# New indicators of illegal drug use to compare drug user populations for policy evaluation

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## ABSTRACT

**BACKGROUND:** New trends in drug consumption show a trend towards higher poly-use. Epidemiological indicators presently used are mostly based on the prevalence of users of the "main" substances and the ranking of harm caused by drug use is based on a single substance analysis.
**METHODS:** In this paper new indicators are proposed; the approach consider the segmentation of the population with respect to the frequency of use in the last 30 days and the harm score of the various substances used by a poly-user. Scoring is based on single substance score table reported in recent papers and principal component analysis is applied to reduce dimensionality. Any user is characterized by the two new scores: frequency of use score and poly-use score.
**RESULTS:** The method is applied to the drug user populations interviewed in Communities and Low Threshold Services within the Problem Drug Use 2012 survey in four different European countries. The comparison of the poly-use score cumulative distributions gives insight about behavioural trends of drug use and also evaluate the efficacy of the intervention services. Furthermore, the application of this method to School Population Survey 2011 data allows a definition of the expected behaviour of the poly-drug score for the General Population Survey to be representative.
**CONCLUSIONS:** In general, the method is simply and intuitive, and could be applied to surveys containing questions about drug use. A possible limitations could be that the median is chosen for calculating the frequency of use score in questionnaires containing the frequency of drug use in classes.

*Key words: health indicators of drug use, cumulative distributions, survey data set comparisons, behavioural trends.*

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***DOI:*** ***10.2427/8891***
*Published as Online First on June 3, 2014*

## INTRODUCTION

New trends in drug consumption present new challenges for monitoring and assessing the demand for drugs, the size of the drug market and the lifestyles of users. Drug consumption shows higher and higher proportions of poly-use. Poly drug use has widely been recognized as a serious health risk [1,2]. For these reasons, a large amount of research has focused on identifying which drugs are usually combined together and on the consequences of combining them [3-5].

By contrast, epidemiological indicators used to monitor and evaluate drug policies are mostly based on the prevalence of users of the "main" substances and the ranking of the harm of substances is based on a single substance analysis [6-9]. Also the definition of Problem Drug User (PDU) according to the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) is based on single substance abuse [10]. New comprehensive indicators are thus needed to overcome the limits of the presently used methods, which were mostly developed in the nineties when poly-drug use was basically unknown and the number of psychoactive substances in the market was very low. Presently poly-drug use represents "normality" among frequent users, with the exception of "pure" cannabis users [11], and more and more psychoactive substances appear in the market every year. In 2010 forty two new psychoactive substances were detected by European Police Office (Europol), forty seven in 2011, and more than seventy in 2012.

In the present contribution new epidemiological indicators are introduced to weight the consumption of several psychoactive substances during the same period of time. The indicators take into account both the frequency of use and the harm caused by the various substances used, providing a tool to evaluate policies and, in particular, demand reduction and primary prevention interventions. Furthermore, the indicators can be applied to various populations of drug users if the data sets provides the necessary information.

To this aim, the following issues are dealt with:

- the segmentation of the consumer population, based on the intensity of use [12];
- the harm caused by poly-use, represented by a score based on the ranking proposed by van Amsterdam et al. in 2010 [8];
- the application of these indicators in various countries to drug user populations.

In the following sections the methodology is described and applied to the Problem Dug Use 2012 (PDU 2012) survey among drug users assisted by Communities and Low Threshold Services in four European countries. General exploratory analyses are reported in [13]. Respondents were asked to give information about their drug use in a questionnaire. The countries were: Catalonia (Spain), Czech Republic, Italy and Portugal. The sample sizes are Catalonia 513, Czech Republic 148, Portugal 381 and Italy 720.

The indicators show how the data can be used for comparison and analysis of interventions in these countries. Furthermore, a comparison with the application of this method to a survey about drug use among teenagers (School Population Survey) gives interesting insights about the drug use of different subpopulation on the drug scene.

## METHOD

The two indicators, recently introduced to analyze teenage drug users [14], measure respectively the frequency of drug use and the harm score of the substances used, taking into account poly-use.

