



LJMU Research Online

Hay, G, Kraus, L, Richardson, C, Yargic, I, Ilhan, M, Ay, P, Civil, F, Pinarci, M, Toncoglu, T, Piontek, D and Schulte, B

Estimating high risk cannabis and opiate use in Ankara, Istanbul and Izmir

<https://researchonline.ljmu.ac.uk/id/eprint/7215/>

Article

Citation (please note it is advisable to refer to the publisher's version if you intend to cite from this work)

Hay, G, Kraus, L, Richardson, C, Yargic, I, Ilhan, M, Ay, P, Civil, F, Pinarci, M, Toncoglu, T, Piontek, D and Schulte, B (2016) Estimating high risk cannabis and opiate use in Ankara, Istanbul and Izmir. Drug and Alcohol Review, 36 (5). pp. 626-632. ISSN 1465-3362

LJMU has developed [LJMU Research Online](#) for users to access the research output of the University more effectively. Copyright © and Moral Rights for the papers on this site are retained by the individual authors and/or other copyright owners. Users may download and/or print one copy of any article(s) in LJMU Research Online to facilitate their private study or for non-commercial research. You may not engage in further distribution of the material or use it for any profit-making activities or any commercial gain.

The version presented here may differ from the published version or from the version of the record. Please see the repository URL above for details on accessing the published version and note that access may require a subscription.

For more information please contact researchonline@ljmu.ac.uk

<http://researchonline.ljmu.ac.uk/>



Estimating high risk cannabis and opiate use in Ankara, Istanbul and Izmir

Journal:	<i>Drug and Alcohol Review</i>
Manuscript ID	CDAR-2016-0010.R2
Manuscript Type:	Original Paper
Date Submitted by the Author:	n/a
Complete List of Authors:	<p>Kraus, Ludwig; IFT Institut für Therapieforschung , Social and Clinical Epidemiology; Centre for Social Research on Alcohol and Drugs, SoRAD, Hay, Gordon; Centre for Public Health, Liverpool John Moores University</p> <p>Richardson, Clive; Department of Economic and Regional Development, Panteion University of Social and Political Sciences</p> <p>Yargic, Ilhan; İstanbul University, Faculty of Medicine, Department of Psychiatry</p> <p>Ilhan, Mustafa; Gazi University, Faculty of Medicine, Department of Public Health</p> <p>Ay, Pinar; Marmara University, Faculty of Medicine, Department of Public Health</p> <p>Civil, Füsün; Gazi University, Faculty of Medicine, Department of Public Health</p> <p>Pinarci, Mustafa; Turkish National Police, Turkish Monitoring Centre for Drugs and Drug Addiction</p> <p>Tuncoglu, Tolga; Turkish National Police, Turkish Monitoring Centre for Drugs and Drug Addiction</p> <p>Piontek, Daniela; IFT Institut für Therapieforschung</p> <p>Schulte, Bernd; Zentrum für Interdisziplinäre Suchtforschung der Universität Hamburg Klinik für Psychiatrie & Psychotherapie, Universitätsklinikum Hamburg-Eppendorf</p>
Keywords (Please ensure that the Keywords and a short Running Head are also included in the manuscript file):	Capture-recapture method, Multiplier method, High risk cannabis use, High risk opiate us, Turkey

SCHOLARONE™
Manuscripts

Estimating high risk cannabis and opiate use in Ankara, Istanbul and Izmir

Kraus, L., PhD, Prof^{1,2}, Hay, G., PhD³, Richardson, PhD, Prof⁴, C., Yargic, I., MD, Prof⁵, Ilhan, M., PhD, Prof⁶, Ay, P., MPH, Prof⁷, Civil, F., MSc⁶, Pinarci, M., MSc⁸, Tuncoglu, T., MSc⁸, Piontek, D., PhD¹ & Schulte, B., MPH⁹

- 1) IFT Institute for Therapy Research, Munich, Germany
- 2) Centre for Social Research on Alcohol and Drugs, SoRAD, Stockholm University, Sweden
- 3) Centre for Public Health, Liverpool John Moores University, Liverpool, United Kingdom
- 4) Department of Economic and Regional Development, Panteion University of Social and Political Sciences, Athens, Greece
- 5) Istanbul University, Faculty of Medicine, Department of Psychiatry, Istanbul, Turkey
- 6) Gazi University, Faculty of Medicine, Department of Public Health, Ankara, Turkey
- 7) Marmara University, Faculty of Medicine, Department of Public Health, Istanbul, Turkey
- 8) Turkish National Police, Turkish Monitoring Centre for Drugs and Drug Addiction, Ankara, Turkey
- 9) Centre for Interdisciplinary Addiction Research, Hamburg University, Department of Psychiatry, University Medical Centre Hamburg-Eppendorf, Hamburg, Germany

Word count: Text: 3,437; Abstract: 235

Keywords: Capture-recapture method, Multiplier method, high risk cannabis use, high risk opiate use, Turkey

Corresponding author:

Prof. Dr. Ludwig Kraus,
IFT Institut für Therapieforschung, Munich, Germany,
Parzivalstr. 25
D-80804 Munich, Germany
Telephone: +49 8936080430,
e-mail: kraus@ift.de

