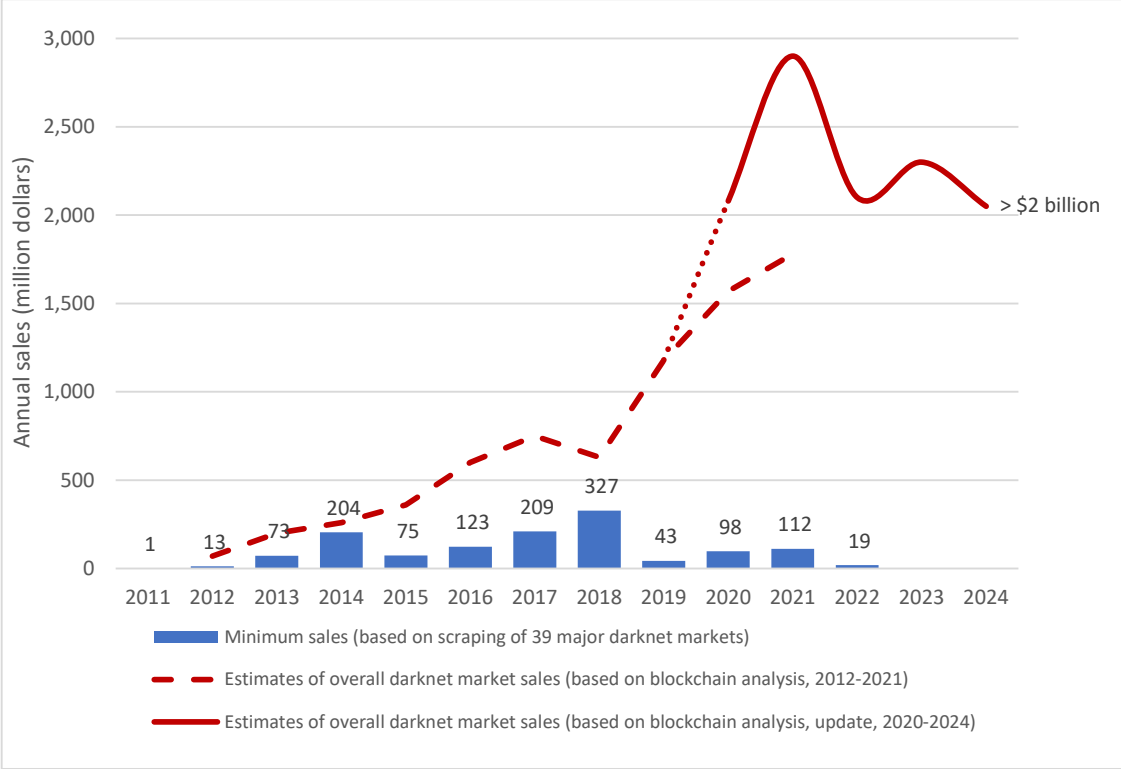
The operations of Hikari Labs, however, have been rendered difficult in recent years as platforms operating on the darknet successfully introduced measures to prevent such scraping – and thus no more results after 2022 have been published by UNODC.

The main sources of information in more recent years have been the data collected by **Chainanalysis**, based on an analysis of the blockchains of major crypto-currencies. The work of Chainanalysis mainly consists of systematically analysing existing blockchains (such as for bitcoins) and identifying (digital) wallet addresses which are apparently linked to criminal activities, including drug trafficking, using open-source intelligence (scanning of public websites, social media, fora, blockchain explorers), analysing transaction patterns with various darknet markets while cooperating with darknet exchanges and with law enforcement. The financial flows between the various “illicit” addresses (i.e. addresses linked to criminal activities) are then analysed and recorded. Such data and analyses are also the basis for the annual Crypto Crime Reports issued by Chainanalysis.

The analysis of such blockchain data revealed overall significantly higher levels of darknet market activities than the minimum sales data collected via web-crawler techniques on major darknet markets, notably in more recent years.

Irrespective of differences, both data sets indicated a strong increase in darknet market activities until 2021, followed by a strong decline of such darknet market activities in 2022, primarily linked to the dismantling of Hydra market by the German authorities in April 2022. This was a mainly Russian speaking darknet market, which in the years prior to its dismantling (based on data from Chainanalysis) seems to have accounted for close to 80 per cent of all darknet market activities.

Figure. Observed minimum sales on 39 major darknet markets (mostly drug-related), 2011-2022 and estimates of overall darknet market sales (mostly drug-related) based on blockchain analysis, 2012-2024



Sources: UNODC calculations based on Hikari Labs data and Chainanalysis, Crypto Crime Report 2025 (and previous years).