### The segmentation of the consumer population with respect to the frequency of use in the last thirty days

Various surveys are employed to collect data about frequency of use in the last 30 days (lifetime prevalence and last 12 months prevalence are also recorded). Five classes of frequency are generally considered for each substance (measured in days of consumption in the last 30 days): 1-2, 3-5, 6-9, 10-19, >19.

In a previous study [12], the population of drug users was segmented into three classes characterized by different frequencies of use in the last thirty days, on the basis of the classes in the questionnaires. In particular:

a. the first and second classes correspond to occasional users,
b. the third and fourth to regular users,
c. the last one to intensive users.

A problem for calculating the global frequency of use arises for poly-users. In fact, most consumers (with the exception of occasional users and pure cannabis users) report the use of various substances in the last thirty days.

The proposed approach consists in including the frequencies of use and the substances used in a table to classify and weight poly-users. As an example, if a user

declares having consumed in the last thirty days: cannabis in the second class of frequency of use (3-5) and cocaine in the first one (1-2), it is possible to evaluate an overall frequency of use in the last thirty days by taking the medians of the classes and totalling them up. The user has then an overall frequency of use of 5.5 and is classified in the second segment: the regular users (Table 1), although he/she would be classified among occasional users for each substance.

### The global harm score of the substances

The proposed approach for scoring the harm of various substances is based on the scores proposed by van Amsterdam et al [8]. The analysis reported in the present contribution takes into account the physical harm (acute and chronic toxicity) and dependence scores only, because the social harm depends on the prevalence of use of the substances which may also vary according to country. These aspects have been considered in a paper in which up-dated estimates of prevalence, taking into account poly-use, were calculated for Italy [11].

Van Amsterdam [8] proposed the means of the various scores as a synthetic index. In the present contribution a preliminary explorative analysis, using principal components [15], allows for the proposal of a weighted mean as the unique global index to score the overall physical harm of the s ubstances used by poly-users (tobacco has been excluded from this analysis).

In Table 2 the basic three variables of van Amsterdam et al. are reported. Principal component analysis is applied to the three vectors X, Y and Z. The variances explained by the three principal components are respectively: 77%, 14%, 9%. With respect to the un-weighted mean proposed by van Amsterdam, the first principal component explains a greater variability of the data, thus it is more representative. The unique index obtained by weighting each substance with the first component is denoted by W. The index provides an ordering of the substances that is used to evaluate the physical harm for poly-drug users.

### The poly-use score

The rule proposed to combine the harm caused by the different substances used by any user in the last thirty days advocated evaluating the global degree of harm for poly-drug users. For the i-th user the poly-drug score is simply obtained by adding up the score of each substance multiplied by frequency of use for all the substances used in the last thirty days. If the score of substance j is denoted by $w_{ij}$ and the frequency of use of the substance by $f_{ij}$, then the global harm Hi of i-th user is given by

$$H_i = \sum w_{ij} f_{ij}$$

where the equation includes all the substances used in the last thirty days.

According to the proposed approach and taking into account the frequency of use, any user is characterized by the two scores frequency of use score and poly-use score. The scores have no maximum and show a very high variability, so a normalization should be considered. Neverthless, since the system of score is applied to a survey conducted homogenously in different countires, it was chosen to use absolute scores.

## RESULTS

The poly use score is applied to PDU 2012 survey to compare situations in various

TABLE 1

POLY-DRUG USE FREQUENCY CALCULATION: AN EXAMPLE

| | FREQUENCY OF USE (MEDIAN VALUE FOR THE CLASS) | | | | | |
|---|---|---|---|---|---|---|
| SUBSTANCE | 0 | 1.5 | 4 | 7.5 | 14.5 | 25 |
| CANNABIS | | | X | | | |
| COCAINE | | X | | | | |
| TOTAL SCORE | | | | | | 5.5 |