Abstract

Aims. Information on high risk drug use in Turkey particularly at the regional level is lacking. The present analysis aims at estimating high risk cannabis (HRCU) and high risk opiate use (HROU) in the cities of Ankara, Istanbul and Izmir. **Design and Methods.** Capture-recapture (CRC) and multiplier methods (MM) were applied based on treatment and police data stratified by age and gender in the years 2009 and 2010. Case definitions refer to ICD-10 cannabis (F.12) and opiate (F.11) disorder diagnoses from out- and inpatient treatment records and illegal possession of these drugs as recorded by the police. **Results.** HRCU was estimated at 28,500 (8.5 per 1,000; 95%-CI: 7.3-10.3) and 33,400 (11.9 per 1,000; 95%-CI: 10.7-13.5) in Ankara and Izmir, respectively. Using multipliers based on CRC estimates for Izmir, HRCU in Istanbul was estimated up to 166,000 (18.0 per 1,000; range: 2.8-18.0). CRC estimates of HROU resulted in 4,800 (1.4 per 1,000; 95% CI: 0.9-1.9) in Ankara and multipliers based on these gave estimates up to 20,000 (2.2 per 1,000; range: 0.9-1-7) in Istanbul. HROU in Izmir was not estimated due to the low absolute numbers of opiate users. **Discussion and Conclusions.** While HRCU prevalence in both Ankara and Izmir was considerably lower in comparison to an estimate for Berlin, the rate for Istanbul was only slightly lower. Compared to the majority of European cities HROU in these three Turkish cities may be considered rather low.

Introduction

It is important to epidemiologists to be able to track the numbers of substance users in an area, and it is essential to health and social service providers to know the numbers of problem drug users (PDU) for whom services will in the first place be required. Consequently, the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) has established as one of its five Key Indicators, the estimation of the numbers of high-risk drug users (HRDU, a recent redefinition and renaming of the former PDU Key Indicator). Member States are expected to provide annual estimates of the numbers of persons involved in high-risk drug use, meaning “recurrent drug use that is causing actual harms (negative consequences) to the person (including dependence, but also other health, psychological or social problems) or is placing the person at a high probability/risk of suffering such harms” [1].

As implemented in most countries, the HRDU indicator has tended to focus on marginalized heavy users of opiates. The EMCDDA has produced a series of guidelines describing estimation methods. These include direct methods of counting through surveys, which *may be* practicable for cannabis but are generally held to be unsuitable for substances such as opiates, the marginalized users of which may tend to be unreachable in conventional surveys and unwilling to admit to their illegal activity. Indirect methods may be required for the hard-to-reach populations. These include multiplier methods and capture-recapture estimation from incomplete but overlapping lists; these methods are widely used in EU countries and affiliated states. The study reported in the present paper was carried out in order to apply for the first time methods of this kind to estimating numbers of drug users in Turkey, within the context of moving towards the harmonisation of information in Turkey with the European Union.

1
2
3 Previous epidemiological studies investigating substance use in Turkey have been limited
4 primarily to self-reports in school and university-based surveys. Compared to EU countries,
5 the available data in Turkey suggest rather low prevalence rates for any drug use, including
6 cannabis [2] which appears to be the most widely used substance among school and university
7 students. The rates that have been reported vary depending on the setting, study population
8 and year of the survey. Lifetime prevalence rates of self-reported drug use among university
9 students range between 2.3 and 6.6% [3-7]. Naturally, lower rates of any lifetime use were
10 recorded among primary and secondary school students [8-10]. Beyond these studies that
11 have been conducted at the regional or city level among school or university students there
12 are very few referring to the general population [11;12].
13
14
15
16
17
18
19
20
21
22
23
24
25
26

27 Estimates of drug use and drug use patterns derived from school, college or population studies
28 rely on self-reports. However, as in every country, drug laws and prosecution of possession
29 may result in drug users hiding this particular behaviour and not admitting it even if
30 anonymity is assured. Depending on the degree of stigmatization and social exclusion of drug
31 users, surveys are likely to miss this subgroup. Thus, the lack of reliable data on drug use and
32 particularly on opiate use in the general population calls for the application of indirect
33 methods of estimating the drug using population. The capture-recapture method (for an
34 overview see [13]) employs information from various sources where drug users are registered,
35 such as treatment services, police or the criminal justice system (convictions or probation).
36 Registers are usually available at regional or community level. It is necessary to be able to
37 identify individuals, in order to determine whether the same person appears in more than one
38 register. Alternatives to capture-recapture analysis include Multiplier Methods [14]. The drug
39 using population is derived by estimating what proportion of the population is hidden and
40 applying this figure to the number of observed users. The present study set out to estimate the
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 numbers of high risk opiate and cannabis users in the three largest Turkish cities of Ankara,
4
5 Istanbul and Izmir.
6
7

