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Abstract

Background: Research suggests that there is an increasing trend in drug-related deaths worldwide: an estimated 69 000 individuals lose their lives due to substance abuse annually.

Aims: To determine the geographical pathology of drug-related deaths in the Islamic Republic of Iran and to evaluate incidence trends, with a focus on identifying high- and low-risk regions.

Methods: For this ecological study, we collected data from the 2 main sources (the Legal Medicine Organization and the Ministry of Health and Medical Education) responsible for

registering substance-related deaths during 2014–2017. Data analysis was conducted using Joinpoint regression analysis, Global Moran's I and Anselin Local Moran's I.

Results: Of the 12 386 drug-related deaths in 2014–2017, most occurred during the summer months; 7162 of these were among middle-aged individuals. The mean age of children and adolescents who died of substance abuse was 5.2 [standard deviation (SD) 4.6] years. In the young adult group, mean age at death was 20.7 (SD 2.5) years; it was 34.2 (SD 5.4) years for adults and 55.6 (SD 9.8) years for older adults. Changes in mortality rate peaked in 2017 (annual percentage change = 0.52); in the last months of the study period there was a nonsignificant decrease (annual percentage change = –6.99) in the incidence (average annual percentage change = –0.5; 95% confidence interval: –3.2, 2.3).

Conclusion: Deaths due to substance abuse will remain a huge public health problem unless policy- and decision-makers determine why this problem continues to increase despite the extensive efforts on regulation and find ways to mitigate it.

Keywords: drug-related death, incidence, spatial distribution, temporal trend, substance abuse, Iran

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Introduction

Substance intoxication is dangerous and often fatal (1). Drug-related death is defined as any

psychological or behavioural disorder due to psychoactive substance misuse (ICD-10: F11–F16, F19) leading to intentional or unintentional self-intoxication with substances for unknown intentions or exogenous causes (2). Research suggests that there is a generally increasing trend in the drug-related deaths rate worldwide (1). According to a World Health Organization estimate, 69 000 individuals lose their lives due to substance overdose every year (3). Although older age is one of the risk factors for substance overdose (4), studies conducted in the United States of America (USA) have shown increasing rates of substance-related suicide and intoxication in adolescents and adults (5,6). According to the national trends in the USA, during 1999–2016 the drug-related deaths rate in children and adolescents increased by 268.2% (7). The mortality rate due to substance intoxication among children in developing countries is 4 times greater than that in other countries (8). Although substance intoxication in the Islamic Republic of Iran is one of the main causes of poisoning among children and adolescents (2,9), a 5-year longitudinal study showed that substance intoxication was most common in adult men aged 30–39 years (10).

Our study was designed and conducted to investigate the trend for drug-related deaths rates in different population groups (children, adolescents, young adults, adults, older adults) during 2014–2017, with a special focus on identifying high- and low-risk regions (provinces) in the Islamic Republic of Iran.

Methods

Study design

An ecological design was used for this study, conducted in 2021. We describe the spatial distribution and trend of disease incidence rates (11). Using this design, the spatial patterns (multiple-group study) and the time trends were investigated simultaneously (12).

Data sources

We surveyed 3 main types of data sources covering 2014–2017. Data from the 2 main sources of drug-related deaths registers in the Islamic Republic of Iran: the Legal Medicine Organization and the Ministry of Health and Medical Education, were examined. The capture–recapture method was used to calculate number of deaths.

The third data source, the geographic coordinates of the patients, was obtained using the most recent information available on the Google Map software and the georeferenced layers of the Iranian provinces. We used aggregate data and compared the distributions of the disease in different provinces and areas (13,14).

Spatial and descriptive information related to the study area

The Islamic Republic of Iran is located in the Middle East, in the southwestern region of Asia between 25°3′ and 39°47′ north and 44°5′ and 63°18′ east. It has 31 provinces and an area of 1 648 195 km2. Based on the last census, carried out in 2016, the population is estimated at 79 927 270 (15).

Target and study population

This study was designed to cover all cases of poisoning with drugs, and all met the eligibility criteria of the study. The inclusion criteria were: a known place of residence and diagnosis of drug-related deaths according to ICD-10 codes (2) in terms of the type of poisonous substance. The age classification was based on the large demographic classifications of the Statistical Center of Iran that regards age up to 14 years as child and adolescent, 15–24 years as young adult, 25–44 years as adult and 45–64+ years as older adult (16).