TABLE 2

VARIABLES USED FOR THE PRINCIPAL COMPONENT ANALYSIS: X, Y AND Z [8] AND THE OVERALL PHYSICAL HARM SCORE (W) OF THE DIFFERENT SUBSTANCES OBTAINED BY WEIGHTING THE FIRST PRINCIPAL COMPONENT

| SUBSTANCE | ACUTE TOXICITY (X) | CHRONIC TOXICITY (Y) | DEPENDENCE (Z) | SUBSTANCE | OVERALL PHYSICAL HARM SCORE (W) |
|---|---|---|---|---|---|
| CRACK COCAINE | 2.39 | 2.63 | 2.82 | CRACK COCAINE | 2.67 |
| HEROIN | 2.37 | 2.03 | 2.89 | HEROIN | 2.51 |
| ALCOHOL | 1.89 | 2.47 | 2.13 | ALCOHOL | 2.18 |
| METHAMPHETAMINE | 2.03 | 2.18 | 2.24 | METHAMPHETAMINE | 2.18 |
| COCAINE | 1.95 | 2.05 | 2.13 | METHADONE | 2.12 |
| AMPHETAMINE | 1.71 | 1.89 | 1.95 | COCAINE | 2.07 |
| METHADONE | 1.95 | 1.42 | 2.68 | AMPHETAMINE | 1.88 |
| ECSTASY | 1.34 | 1.34 | 0.61 | GHB | 1.47 |
| GHB | 1,84 | 0.79 | 1.71 | BENZODIAZEPINES | 1.31 |
| KETAMINE | 1.55 | 0.92 | 0.84 | BUPRENORPHINE | 1.30 |
| CANNABIS | 0.84 | 1.53 | 1.13 | CANNABIS | 1.18 |
| LSD | 1.47 | 0.68 | 0.03 | KETAMINE | 1.05 |
| BUPRENORPHINE | 1.21 | 0.76 | 1.71 | ECSTASY | 1.03 |
| METHYLPHENIDATE | 0.92 | 0.83 | 0.86 | METHYLPHENIDATE | 0.87 |
| BENZODIAZEPINES | 0.97 | 0.76 | 1.89 | ANABOLIC STEROIDS | 0.81 |
| ANABOLIC STEROIDS | 0.45 | 1.24 | 0.71 | KHAT | 0.73 |
| KHAT | 0.39 | 0.95 | 0.76 | LSD | 0.61 |
| MAGIC MUSHROOMS | 0.89 | 0.13 | 0.03 | MAGIC MUSHROOMS | 0.28 |

countries, as is shown. The analysis has been based on answers given to questions about the drug use over the last thirty days prior treatment (the complete questionnaire as well general explanatory analyses are reported in [13]).

Results are reported in Table 3. The cumulative distributions of poly-drug use score are reported in Figure 1.

According to the method, the drug users interviewed in Catalonia (Spain) were all intensive and poly-users. For this reason the frequency of use and score distribution are not reported in Figure 1, for Catalonia, while Czech Republic, Italy and Portugal can be easily compared as the score scale is the same.

The tables and graphics of the analyses provide a clear representation of the population under study. So, it was possible to conclude that the populations in Italy and Portugal are similar to one another, whereas the population in the Czech Republic was rather prudent; this is also due to the fact that services in this country assist younger people with respect to the other countries. The mean age is lower than 30 in Czech Republic and higher than 35 in all the other countries.

Furthermore, it has to be taken into account that the respondents in Catalonia were all intensive users prior to assistance; so it is possible to conclude that the population surveyed in Catalonia is rather different from those surveyed in the other countries.

The cumulative distributions gives a global and significant overview of the local situation of a specific country which is easy to compare with figures from other countries.

Apart from the numerical results in the table, it is easy to recognize the movement of the median towards higher values passing from occasional users to intensive users. This depends on the kind of drugs available in the country and on poly-use behaviours of the drug users.