8 9 **Methods**

10 *Data sources*

11
12 Drug-related data was requested for in- and out-patient treatment as well as for police arrests
13
14 consisting of personal ID code, demographic information such as age, gender and region, type
15
16 of drug use, and, for the treatment data, diagnosis of substance use disorders. Data was
17
18 collected according to the area where the person obtained addiction treatment or was arrested,
19
20 and was recorded at the level of provinces rather than cities. However, as the three cities are
21
22 overwhelmingly the main population centers of their respective provinces, we will hereafter
23
24 refer to cities rather than provinces. For reasons of data protection, personal information of
25
26 each individual in each source was coded. The identifiers were used to determine the overlap
27
28 between sources and were deleted once the overlap pattern had been established. The code
29
30 used for each individual in each of the sources was forename initial, surname initial, date of
31
32 birth and gender. For both sources information was available for the years 2009 and 2010.
33
34
35
36
37
38
39
40

41 *Case Definition*

42
43 Records on inpatient and outpatient treatment were based on ICD-10 codes indicating
44
45 diagnoses of substance use disorders (F10-F19). Police records contained labels of the drug
46
47 involved in the person's arrest for drug possession. The pattern of drug use captured by the
48
49 combination of cannabis- or opiate-related disorders and an indicator of illegal possession of
50
51 cannabis or opiates was labelled "high risk cannabis use" (HRCU) and "high risk opiate use"
52
53 (HROU). In this context, high risk use defines a drug-using behaviour that may eventually
54
55 lead to health or judicial high risks.
56
57
58
59
60

Statistical Analysis

Data were analysed using the capture-recapture method (CRC) [15]. For all analyses, data were stratified by age group (15-24, 25-34, and 35-64 years) and gender, and log-linear Poisson regression models were fitted separately to the stratified pattern of overlaps between the sources of data. It is not recommended to use CRC with only two sources, because it is then necessary to assume independence of the two sources [16]; this is an untestable and usually improbable assumption. For this reason, four-source analyses were carried out, treating each year's data from treatment and police as a separate source. Other studies have also increased the effective number of sources by using the same source in different periods of time [17-19]. For each stratified analysis the simplest 22 models were fitted; these models had up to two two-way interactions between data sources. The deviance statistic, the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) were used to assess how well each model fitted the data [20]. If none of these models provided a good fit, age categories were collapsed and analyses were repeated; in the event, this was done for all the analyses of females. The best fitting model was used to estimate the size of the "hidden population" of drug users who had not been recorded by any data source. Confidence intervals around these estimates were constructed by the profile likelihood method [21]. Confidence intervals for the totals of separate estimates across age groups and gender were derived by a simulation-based method [22].

For estimating the number of high risk cannabis as well as high risk opiate users in Istanbul, none of the models resulted in satisfactory model fit. Instead, the ratio of the number of estimated users to the number of "captured" users in Izmir (for cannabis) and Ankara (for opiates) was used as multiplier on each of the four sources [14;23]. The reason for choosing

1
2
3 Izmir instead of Ankara as an anchor for the Multiplier Method (MM) was based on Turkish
4 experts' view on drug use in the three cities. Izmir and Istanbul are both quite 'western' in
5 outlook and it was felt appropriate to assume that a cannabis multiplier for Izmir would be
6 valid for Istanbul. Conversely, opiate use was observed an issue in Ankara and Istanbul, but
7 not in Izmir. Inspection of the raw data confirmed these subjective observations. Due to the
8 low absolute numbers of opiate users "captured" in Izmir (Table 1), we refrained from
9 estimating HROU. For calculating population rates for HRCU and HROU users per 1,000
10 population, data on the numbers of 15–64 year-olds by age group and gender were obtained
11 for each province for the years 2009 and 2010 from the Turkish population registry. The
12 averages of the two years were taken.
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27

Table 1

Results

Estimates of the number of high risk cannabis users

32
33
34
35
36
37 For Ankara, the Poisson log-linear model that included the interaction between the two years
38 of treatment data provided an adequate fit to the data in the analysis of cannabis use in each
39 age group for males and in an analysis for all females. Table 2 presents the key results. The
40 estimated number of male users was 26,428 and of females 2,064, resulting in a male to
41 female ratio of 13:1. The rates per 1,000 population aged 15 to 64 years were 15.8 (95% CI:
42 13.5-19.3) among males, 1.2 (95% CI: 0.7-2.6) among females and 8.5 (95% CI: 7.3-10.3)
43 overall.
44
45
46
47
48
49
50
51
52
53
54

Table 2

1
2
3 The same model provided an adequate fit to the data on males in Izmir, in every age group,
4 and to all females (Table 2). The number of male users was estimated at 30,140 and of
5 females at 3,244, resulting in a male to female ratio of 9:1. Rates per 1,000 population were
6
7 21.3 (95% CI: 19.2-23.6) for males, 2.3 (95% CI: 1.3-5.0) for females and 11.9 (95% CI:
8
9 10.7-13.5) overall.
11
12

