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Abstract

Background: Drug use disorders are significant social and public health concerns in the Islamic Republic of Iran; however, little is known about drug-related mortality.

Aims: We quantified the spatial and age distribution of direct illicit-drug-related mortality in the Islamic Republic of Iran, to inform harm reduction policies and interventions.

Methods: We modelled and mapped registered illicit-drug-related deaths from March 2016 to March 2017. Data were obtained from the Iranian Forensic Medicine Organization. Besag–York–Mollie models were fitted using Bayesian spatial analysis to estimate the relative risk of illicit-drug-related mortality across different provinces and age groups.

Results: There were 2203 registered illicit-drug-related deaths during the study period, 1289 (58.5%) occurred in people aged 20–39 years and among men (n = 2013; 91.4%). The overall relative risk (95% credible interval) of illicit-drug-related mortality in the provinces of Hamadan (3.37; 2.88–3.91), Kermanshah (1.90; 1.55–2.28), Tehran (1.80; 1.67–1.94), Lorestan (1.71;

1.37–2.09), Isfahan (1.40; 1.21–1.60), and Razavi Khorasan (1.18; 1.04–1.33) was significantly higher than in the rest of the country.

Conclusion: We found evidence of age differences and spatial variations in illicit-drug-related mortality across different provinces in the Islamic Republic of Iran. Our findings highlight the urgent need to revisit existing drug-use treatment and harm reduction policies and ensure that overdose prevention programmes are adequately available for different age groups and settings.

Keywords: illicit drug use, disorders, mortality, Bayesian analysis, overdose, harm reduction, Iran

Citation: Rostami M; Jalilian A; Ghadirzadeh MR; Nazparvar B; Rezaei-Zangeneh R; Karamouzian M. Bayesian spatial analysis of age differences and geographical variations in illicit-drug-related mortality in the Islamic Republic of Iran. East Mediterr Health J. 2023;29(1):24–32. https://doi.org/10.26719/emhj.23.003

Received: 06/12/20; accepted: 05/10/22

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Introduction

Data on drug-use-related mortality in the Eastern Mediterranean Region (EMR) are scarce because of the limited capacities in surveillance and data analysis (1,2). However, mental health and drug-use disorders are significant contributors to years lost due to disability in several countries in the EMR (2). In the Islamic Republic of Iran, where data on drug-use disorders are more available than in the rest of the region, mental health and drug-use disorders are among the leading contributors to disease burden (3). Drug-use disorders are associated with many adverse mental and physical health outcomes, such as mood and anxiety disorders (4), HIV

infection and viral hepatitis (5), suicidal ideation and attempts (6), and fatal overdose (7).

The Iranian Mental Health Survey of 7841 adults in 2011 estimated the past 12-month prevalence of drug-use disorders to be 2.4%; defined according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (4). The pattern of illicit drug-use in the Islamic Republic of Iran has changed, and methamphetamine use has increased significantly in the past few years (8,9), although opium remains the most frequently used illicit drugs (10). The sociocultural acceptability of opium in the Islamic Republic of Iran could be attributed to the history of its production in the country before the Islamic Revolution, its proximity to Afghanistan (the country with the highest opium production in the world), and its location on the Balkan drug trafficking route (7,11,12). A population size estimation in 2013 found that ~2 million people used drugs illicitly and ~200 000 injected drugs in the Islamic Republic of Iran (13). Drug-use disorders are more common among specific demographic categories, such as men, divorced people, and those with low socioeconomic status (4).

There is a growing body of evidence on the epidemiology of illicit drug-use in the Islamic Republic of Iran, but data on illicit-drug-related mortality are scarce and incomplete (14). According to forensic evidence, the overall death rate from illicit drug-use in 2015 was 3.82 per 100 000 (15). However, for several reasons, Iranian illicit-drug-related mortality statistics are prone to under-registration and misclassification bias (7,16). For example, the data are collected by a few health organizations using various techniques. An integrated source of data collection across the country is still lacking, which complicates estimation and monitoring of illicit-drug-related mortality over time (17). The use of accurate statistics from the Iranian Forensic Medicine Organization to assess the national and provincial burdens of illicit-drug-related mortality provides valuable insight for health policy-makers and informs resource allocation, interventions, and evaluation efforts (3).

In this study, we aimed to provide an overall picture of direct illicit-drug-related mortality (i.e. deaths specific to drug toxicity and not including blood-borne diseases associated with drug use) across different age groups and Iranian provinces. Our findings provide an overview of illicit-drug-related mortality in the Islamic Republic of Iran and help inform drug use treatment and harm reduction interventions in the country.

Methods

Study population

The Islamic Republic of Iran is a Muslim majority country in the EMR and has 31 provinces. About 80 million people were living in the country in 2016; 74% of whom resided in urban areas, 31% were aged 60 years (18).