For Italy, in a previous work [12] this method was applied to the School Population Survey 2011 (SPS 2011). So it is interesting to apply the indicators on different subpopulation of drug users, the problem drug users and the teenagers, to make comparisons and study the

TABLE 3

FREQUENCY SCORE AND POLY USE SCORE FOR THE SURVEY DATA PDU2012

| CATALONIA (SPAIN) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| DRUG USERS | N | MEAN | MEDIAN | 1ST QUARTILE | 3RD QUARTILE | MIN | MAX | SD | CV[a] |
| Intensive | 439 | 661.3 | 678 | 620.4 | 724 | 174.14 | 778 | 88.8 | 13.4 |
| **CZECH REPUBLIC** | | | | | | | | | |
| DRUG USERS | N | MEAN | MEDIAN | 1ST QUARTILE | 3RD QUARTILE | MIN | MAX | SD | CV |
| Occasional | 7 | 4.9 | 4.2 | 3 | 4.5 | 4.1 | 8.3 | 1.5 | 30.6 |
| Regular | 28 | 19.8 | 22.5 | 13 | 23 | 5.8 | 26.3 | 6.6 | 33.6 |
| Intensive | 87 | 69.4 | 59 | 38.6 | 79.5 | 27.9 | 723.7 | 76.4 | 110.1 |
| **ITALY** | | | | | | | | | |
| DRUG USERS | N | MEAN | MEDIAN | 1ST QUARTILE | 3RD QUARTILE | MIN | MAX | SD | CV |
| Occasional | 44 | 7.2 | 8 | 3 | 9.5 | 2 | 10.7 | 3 | 42.1 |
| Regular | 143 | 23.5 | 22 | 18.5 | 28.6 | 4.1 | 47 | 7.5 | 32 |
| Intensive | 461 | 149.2 | 125.4 | 75 | 199.3 | 26.4 | 653.8 | 98.9 | 66.3 |
| **PORTUGAL** | | | | | | | | | |
| DRUG USERS | N | MEAN | MEDIAN | 1ST QUARTILE | 3RD QUARTILE | MIN | MAX | SD | CV |
| Occasional | 27 | 7.8 | 6.5 | 4.2 | 9 | 3.8 | 10 | 2.2 | 28.8 |
| Regular | 95 | 22.6 | 18.5 | 17.5 | 25.4 | 8.9 | 43.6 | 8.1 | 35.7 |
| Intensive | 247 | 161 | 133.2 | 83.5 | 227 | 30.4 | 539.1 | 98.1 | 60.9 |

[a] Coefficient of variation

TABLE 4

SYNTHETIC STATISTICS FOR SPS2011 AND PDU2012

| SCORES OF INTENSIVE USERS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SAMPLE | N | MEAN | M EDIAN | 1ST QUARTILE | 3RD QUARTILE | MIN | MAX | SD | CV[a] |
| SPS 2011 | 945 | 59.5 | 58.9 | 34.5 | 59 | 14 | 467.5 | 38.68 | 64.9 |
| PDU 2012 | 461 | 149.2 | 125.4 | 75 | 199.3 | 26.4 | 653.8 | 98.9 | 66.3 |

[a] Coefficient of variation

behaviours of consumption. In Figure 2 (a, b, c) the cumulative distributions for the three segments of frequency of use (occasional, regular and intensive) are reported. The synthetic statistics, only for intensive users, are reported in Table 4.

As can be seen there is always a difference between the two cumulative distributions in each segment of frequency of use, that is logically higher for problematic users. This means, for instance, that the scores calculated for the General Population Survey (GPS) are expected to be in the middle of the two cumulative distributions. Thus, the GPS can be accepted as reasonably representing the real situation if at least this is observed. Otherwise, the survey is not representative of the real general population.