13
14
15
16 For Istanbul, the model including the interaction between the two years of treatment data
17 fitted only the data for males aged 35-64 years. The interaction between the two years of
18 police data had to be added in order to obtain statistically acceptable fit in the other two age
19 groups. However, the resulting estimates of hidden populations for both genders yielded
20 implausible estimates with excessively wide confidence intervals. Instead, the multiplier
21 approach based on the estimates for Izmir was applied yielding a total ranging between
22 160,373 and 166,045 high risk cannabis users for the two treatment sources and between
23 26,078 and 34,456 high risk cannabis users for the two police sources. Rates per 1,000
24 population aged 15 to 64 years ranged between 2.8 and 18.0 depending on data source (range
25 for males: 5.1-32.3; range for females: 0.5-3.4; data for genders not shown) (Table 3).
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45

46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
Table 3

Estimates of the number of high risk opiate users

The results of the capture-recapture estimation of high-risk opiate use in Ankara are shown in Table 2. Only 121 female opiate users were observed, while seven times as many male users were identified in the four sources. In all male age groups the interaction between the two treatment years yielded the best model fit. In the combined female sample, it was necessary to use the interaction between treatment in 2009 and police in 2010. A total of 4,760 (1.4 per

1
2
3 1,000; 95% CI: 0.9-1.9) opiate users was estimated for Ankara, with 4,117 (2.5 per 1,000;
4
5 95% CI: 2.1-3.2) male and 643 (0.4 per 1,000; 95% CI: 0.2-0.8) female users.
6
7

8
9
10 Based on the estimates for HROU in Ankara, multipliers for each of the four data sources
11 were constructed and applied as multipliers to the Istanbul data (Table 3). The estimates
12 ranged between 8,204 and 20,114 high risk opiate users in total, depending on data source
13 (rates per 1,000: 0.9-2.2). The estimates for males ranged from 7,711 (1.7 per 1,000) to
14 19,600 (4.2 per 1,000) and for females from 493 (0.1 per 1,000) to 2,053 (0.4 per 1,000) (data
15 for genders not shown).
16
17
18
19
20
21
22
23

24 25 **Discussion**

26
27 To the best of our knowledge, this is the first study estimating the number of high risk
28 cannabis and opiate users in major Turkish cities, namely Ankara, Istanbul and Izmir, using
29 capture-recapture and multiplier methods. While the main focus of the study was on
30 estimating substance use related disorders according to the ICD-10 definition, only the
31 treatment data met this condition. Given the less rigorous definitions of high risk behaviour
32 found in police records, we need to acknowledge that our estimates may also encompass drug
33 users who do not fulfil the ICD-10 criteria of harmful use or dependence. However, expert
34 opinion supports the view that subjects registered by the police because of drug use may be
35 considered high risk drug users.
36
37
38
39
40
41
42
43
44
45
46
47
48

49 The capture-recapture method yielded higher rates of high risk cannabis users per 1,000
50 population in Izmir (11.9; 95% CI: 10.7-13.5) than in Ankara (8.5, 95% CI: 7.3-10.2). Using
51 the CRC results for Izmir as anchor for estimating HRCU in Istanbul resulted in a wide range
52 with a minimum mean of 2.8 and a maximum mean of 18.0 per 1,000. Applying the lower
53
54
55
56
57
58
59
60

1
2
3 and upper limits of the 95% CI of the CRC point estimate the range widened to 2.3-23.4 cases
4
5 per 1,000. The multiplier method provided estimates for each of the four sources separately.
6
7 Rates derived from police data (2.8-3.7 per 1,000) were much lower than those from
8
9 treatment data (17.4-18.0 per 1,000). This is due to substantial differences between the
10
11 numbers of individuals known to the police in Izmir and Istanbul and between individuals
12
13 presenting for treatment in both cities. In fact, in the two younger age groups the number of
14
15 cases known to the police in Istanbul was only slightly higher than in Izmir, while in the older
16
17 age group and in females the absolute number of cases known to the police in Istanbul was
18
19 even lower than in Izmir. Conversely, the number of people presenting for treatment was
20
21 between three to five times higher in Istanbul than in Izmir. Given a 3.5 times larger
22
23 population in Istanbul than Izmir, a much higher number of arrests for cannabis possession
24
25 would have been expected in Istanbul. Apart from the unexpectedly low numbers of police
26
27 arrests that clearly underestimates the true prevalence when used in the multiplier method,
28
29 there was almost no overlap observable between individuals identified by police and
30
31 treatment services in the two consecutive years, which led to implausible CRC estimates.
32
33
34
35
36
37

38 Unfortunately, comparable data on high risk cannabis users are available neither in Turkey
39
40 nor in member states of the European Union. While the EMCDDA collects prevalence and
41
42 treatment data, estimates of HRCU using standardized methods are missing [24]. However,
43
44 the estimates of HRCU for Ankara, Istanbul and Izmir may be compared with the results of
45
46 the most recent study conducted in Berlin in 2012 using DSM-IV diagnoses for cannabis use
47
48 disorders [25]. Based on survey data the estimated mean rate of 25 HRC users per 1,000
49
50 population for Berlin was more than twice as high as the estimate for Izmir (11.9) and three
51
52 times as high as the estimate for Ankara (8.5). Compared to the estimate for the German
53
54
55
56
57
58
59
60

1
2
3 capital, the mean rate of HRCU for Istanbul based on treatment data (18.0) was only slightly
4
5 lower.
6
7