Note: the significantly higher numbers in the estimates of Chainanalysis for 2020 and 2021 in later years were mainly due to the fact that Chainanalysis identified a number of additional "illicit" addresses in later years and added the transactions linked to these addresses in 2020 and 2021 to the overall estimates.

Following a strong decline in the first half of 2022, transactions started to recover in the second half of 2022 and in 2023 before showing another drop in 2024 while still remaining above the $2 billion benchmark figure. The drop in 2024 was partly due to further law enforcement successes in a number of countries but may have been partly also a statistical artefact as some actors on the darknet markets moved from the traditional Bitcoin to the popular privacy coin Monero which – for the time being – is not properly monitored by Chainanalysis.

Recent results by Chainanalysis suggested that in particular various Russian speaking platforms (such as Kraken darknet market, Mega, Blackspruit, OMG/OMG Market) tried to fill the void created by the dismantling of Hydra Market in 2022 while Abacus emerged as

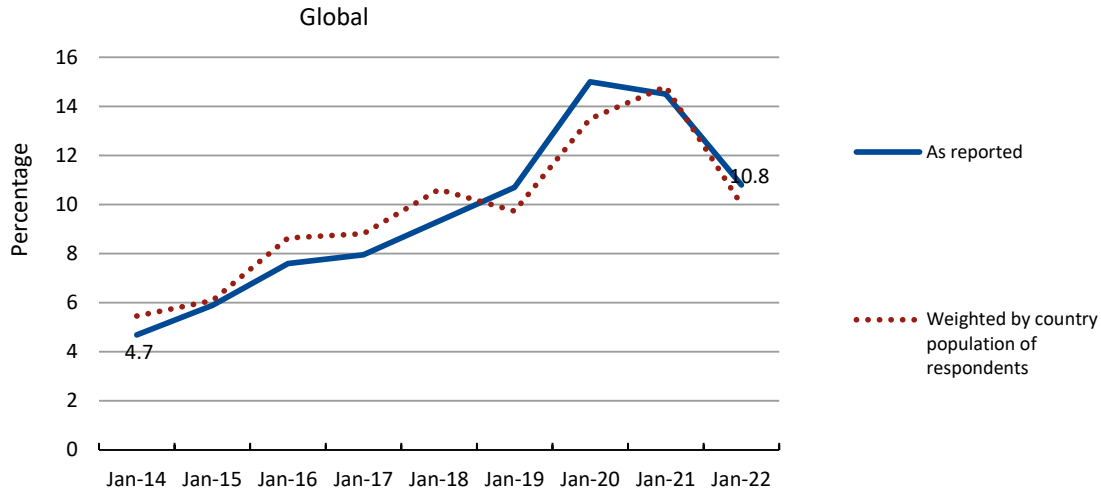
the largest “western” market, though only ranking 6th on the global darknet markets ranking in 2024 based on overall transactions.

In addition, various Internet sites regularly provide estimates on the importance of the various darknet markets, usually based on the number of identified listings. One such ranking, based on the situation in May 2025, put Abacus first, followed by a number of other darknet markets for which the sale of drugs, however, was no longer of major importance.

Another source of information on trends in darknet markets, used in previous editions of the World Drug Report, came from data collected via the **Global Drug Survey**. Even though this information was not based on a random sample, as usually used in social sciences, the mere size of the number of participants (around 100,000 people, including some 54,000 persons per year reporting on drug purchases via the darknet over the period 2014-2022) helped to shed some light on underlying trends. The results from this survey basically backed up the results from Hikari Labs and Chainanalysis and provided additional insights into the operations of the darknet markets worldwide.

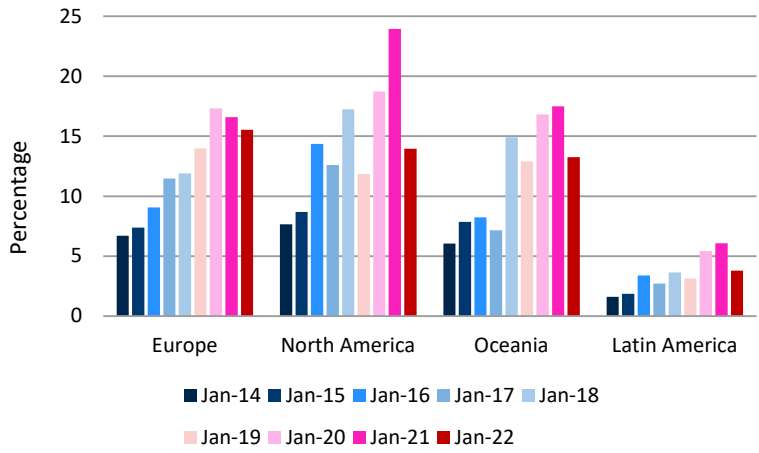
As no new data have been published since 2022, the Global Drug Survey results are no longer shown and discussed in the 2025 World Drug Report, though they can be still found in previous editions of the World Drug Reports, and their findings are still valid.