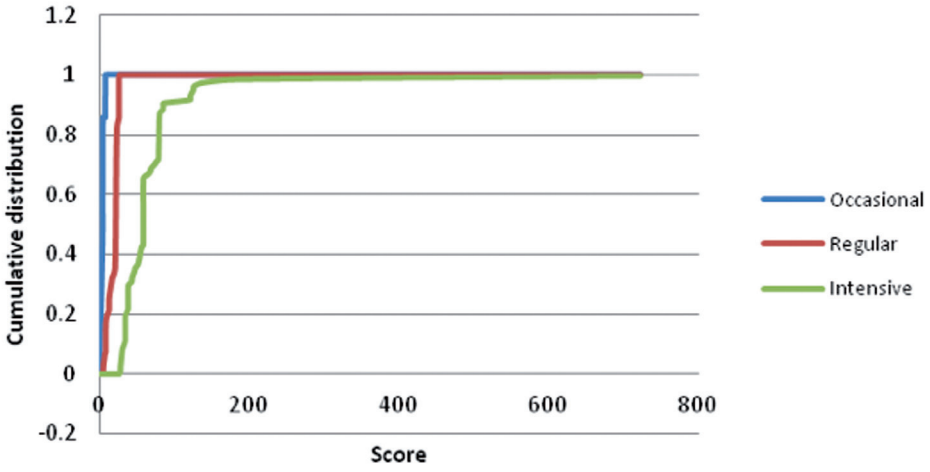
## DISCUSSION

The present application of the new indicators has shown the effectiveness of methodology,which takes into account recent trends in drug use such as poly-use and frequency of use. It could

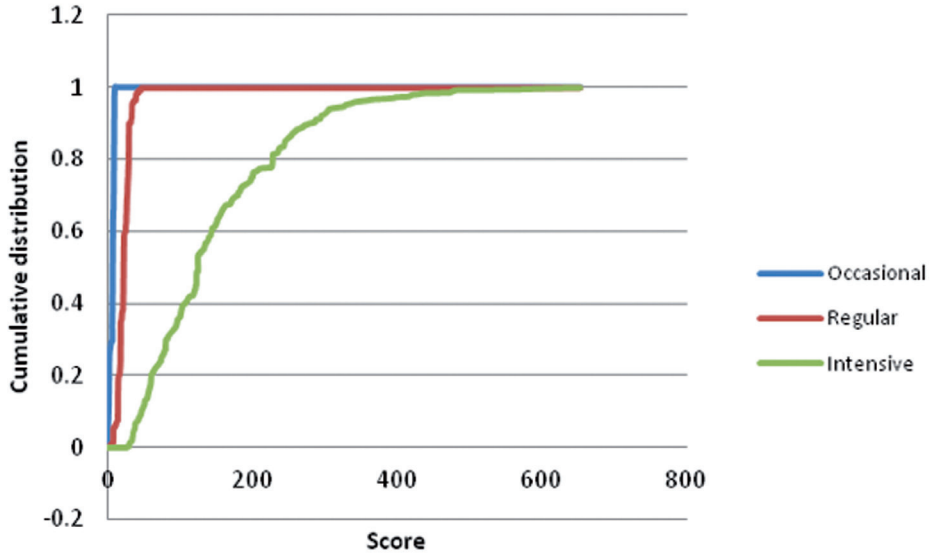
FIGURE 1

CUMULATIVE DISTRIBUTIONS OF POLY-USE SCORES OF THE THREE SEGMENTS OF FREQUENCY SCORES FOR THE CZECH REPUBLIC (A), ITALY (B) AND PORTUGAL (C)

A)




B)




C)