8
9 The prevalence of high risk opiate users based on CRC was estimated at 1.4 per 1,000 (95%
10 CI: 0.9-1.9) in Ankara and using Ankara as anchor for the multiplier method at between 0.9
11 and 2.2 in Istanbul. Compared to the overall Turkish estimate of 0.26 per 1,000 inhabitants
12 aged 15-64 years in the year 2011, the figures for Ankara and Istanbul derived from the
13 present analysis were higher. Rates of high risk opiate users can also be compared to national
14 estimates reported by the European Monitoring Centre for Drugs and Drug Addiction [26].
15 According to the EMCDDA, estimates of HROU at the city level vary from 2.3 in Budapest
16 (in 2005) to 19.8 in Manchester (in 2006) [27]. Compared with these figures and the results
17 from the most recent CRC study in Berlin with estimates ranging between 4.7 and 7.0 per
18 1,000 population for the year 2010 [28], the estimates for the two Turkish cities may still be
19 considered low.
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35

36 In order to justify the validity of the results, the assumptions that must be met in applying
37 capture-recapture methods must be considered. (1) The “closed population” assumption may
38 be violated if drug users begin or stop using drugs, or if they move into or out of the area that
39 is being studied within that time period. The issue of starting and stopping drug use is usually
40 dealt with by restricting the time period of the study. However, in the present case it was
41 necessary to use two years, a longer period than usual, in order to have an adequate number of
42 data sources. (2) Matching individuals through the anonymous identifiers may not have been
43 free of mistakes. Cross-referencing with a reduced set of identifiers can lead to false matching
44 and impact on the validity of the prevalence estimates. In each data source we found about 5%
45 of persons born on January 1st which, in Turkey, is the registration date used for individuals
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 with unknown day and month of birth. A slightly overrepresentation of these cases may have
4
5 led to more overlaps due to false positive matches. (3) The “heterogeneity” assumption
6
7 addresses the possibility of different probabilities for individuals of appearing in a particular
8
9 source, for example, young drug users may be less likely than older drug users to have started
10
11 treatment and therefore appear in a treatment data source. This risk was reduced by stratifying
12
13 samples according to age and gender. Nevertheless, recent research has examined the impact
14
15 of possible breaches of the traditional capture-recapture assumptions, such as heterogeneity of
16
17 capture and independence of data sources [29;30]. As all of these mechanisms may
18
19 simultaneously impact on the overlap patterns of the data used for CRC, it can be said that
20
21 influences lowering the overlap will generally result in overestimating the true prevalence,
22
23 whereas increasing the overlap will result in underestimating the true prevalence. Statistics on
24
25 drug-related deaths, although very likely subject to underreporting, suggest low numbers of
26
27 opiate-related deaths in the three cities, which supports the findings of a low prevalence of
28
29 high risk opiate users in Turkey [31].
30
31
32
33
34
35

36 Due to the wide range of the presented estimates the multiplier method may be regarded as
37
38 inaccurate and less reliable than CRC. Nevertheless, when using Ankara instead of Izmir as
39
40 anchor for estimating HRCU in Istanbul, results turned out to be rather similar except for a
41
42 narrower range of estimates (data available on request). We also note that changes in the
43
44 numbers in treatment between 2009 and 2010 could indicate that the proportions in treatment
45
46 vary across time, perhaps due to treatment being more accessible in the later year. This may
47
48 have an impact on the assumption that a common multiplier can be used across different time
49
50 periods and also across different geographical areas. Table 3 does, however, suggest that a
51
52 treatment multiplier produces consistent estimates across years in Istanbul. For estimating
53
54 high risk drug use in other Turkish cities alternative indirect methods such as synthetic
55
56
57
58
59
60

1
2
3 estimation could have been used [32]. Unfortunately, the three cities are too few and not
4
5 suitable for a geographical representation of urban areas in Turkey. Respondent driven
6
7 sampling (RDS) [33] has been found efficient and effective for investigating drug-using
8
9 populations. Recent developments [34] provide a method for estimating population size and
10
11 hence drug use prevalence from RDS data, although this is still relatively untested. However,
12
13 in contrast to our use of existing administrative data for CRC estimation, RDS requires
14
15 special studies, which are unlikely to be feasible on a large scale.
16
17
18
19

20
21 The main limitations of the study refer to the reliability and validity of the register data, which
22
23 were not collected for the present purpose of estimating the number of high risk drug users.
24
25 Addiction treatment in Turkey is usually provided in specialized centres established in large
26
27 governmental mental hospitals. In most cases inpatient treatment is limited to only
28
29 detoxification. In some of these treatment centres a 4-week program including group therapies
30
31 and recreational groups is provided in addition to medical management. Due to lack of
32
33 addiction treatment professionals, outpatient treatment available in governmental hospitals is
34
35 limited to only medical management. There are a few small private hospitals that provide
36
37 addiction treatment, but long term rehabilitation or residential treatment is not available [31].
38
39 Also the wide variation in the number of drug users arrested by the police over the years and
40
41 across cities raises questions regarding the validity of the data. It is unclear whether this
42
43 variation resulted from differences in police activities, changes over time, or errors in or lack
44
45 of reporting, or whether it reflects differences in drug using behaviour. More research is
46
47 needed to understand the data collection mechanisms.
48
49
50
51
52
53