Data sources

Under Iranian laws and regulations, all deaths due to suspicious or unknown causes are referred to the Forensic Medicine Organization. Forensic physicians and pathologists examine the cases, determine the exact cause of death, and issue death certificates (15,16). These certificates are commonly issued in response to law enforcement requests; therefore, the direct cause of death is summarized as "death due to illicit drug abuse", accompanied by the corresponding International Classification of Diseases codes (F11–F19) (16). For this study, data on all available illicit-drug-related mortality were obtained from the Iranian Forensic Medicine Organization. Additional data were retrieved about nationality, age group, sex, and the primary province of residence (18). We included 2203 direct drug-related deaths registered from 21 March 2016 to 20 March 2017, including 2013 deaths in men and 190 in women. This study interval was chosen because the relevant data were only available for this period.

Data analysis

Illicit drugs included opium and other unregulated opioids, amphetamines and unregulated stimulants, hallucinogens, inhalants, cannabinoids, psychoactive drugs, and other unspecified drugs (e.g. synthetic drugs). Given the small number of women who died from illicit drug use, we did not build sex-based spatial models to avoid potential sparse data bias. We used the Iranian Population and Housing Census of 2016 to obtain data on the age distribution of the provincial population (18). Age groups were categorized into 0–19, 20–39, 40–59, and ≥ 60 years.

Model characteristics

Despite racial homogeneity in the Islamic Republic of Iran, ethnic heterogeneity is significant, and languages, religion, and socioeconomic status vary significantly across different regions of the country. Therefore, we expected to see heterogeneity and spatial correlation in the relative risk (RR) of illicit-drug-related mortality. A statistical model that accounted for possible spatial correlation and province-specific variations was a reasonable choice for modelling illicit-drug-related mortality in the Islamic Republic of Iran. Therefore, we used a Bayesian model (i.e. Besag–York–Mollie) and mapped registered deaths to estimate mortality risk across the country. Bayesian hierarchical models help explain sampling variabilities in spatial random effects (19). The Besag–York–Mollie model is suitable for addressing unobserved heterogeneity or spatial correlation and independent province-specific variations (20). A scaled version of the Besag–York–Mollie model accounts for the spatially structured component and provides an intuitive way to assign priors to the model parameters (19,21). R version 3.6.1 (R Foundation, Vienna, Austria) was used for all statistical analyses.

Ethical considerations

The study protocol was reviewed and approved by the Ethics Committee of Kerman University of Medical Sciences (reference number: IR.KMU.REC.1397.433). No informed consent was required for this study, given the anonymized and deidentified nature of the illicit-drug-related mortality data.

Results

The present study included 2203 illicit-drug-related deaths, registered from 21 March 2016 to 20 March 2017. The age distribution was: 0–19 years (4.8%, n = 106); 20–39 years (58.5%, n = 1289); 40–59 years (31.7%, n = 698); and ≥ 60 years (5.0%, n = 110). Most deaths occurred in men (n = 2013; 91.4%).

Compared with the rest of the country, the overall RR of illicit-drug-related mortality was significantly higher in Hamadan (RR: 3.37; 95% credible intervals [CrI]: 2.88–3.91), Kermanshah (RR: 1.90; 95% CrI: 1.55–2.28), Tehran (RR: 1.80; 95% CrI: 1.67–1.94), Lorestan (RR: 1.71; 95% CrI: 1.37–2.09), Isfahan (RR: 1.40; 95% CrI: 1.21–1.60), and Razavi Khorasan (RR: 1.18; 95% CrI: 1.04–1.33) (Figure 1). Table 1 presents a summary of the number of illicit-drug-related deaths, $Y_{i,j}$, and the respective population, $P_{i,j}$, for each province (i) in different age groups (j). Table 1 also presents the expected number of illicit-drug-related deaths, $E_{i,j}$, and the posterior mean of the RR, $\theta_{i,j}$, for each province and age group. The posterior mean, standard deviation, and 95% CrI for model parameters μ_j, τ_j, and ψ_j are presented in Table 2 . Except for the 0–19-years age group, the overall number of observed illicit-drug-related deaths was smaller than their expected values under the null model of homogeneous illicit-drug-related mortality rates for the whole country (Table 2).