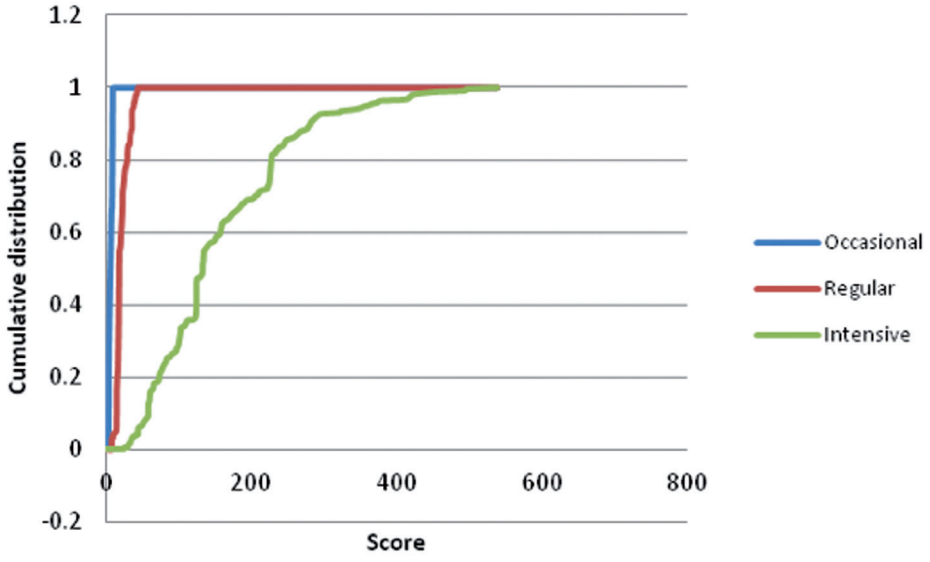


FIGURE 2a

CUMULATIVE DISTRIBUTIONS OF OCCASIONAL USERS

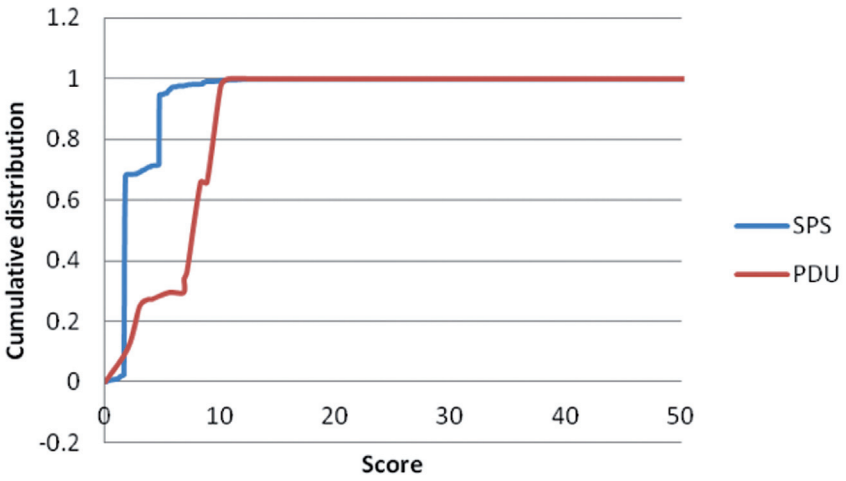
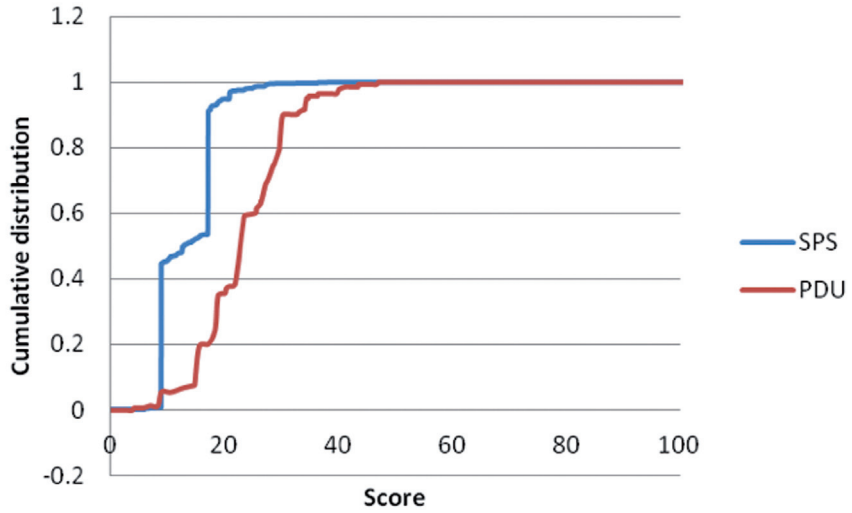