54
55 Nonetheless, despite these limitations, the present analysis yielded for the first time estimates
56
57 of the scale of high risk drug cannabis and opiate use in three major Turkish cities using
58
59
60

1
2
3 capture-recapture and multiplier methods. It demonstrates the feasibility of these approaches
4
5 and calls for further activities in the monitoring of drug use. Future studies will be necessary
6
7 to validate these initial estimates.
8
9

10 11 12 13 14 **Acknowledgements**

15
16 The study was conducted within the Turkish-German Twinning Project (TR 07 IB JH 02) and
17
18 the third Pre-Accession Financial Assistance Program (IPA-3). The Turkish-German
19
20 Twinning Project was funded by the European Commission and IPA-3 was funded by the
21
22 European Monitoring Centre for Drugs and Drug Addiction (Contract CC.11 IPA3.080). The
23
24 authors like to thank the data holders for their collaboration and providing the requested data.
25
26 In particular, Serdar GÜL (Ministry of Interior – Turkish National Police), Serap GÖRÜCÜ
27
28 (Ministry of Justice – DG of Prisons and Detention Houses), Işıl KILIÇ KOÇ (Ministry of
29
30 Justice – DG of Probation Services), Mehmet AKGÜN (Ministry of Health), Berin
31
32 SARIOĞLU (Ministry of Social Affairs – Social Security Institution).
33
34
35
36
37
38
39
40

41 **Declaration of interest**

42
43 The authors have no conflict of interest.
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

References

- [1] European Monitoring Centre for Drugs and Drug Addiction (EMCDDA). PDU (problem drug use) revision summary. Lisbon: European Monitoring Centre for Drugs and Drug Addiction; 2013.
- [2] European Monitoring Centre for Drugs and Drug Addiction (EMCDDA). European drug report 2011. Trends and developments. Lisbon: European Monitoring Centre for Drugs and Drug Addiction; 2011.
- [3] Akvardar Y, Demiral Y, Ergor G, Ergor A, Bilici M, Akil OO. Substance use in a sample of Turkish medical students. *Drug Alcohol Depend* 2003 Nov 24;72(2):117-21.
- [4] Altindag A, Yarik M, Yengil E, Karazeybek AH. Sanliurfa'da universite ogrencilerinde madde kullanimi [Substance use among university students in Sanlyurfa]. *Bagimlilik Dergisi* 2005;6(2):60-4.
- [5] Ayvasik HB, Sumer HC. Individual differences as predictors of illicit drug use among turkish college students. *J Psychol* 2010;144(6):489-505.
- [6] Deveci ES, Acik Y, Ferdane OA, Deveci F. Prevalence and factors affecting the use of tobacco, alcohol and addictive substance among university students in eastern Turkey. *Southeast Asian J Trop Med Public Health* 2010 Jul;41(4):996-1007.
- [7] Ilhan IO, Yildirim F, Demirbas H, Dogan YB. Prevalence and sociodemographic correlates of substance use in a university-student sample in Turkey. *Int J Public Health* 2009;54(1):40-4.
- [8] Çorapçioğlu A, Ögel K. Factors associated with ecstasy use in Turkish students. *Addiction* 2004;99(1):67-76.
- [9] Tot S, Yazici K, Yazici A, Metin O, Bal N, Erdem P. Psychosocial correlates of substance use among adolescents in Mersin, Turkey. *Public Health* 2004 Dec;118(8):588-93.
- [10] Turkish Monitoring Centre for Drugs and Drug Addiction (TUBİM). 2014 National report (2013 data) to the EMCDDA by the Reitox National Focal Point: New developments, trends and in-depth information on selected issues. Turkey: Turkish Monitoring Centre for Drugs and Drug Addiction; 2014.
- [11] Turkish Psychological Association. Türkiye'de madde kullanimi ve bagimliliği profili arastirmasi: nihai rapor [Study of substance use and abuse profile in Turkey: Final report]. Ankara: Turkish Psychological Association; 2002.
- [12] General Directorate of Family and Social Research (ASAGEM). Adolescent profile in Turkey. Ankara: ASAGEM; 2010.
- [13] International Working Group for Disease Monitoring and Forecasting. Capture-Recapture and multiple-record systems estimation II: applications in human diseases. *Am J Epidemiol* 1995;142(10):1059-68.