Statistical analysis

The statistical analysis covered 3 main parts: descriptive analysis of the epidemiological and demographic indicators of patients; analysis of the temporal trends of incidence of DRD; and spatial analysis of poisonous substance

Crude death rates (No. of cases per 100 000 population) were estimated during 2014–2017 (based on the 2016 census). Adjusted death rates were determined using a direct method based on the standard population of the USA in 2000 (17). The age-adjusted rate for each province was compared with the national age-adjusted rate using the Z-test. Statistical tests were carried out at a significance level of 0.05. We used StataMP, version 13, Excel and SPSS, version 23, for this section.

The second part was the time trend analysis: the analyses related to the crude death rate time trend were performed according to year, month and age group of the person. To analyse the trend for deaths caused by drug abuse, the mortality rates were considered the dependent variables and year and month were considered the independent variables. The rate for drug-related deaths was calculated separately for each age group. Along with detecting the exact time of joinpoints, the average annual percent change, annual percent change and slope changes of the regression line were estimated at 95% confidence interval (95% CI) for the annual trend for incidence of death from the disease during 2014–2017. These were determined using regression analysis of the endpoints on the Joinpoint regression statistical program, version 4.9.0.0.

The third part of the statistical analysis was the spatial pattern and cluster analysis. The spatial pattern of clustering was analysed using 2-sided α and 0.05 significance level. To evaluate the spatial distribution of incidence of disease, the cumulative drug-related deaths incidence rate was initially calculated for each province.

To assess spatial autocorrelation of the disease, we used the Global Moran's I index. The values related to this index range from −1 to +1, with the latter showing a more clustered and the former indicating a more dispersed distribution of the variable (18). The "zero" values are an indication of the randomly spatial distribution of the phenomenon under study (18).

Anselin Local Moran's I index was used for locating the high- and low-risk clusters or spots for drug-related deaths, it divides the polygons into 5 parts: high–high, low–low, low–high, high–low and not significant. High–high indicates a high incidence rate within a zone and its neighbouring areas, i.e. high-risk clusters of disease incidence, or, to use a more literal term, its hotspots; low–low indicates a low incidence of disease within a zone and its surrounding areas, i.e. the low-risk disease clusters or the cold spots (15,19,20).

Results

Descriptive

Of the 12 386 drug-related deaths during 2014–2017, the greatest number, 3513, occurred during the summer, and middle-aged people accounted for 7162 deaths. The age-adjusted drug-related deaths rate was 7.8 times greater in men than in women. Adults accounted for the highest number of drug-related deaths. The drug-related deaths rate increased in all age groups except for the child–adolescent group, which showed a significant increase in 2015 and a sharp decrease in 2016. The mean age of children and adolescents who died of substance use was reported as 5.2 (SD 4.6) years. Mean age was 20.7 (SD 2.5) years among the young adult group, 34.2 (SD 5.4) years for adults and 55.6 (SD 9.8) years for older adults. Over the 4-year period, the crude death rate per 100 000 persons was 15.14 and the age-adjusted death rate was 14.76 (Table 1).

Hamedan and Kermanshah provinces had the highest age-adjusted drug-related deaths rates, while Golestan, Bushehr and West Azarbaijan had the lowest rates (Table 2). The provinces where drug-related deaths was higher or lower than the national age-adjusted rate are shown in Table 2 : the difference was statistically significant for the 9 provinces with the highest rates and the 12 provinces with the lowest rates (P

Spatial autocorrelation and identifying the clusters

To analyse the spatial distribution of the disease, first the cumulative rate of incidence was calculated in 100 000 individuals. The 8 provinces with the highest 8 cumulative incidence rates were: Khorasan Razavi (18.7), Semnan (18.7), Tehran (21.2), Alborz (21.2), Hamedan, 25.8), Kermanshah (32.3), Lorestan (23.8) and Zanjan (22.9). The provinces with the lowest cumulative incidence rates were: Bushehr (5.6), Khouzestan (7.9), Azarbayjan Sharghi (5.7), Golestan (6.3) and Mazandaran (5.8)

The results obtained via Global Moran's I analysis gave a value for this index of 0.269, indicating the intensity of autocorrelation and the high tendency to clustering. The z-score value of 4.9 (P