FIGURE 2b

CUMULATIVE DISTRIBUTIONS OF REGULAR USERS

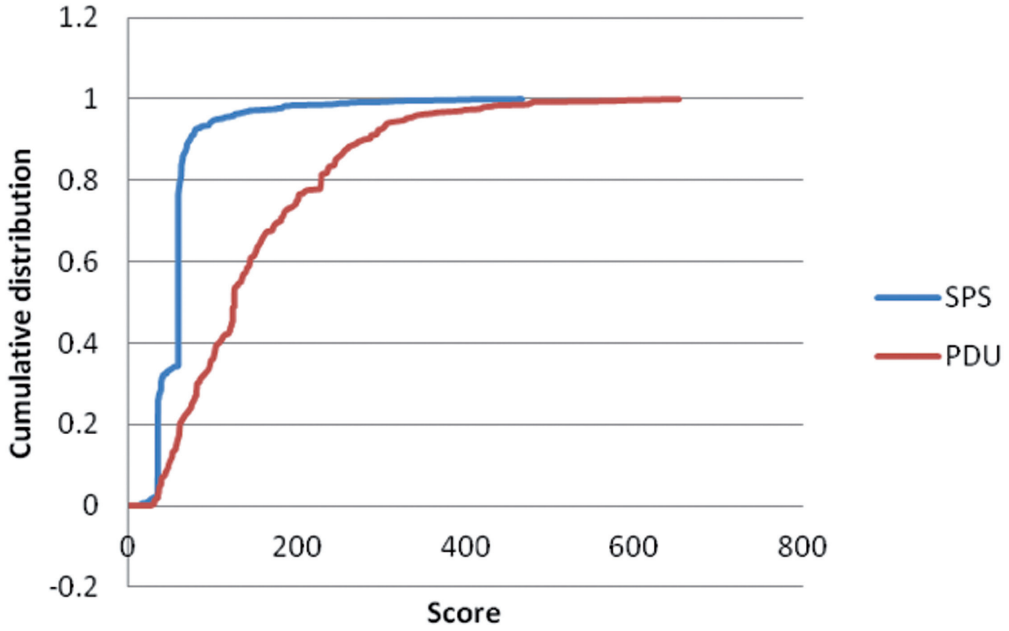



be a reliable measures of the harm of drug use, but could also give information in the evaluation of interventions aimed at reducing drug use or the harm caused by it. It is actually an easily calculated double dimensions indicator (frequency of use and harm use score) for any kind of survey containing questions about drugs use in a certain period of time (last month, last year, lifetime). It is useful for cross-countries comparisons but also for measuring the reliability and representativeness of a survey.

These tools needs now to be applied to

FIGURE 2c

CUMULATIVE DISTRIBUTIONS OF INTENSIVE USERS




various other surveys in order to compare new countries and population situations. The score used here could be useful for the GPS and even more so for European School Survey Project on Alcohol and Other Drugs (ESPAD) to analyze the onset of drug use and the first increment of frequency of use and poly-drug score in teenagers. It has been applied to Italian students [14] and it will be applied to the other countries, as soon as the requested data will be provided.

In case of comparable General Population Surveys conducted in different countries (i.e. having the same biases and similar response rate) the scores proposed could be used as unique indicators for comparisons and evaluation of services and policies. Also the representativeness of the GPS can be analyzed. The same methodology can also be applied in different regional situations inside a country. This may reveal where interventions are more effective, so that their methods can be analysed and applied to other regions.

A very interesting tool for statistical analysis is the cumulative distribution. They are calculated and graphically represented in various combinations in order to study in depth different drug users populations and make easily country comparisons.

The results have some possible limitations due to the survey questionnaires which contains frequency of use in classes, and in this case the median or some representative value is chosen for calculating the frequency of use score. Also, the scores have no maximum and show a very high variability depending also on the population undue study, but this issue will be addressed in a future work, by normalizing the scores observed with a suitable method.

***ACKNOWLEDGEMENTS:*** *Work developed within the framework of the EU project JUST/2010/DPIP/AG/1410: New methodological tools for policy and programme evaluation.*

*This publication has been produced with the financial support of the Prevention and Information Programme of the European Commission. The contents of this publication are the sole responsibility of the authors and can in no way be taken to reflect the views of the European Commission.*

*We want to acknowledge the important comments and suggestions of the anonymous referees in helping produce this paper*

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