- 1
2
3 [14] Kraus L, Augustin R, Frischer M, Kümmler P, Uhl A, Wiessing L. Estimating
4 prevalence of problem drug use at national level in countries of the European Union
5 and Norway. *Addiction* 2003;98(4):471-85.
6
- 7 [15] Hay G, Gannon M, Macdougall J, Eastwood C, Williams K, Millar T. Opiate and
8 crack cocaine use: A new understanding of prevalence. *Drug-Edu Prev Polic*
9 2010;17(2):135-47.
10
- 11 [16] International Working Group for Disease Monitoring and Forecasting. Capture-
12 Recapture and multiple-record systems estimation I: history and theoretical
13 developments. *Am J Epidemiol* 1995;142(10):1047-58.
14
- 15 [17] Wickens TD. Quantitative methods for estimating the size of a drug-using population.
16 *J Drug Issues* 1993;23:185-216.
17
- 18 [18] Domingo-Salvany A, Hartnoll RL, Maguire A, Suelves JM, Antó JM. Use of Capture-
19 Recapture to estimate the prevalence of opiate addiction in Barcelona, Spain, 1989.
20 *Am J Epidemiol* 1995;141:567-74.
21
- 22 [19] Choi YH, Comiskey CM. Methods for providing the first prevalence estimates of
23 opiate use in Western Australia. *Int J Drug Policy* 2011;14(4):297-305.
24
- 25 [20] Lindsey JK, Jones B. Choosing among generalized linear models applied to medical
26 data. *Stat Med* 1998;17(1):59-68.
27
- 28 [21] Cormack RM. Interval estimation for mark-recapture studies of closed population.
29 *Biometrics* 1992;48:567-76.
30
- 31 [22] Gemmell I, Millar T, Hay G. Capture-recapture estimates of problem drug use and the
32 use of simulation based confidence intervals in a stratified analysis. *J Epidemiol*
33 *Community Health* 2004 Sep;58(9):758-65.
34
- 35 [23] Kraus L, Kümmler P, Augustin R, Pfeiffer T, Simon R, Wiessing L, et al. Key
36 epidemiological indicator: Prevalence of problem drug use - Guidelines. Lisbon:
37 European Monitoring Centre for Drugs and Drug Addiction; 2004. EMCDDA Project
38 CT.02.P1.58.
39
- 40 [24] European Monitoring Centre for Drugs and Drug Addiction (EMCDDA). European
41 drug report 2015. Trends and developments. Lisbon: European Monitoring Centre for
42 Drugs and Drug Addiction; 2015.
43
- 44 [25] Kraus L, Pabst A, Gomes de Matos E, Piontek D. Epidemiologischer Suchtsurvey
45 2012. Repräsentativerhebung zum Gebrauch und Missbrauch psychoaktiver
46 Substanzen bei Jugendlichen und Erwachsenen in Berlin [2012 Epidemiological
47 Survey of Substance Abuse in Berlin]. München: IFT Institut für Therapieforschung;
48 2014. IFT-Berichte Bd. 185.
49
- 50 [26] European Monitoring Centre for Drugs and Drug Addiction (EMCDDA). Table PDU-
51 1. Estimates of high risk drug use, opioids, most recent estimates (latest year), rate per
52 1000 aged 15-64. Available:
53 <http://www.emcdda.europa.eu/data/2014#displayTable:PDU-01-1> [accessed
54 18.09.2015]; 2014.
55
56
57
58
59
60

- 1
2
3 [27] European Monitoring Centre for Drugs and Drug Addiction (EMCDDA). Data and
4 statistics. Available: [http://www.emcdda.europa.eu/data/stats2015#displayTable:POU-](http://www.emcdda.europa.eu/data/stats2015#displayTable:POU-Subnat)
5 Subnat [accessed 25.09.2015]; 2015.
6
7 [28] Kraus L, Steppan M, Piontek D. Schätzung der Prävalenz substanzbezogener
8 Störungen in Berlin: Opioide, Kokain und Stimulanzen [Estimating the prevalence of
9 substance use disorders in Berlin: Opioides, cocaine and stimulants]. München: IFT
10 Institut für Therapieforchung; 2015.
11
12 [29] Jones HE, Hickman M, Welton NJ, De Angelis D, Harris RJ, Ades AE. Recapture or
13 precapture? Fallibility of standard capture-recapture methods in the presence of
14 referrals between sources. *Am.J.Epidemiol* 2014;179(11):1383-1393.
15
16 [30] Jones HE, Welton NJ, Ades AE, Pierce M, Davies W, Coleman B et al. Problem drug
17 use prevalence estimation revisited: heterogeneity in capture-recapture and the role of
18 external evidence. *Addiction* 2016;111(3):438-447.
19
20 [31] Turkish Monitoring Centre for Drugs and Drug Addiction (TUBIM). 2010 national
21 report (2009 data) to the EMCDDA by the Reitox National Focal Point: New
22 developments, trends and in-depth information on selected issues. Turkey: Turkish
23 Monitoring Centre for Drugs and Drug Addiction; 2010.
24
25 [32] Rhodes W. Synthetic estimation applied to the prevalence of drug use. *J Drug*
26 *Issues*1993;23(2):297-322.
27
28 [33] Wejnert C, Heckathorn DD. Web-based network sampling: efficiency and efficacy of
29 respondent-driven sampling for online research. *Sociol Method Res* 2008;37(1): 105-
30 134.
31
32 [34] Handcock MS, Gile KJ, Mar CM. Estimating hidden population size using
33 Respondent-Driven Sampling data. *Electronic Journal of Statistics* 2014; 8: 1491-
34 1521.
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Table 1: Number of individuals recorded in each data source by year of registration, drug used, age and gender.