Posterior means of ψ_j parameters implied that the proportion of the variation in the spatial random effect $b_{i,j}$ explained by spatial correlation was 50% for age 0–19 years, 40% for 20–39 years, 44% for 40–59 years, and 24% for ≥ 60 years (Table 2). Therefore, the spatial correlation among provinces was relatively low, as at least half of the spatial variations among provinces were caused by random noise. The posterior means of RR ($\theta_{i,j}$) are shown in Figure 2 . Figure 2 and Table 1 indicate age differences and spatial variations in illicit-drug-related mortality across different provinces. The presented RRs were compared with the global (country-level) estimate. In the 0–19-years age group, the RRs of illicit-drug-related mortality in the provinces of Razavi

Khorasan (RR: 1.97; 95% CrI: 1.15–2.78) and Isfahan (RR: 1.80; 95% CrI: 1.03–2.91) were significantly higher than in the rest of the country. In the 20–39-years age group, the RRs of illicit-drug-related mortality in Hamadan (RR: 3.29; 95% CrI: 2.65–3.98), Kermanshah (RR: 2.28; 95% CrI: 1.79–2.82), Tehran (RR: 1.62; 95% CrI: 1.45–1.79), Lorestan 1.58 (95% CrI: 1.16–2.05), and Isfahan (RR: 1.52; 95% CrI: 1.27–1.80) were significantly higher than in the rest of the country. In the 40–59-years age group, the RRs of illicit-drug-related mortality in Hamadan (RR: 3.14; 95% CrI: 2.34–4.04), Lorestan (RR: 2.0; 95% CrI: 1.37–2.75), and Tehran (RR: 1.88; 95% CrI: 1.65–2.12) were significantly higher than in the rest of the country. In the ≥ 60-years age group, the RRs of illicit-drug-related mortality in Hamadan (RR: 5.24; 95% CrI: 2.94–8.18) and Tehran (RR: 2.46; 95% CrI: 1.83–3.16) were significantly higher than in the rest of the country.

Discussion

We used a spatial Bayesian model to estimate the spatial risk of illicit-drug-related mortality in the Islamic Republic of Iran. We found age differences and spatial variations in illicit-drug-related mortality across different provinces. Most illicit-drug-related deaths occurred in the 20–39-years age group and in the western provinces, comparable with previous studies in the country (15,16).

We found spatial variations in illicit-drug-related mortality in the Islamic Republic of Iran. These findings are consistent with previous reports suggesting that western and south-eastern provinces had the highest drug-related mortality between 2005 and 2012 (16). The observed heterogeneity in drug-related mortality could be partly associated with historical opioid use in some provinces and their proximity to the primary drug trafficking routes from Afghanistan to Europe. It may also be attributed to the different socioeconomic status, literacy levels, unemployment rates, and access to addiction treatment services across different provinces (4,16). Iranian investment in expanding harm reduction services, methadone maintenance treatment in particular, is promising and considered progressive in the EMR (10). For example, as of March 2018, > 700 000 clients had received methadone maintenance services in 7225 outpatient centres (10). However, opioid agonist treatment coverage and accessibility varied greatly and were suboptimal in impoverished settings and border provinces (4,22). Our spatial estimates shed light on the existing geographic disparities in accessing harm reduction and drug use treatment and suggest that relevant interventions and resource allocations need to pay attention to areas with higher risk of drug-related mortality. More importantly, the existing disparities highlight the need to complement existing opioid agonist treatment services by scaling up nationwide, evidence-informed interventions for overdose prevention and management. This could include: increasing the availability and accessibility of naloxone for people likely to experience an opioid overdose; expanding overdose interventions delivered within emergency departments; educating frontline health workers and first responders about detection and treatment of people with overdose symptoms; and supporting community-based and peer-led opioid overdose prevention programmes and responses (23–27).

Our findings highlighted the limitations of current registry systems for illicit drug-use-related deaths and identified potential areas for improvement. In the Islamic Republic of Iran, diagnosis and official registration of deaths are carried out by two primary independent organizations (i.e. medical universities operating under the Ministry of Health and Medical Education, and the Forensic Medicine Organization operating under the supervision of the judiciary system). However, these two organizations do not sufficiently communicate to keep death records updated (28). Given the importance of illicit drug-use-related death data in drug-use surveillance and relevant public health decision-making in the Islamic Republic of Iran, there is a need to ensure that specific details about illicit drug-related deaths (e.g. type and class of drug, and mode of use) are recorded and reported (29). Inconsistent coding practices across clinical settings must be standardized using valid and specific International Classification of Diseases codes. This cannot be achieved without increasing awareness and training about accurate record keeping of illicit drug-use-related deaths for forensic physicians and other healthcare providers involved in recording the causes of death in such cases (30).

Our findings regarding the number of illicit-drug-related events among younger age groups are concerning. Our data cannot elucidate the underlying reasons behind these deaths, but this observation may be explained by a decrease in the age of drug-use initiation among children and adolescents, or because mortality in the 0–19-years age group could have included deaths from accidental drug poisoning (15,31,32). Regardless of the underlying cause of the notable death rate among children and young adults, these findings are alarming. They highlight the need for future overdose-related studies in this age group and improved public health education campaigns and interventions to increase awareness among young people about the overdose risks associated with illicit drugs and prescription opioids (33,34).