Figure. Proportion of people purchasing drugs over the dark web among surveyed Internet users who used drugs in the past year, January 2014 to January 2022 (or latest year available)



Source: UNODC calculations based on Global Drug Survey.

Proportion of people purchasing drugs over the dark web among surveyed Internet users who used drugs in the past year, selected regions and subregions, 2014-2022



Source: UNODC calculations based on Global Drug Survey

5. Drug-related crime and criminal justice system

This section specifies the methodology applied for the calculation of the estimates of people in formal contact with the police, prosecuted and convicted.

Note: The methodology has been further refined and updated since the introduction of these estimates in the 2024 World Drug Report. Results are therefore not directly comparable between the 2024 and 2025 World Drug Reports.

Sources

The Annual Report Questionnaire (ARQ) is the main source used for these estimates. When data are not available, or is not consistent and robust, data from the UN Crime Trends Survey (UN-CTS, https://www.unodc.org/unodc/en/data-and-analysis/United-Nations-Surveys-on-Crime-Trends-and-the-Operations-of-Criminal-Justice-Systems.html) are used. For a limited number of countries, other sources were utilized.

The following steps were implemented to estimate the number of people in formal contact, prosecuted and convicted for drug use/possession, drug trafficking and other drug related offences.

Step 1: Values at the national level

As a general rule, only data for the 2020-2023 period were considered with the most recently reported value being considered for the estimation procedure. If no data were available, the country estimate was left blank. In a few exceptional cases, data older than 2020 was used.

Step 2: Regional estimates

For each of the countries with available data, the rate per 100,000 population for formal contact, prosecution and conviction was calculated for the total number of drug-related offences using the corresponding population for the year in which the data were available. For each of the five regions defined in the World Drug Report, a regional rate was then calculated weighted by the 2023 population figures from the United Nations World Population Prospects. For each of the countries without data in a particular region, the regional rate was applied. Finally, for each of the regions an estimate was produced for the total number of people in formal contact, prosecuted and convicted for any drug-related offence using the rates multiplied by the population figures.

Step 3: Global estimates

Once the regional estimates were obtained, they were summed up to obtain the global estimate.

Step 4: Disaggregating by three offence types (drug trafficking, possession/use and other drug-related offences)

For each of the three offence types, the proportion of the total was calculated for countries with data. Next, a regional proportion was calculated weighted by the total number of offences in each country. The estimated proportions were then multiplied by the estimates obtained in step 2 to compute the estimates for each of the three offence types.

Step 5: Sex disaggregated estimates

The proportion of men and women was calculated for countries with sex disaggregated data. Next, a regional proportion was calculated weighted by the total number of offences in each country. The estimated proportions were then multiplied by the estimates obtained in step 4 to compute estimates for men and women by offence type.

6. Additional references used in the WDR online segment

Infographic: The spread of novel semi-synthetic cannabinoids such as delta-8 THC and HHC

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Mixtures and blends - inadvertent polydrug use (Kush, Tuci, Happy water, etc): Infographic "Examples of drug mixtures and concoctions"

The complete list of references which served as a source for the presented information is as follows:

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Wastewater analysis results obtained from published scientific literature

Certain analyses presented in the web-based segment of the World Drug Report are comparing the wastewater analysis results of various subregions of the world and thus are using also results from the scientific literature to have a wider geographic coverage. While the comparability between SCORE group analyses and the values from various studies published in the scientific literature may not be complete, these results give an indication of the geographic distribution of the use of the studied substances.

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B) Amphetamine and methamphetamine

Methodology is described on the SCORE network website: https://score-network.eu/applications/ and in an EUDA publication: https://www.euda.europa.eu/publications/html/pods/waste-water-analysis_en#section4 Methodology used in the generation of data which were extracted from the published scientific literature is described by the authors in each article. Below is the full list of references.

Studies used to complement SCORE data on mean loads of amphetamine and methamphetamine per 1,000 inhabitants

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Methodology of the wastewater analysis data is described on SCORE network website: https://score-network.eu/applications/ and in the following EMCDDA publication: https://www.emcdda.europa.eu/publications/insights/assessing-drugs-in-wastewater_en

Some additional data were extracted from the scientific literature. Methodology used in the generation of data which was extracted from the published scientific literature is described by the authors in each article. Below is the list of references.

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