Ankara	Year	Cannabis				Opiates			
		Males		Females		Males		Females	
		15-24	25-34	35-64	15-64	15-24	25-34	35-64	15-64
Treatment	2009	60	33	20	24	42	34	34	26
Treatment	2010	165	87	29	41	229	94	47	55
Police	2009	478	631	271	86	98	61	24	25
Police	2010	695	673	290	78	277	136	52	30
Istanbul		15-24	25-34	35-64	15-64	15-24	25-34	35-64	15-64
Treatment	2009	175	177	81	100	98	150	138	83
Treatment	2010	316	221	110	96	282	255	182	157
Police	2009	1,258	1,292	403	66	81	216	353	20
Police	2010	891	976	393	82	121	210	279	23
Izmir		15-24	25-34	35-64	15-64	15-24	25-34	35-64	15-64
Treatment	2009	51	28	14	21	3	5	5	7
Treatment	2010	97	29	26	33	14	12	12	19
Police	2009	1,023	1,086	587	126	0	2	7	0
Police	2010	1,189	1,073	574	117	4	20	11	0

Table 2: Capture-recapture estimates of the number of high-risk cannabis users in Ankara and Izmir, and estimates of the number of high-risk opiate users in Ankara.

Ankara (Cannabis) ¹⁾	Deviance (df ³⁾)	Observed cases	Estimated hidden population	Total	95% confidence interval	Rate per 1,000 ⁴⁾
Males 15-24	14.1 (9)	1,325	8,094	9,419	7,545 – 11,944	23.6 (18.9-29.9)
Males 25-34	8.2 (9)	1,362	9,123	10,485	8,279 – 13,641	24.4 (19.3-31.8)
Males 35-64	6.7 (9)	592	5,932	6,524	4,257 – 10,919	7.7 (5.0-12.9)
All males		3,279	23,149	26,428	22,495 – 32,194	15.8 (13.5-19.3)
Females	10.5 (9)	217	1,847	2,064	1,159 – 4,397	1.2 (0.7-2.6)
Total		3,496	24,996	28,492	24,495 - 34,421	8.5 (7.3-10.3)
Izmir (Cannabis) ¹⁾						
Males 15-24	19.1 (9)	2,230	10,260	12,490	10,693 – 14,773	38.0 (32.6-45.0)
Males 25-34	11.6 (9)	2,089	8,405	10,494	9,009 – 12,382	30.2 (25.9-35.6)
Males 35-64	3.9 (9)	1,146	6,010	7,156	5,670 – 9,291	9.7 (7.7-12.6)
All males		5,465	24,675	30,140	27,162 – 33,451	21.3 (19.2-23.6)
Females	9.3 (9)	282	2,962	3,244	1,807 – 6,941	2.3 (1.3-5.0)
Total		5,747	27,537	33,384	29,813 – 37,637	11.9 (10.7-13.5)
Ankara (Opiates) ²⁾						
Males 15-24	9.3 (9)	574	1,468	2,042	1,660-2,557	5.1 (4.2-6.4)
Males 25-34	9.0 (9)	287	842	1,129	830-1,592	2.6 (1.9-3.7)
Males 35-64	11.8 (9)	141	805	946	501-1,944	1.1 (0.6-2.3)
All males		1,002	2,115	4,117	3,428-5,430	2.5 (2.1-3.2)
Females	12.9 (9)	121	522	643	357-1,398	0.4 (0.2-0.8)
Total		1,123	3,637	4,760	2,973-6,188	1.4 (0.9-1.9)

1) Poisson log-linear models including interaction between treatment in 2009 and 2010

2) Poisson log-linear models including interaction between treatment in 2009 and 2010 for males, and interaction between treatment in 2009 and police in 2010 for females

3) Degrees of freedom

4) Rate per 1,000 population in the relevant age group (15-64 years for totals)

Table 3: Multiplier estimates for high risk cannabis users in Istanbul based on capture-recapture estimates for Izmir, and estimates for high risk opiate users in Istanbul based on capture-recapture estimates for Ankara.

Source	Estimated number of high-risk cannabis users (multiplier CRC Izmir)					Total	Rate per 1,000*	Estimated number of high-risk opiate users (multiplier CRC Ankara)					Total	Rate per 1,000*		
	M		F					Mean (lower-upper)	M		F				Mean (lower-upper)	
	15-24	25-34	35-64	15-64	15-24				25-34	35-64	15-64					
Treatment 2009	42,858	66,337	41,403	15,448	166,045	18.0 (14.6-23.4)	4,765	4,981	3,840	2,053	15,638	1.7 (1.2-2.7)				
Treatment 2010	40,689	79,972	30,275	9,437	160,373	17.4 (14.4-21.9)	2,515	3,063	3,663	1,835	11,076	1.2 (0.8-2.1)				
Police 2009	15,359	12,485	4,913	1,699	34,456	3.7 (3.1-4.7)	1,688	3,998	13,914	514	20,114	2.2 (1.3-4.1)				
Police 2010	9,360	9,545	4,899	2,274	26,078	2.8 (2.3-3.6)	892	1,743	5,076	493	8,204	0.9 (0.5-1.6)				

* rate per 1,000 population in the age group 15-64 years