Our study had some limitations. First, the numbers of deaths reported by the Iranian Drug Control Headquarters and World Drug Report (2018) based on the estimates of the Ministry of Health and Medical Education were higher than those reported in our study. Our use of a selective administrative database such as the Forensic Medicine Organization may have underestimated the number of illicit-drug-related deaths because the organization does not cover all death registrations across the country. Some deaths in rural and remote areas are not referred to the Forensic Medicine Organization for further investigation. There is a time lag between the date of death and when the cause of death is updated in Forensic Medicine Organization records because of the time and resources required to complete an autopsy. Some of the initial clinical reports on drug-related deaths may be revoked after detailed investigation by the Forensic Medicine Organization. Second, our data did not include deaths associated with alcohol use, and we could not assess differential death rates by type of drug because the Forensic Medicine Organization database did not provide data on the type of drug detected during autopsy. Third, given the nature of the data available to us, we did not have any information on drug-specific cause of death, marital status, occupation, and educational levels,

which could have been correlated with illicit-drug-related deaths (15,35). Our provincial data could not provide accurate data on homeless populations who may have died in a province other than their own. Fourth, we could not conduct a sex-specific analysis because of the small number of deaths recorded among women. We were unable to subdivide the 0–19-years age group because of the small sample size, which limited our ability to provide more details on specific groups of children or adolescents. Lastly, the data provided to us did not include detailed information on the manner of death (e.g. accidental or deliberate poisoning) and indirect deaths due to illicit drug use (e.g. road traffic injuries).

Conclusion

We examined data collected from the Iranian Forensic Medicine Organization and identified significant diversity in spatial risk of illicit-drug-related mortality across different age groups and provinces in the Islamic Republic of Iran. Our findings highlight the urgent need to revisit existing harm reduction and drug use treatment policies to ensure that preventive measures, such as overdose prevention and management programmes, are supported and scaled up.

Acknowledgement

The authors are thankful to Dr. Behzad Mahaki for his helpful feedback on the paper. Mohammad Karamouzian was supported by a Banting Postdoctoral Fellowship.

Funding: The study was funded by Kerman University of Medical Sciences.

Competing interests: None declared.

Analyse spatiale bayésienne des différences d'âge et des variations géographiques de la mortalité liée à la consommation de drogues illicites en République islamique d'Iran

Résumé

Contexte : Les troubles liés à la consommation de drogues constituent des préoccupations sociales et de santé publique importantes en République islamique d'Iran ; cependant, très peu d'informations sont disponibles sur la mortalité liée à la drogue.

Objectifs : Nous avons quantifié la distribution géographique et la répartition selon l'âge de la

mortalité directement liée à la consommation de drogues illicites en République islamique d'Iran, afin de guider les politiques et les interventions en matière de réduction des effets nocifs.

Méthodes : Nous avons modélisé et recensé les décès liés à la consommation de drogues illicites enregistrés entre mars 2016 et mars 2017. Les données ont été obtenues auprès de l'Organisation de médecine légale iranienne. Les modèles de Besag, York et Mollié ont été ajustés à l'aide d'une analyse spatiale bayésienne pour estimer le risque relatif de mortalité liée à la consommation de drogues illicites dans les différentes provinces et les différents groupes d'âge.

Résultats : Durant la période de l'étude, 2203 décès liés à la consommation de drogues illicites ont été enregistrés, 1289 (58,5 %) sont survenus chez des personnes âgées de 20 à 39 ans et chez des hommes (n = 2013 ; 91,4 %). Le risque relatif global (intervalle de crédibilité à 95 %) de mortalité liée aux drogues illicites dans les provinces de Hamadan (3,37 ; 2,88-3,91), Kermanshah (1,90 ; 1,55-2,28), Téhéran (1,80 ; 1,67-1,94), Lorestan (1,71 ; 1,37-2,09), d'Ispahan (1,40 ; 1,21-1,60) et de Razavi Khorasan (1,18 ; 1,04-1,33) était nettement plus élevé que dans le reste du pays.

Conclusion : Nous avons constaté des différences d'âge et des variations géographiques en matière de mortalité liée à la consommation de drogues illicites dans différentes provinces de la République islamique d'Iran. Nos résultats soulignent le besoin urgent de revoir les politiques existantes relatives à la prise en charge de la consommation de drogues et à la réduction des effets nocifs ainsi que de veiller à ce que les programmes de prévention des surdoses soient disponibles de manière adéquate pour les différents groupes d'âge et contextes.

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