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## Trends in substance use and in the attributable burden of disease and mortality in the WHO European Region, 2010–16

Jürgen Rehm <sup>1–7</sup>, Jakob Manthey <sup>1</sup>, Kevin D. Shield<sup>2,7</sup>, Carina Ferreira-Borges<sup>8</sup>

- 1 TU Dresden, Institute for Clinical Psychology and Psychotherapy, Dresden, Germany  
2 Centre for Addiction and Mental Health, Institute for Mental Health Policy Research, Toronto, Ontario, Canada  
3 Centre for Addiction and Mental Health, WHO Collaboration Centre, Toronto, Ontario, Canada  
4 Institute of Medical Science, University of Toronto, Toronto, Ontario, Canada  
5 Centre for Addiction and Mental Health, Campbell Family Mental Health Research Institute, Toronto, Ontario, Canada  
6 Department of Psychiatry, University of Toronto, Toronto, Ontario, Canada  
7 Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada  
8 WHO European Office for Prevention and Control of Noncommunicable Diseases, World Health Organization, Regional Office for Europe, Moscow, Russian Federation

**Correspondence:** Jürgen Rehm, Centre for Addiction and Mental Health, Institute for Mental Health Policy Research, 33 Russell Street, Toronto, Ontario, Canada M5S 2S1, Tel: +1 416 535 8501 (ext 36173), Fax: +1 416 595 6068, e-mail: jtrehm@gmail.com

**Background:** This paper examines changes in substance use, and compares the resulting attributable burden of disease in the WHO European Region between 2010 and 2016. **Methods:** Data for 2010 and 2016 on the number of deaths, years of life lost (YLL) and disability-adjusted life years (DALYs) lost were obtained by sex and country from the 2016 Global Burden of Disease (GBD) study. Exposure data for all substances except alcohol were obtained from the same study, while alcohol data were obtained from the WHO. Proportional changes were calculated for the WHO European Region as a whole to identify trends and for sub-regions to identify which regions contributed most to trends. **Results:** In the WHO European Region in 2016, substance use caused 2.1 million deaths, 48.6 million YLL and 57.9 million DALYs lost, representing 22.4, 29.0 and 20.4% of all deaths, YLL and DALYs, respectively. The substance-attributable burden of disease was higher among men than women and highest in the eastern parts of the WHO European Region. Changes in the number of deaths, YLL and DALYs lost between 2010 and 2016 were almost uniformly downward, with the largest proportional changes observed for men. Exposure to tobacco, alcohol and illicit drugs also decreased uniformly. **Conclusions:** Substance use and its attributable mortality and burden of disease have decreased in the WHO European Region since 2010. However, overall levels of substance use and the resulting burden of disease in the Region remain high compared with other regions of the world.  
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### Introduction

In the World Health Organization (WHO) European Region, tobacco and alcohol use, and their associated mortality rates, have decreased from 1990 to 2010.<sup>1,2</sup> At the same time, despite previous sharp increases in life expectancies in Europe,<sup>3,4</sup> country-level trends in life expectancy in Europe have overall flattened out and/or reversed, especially in some of the largest high-income countries of the European Union, such as France, Germany, Italy and the UK.<sup>3,5</sup> These stagnations and reversals in life expectancies, which were also observed in other high-income countries, such as the USA in more recent years, have been hypothesized to be due, in part, to alcohol and illicit psychoactive substance use and attributable mortality.<sup>5–7</sup> Alcohol and illicit drug use are impacting life expectancy, as they are the leading risk factors for mortality

among people younger in age,<sup>8</sup> particularly due to their effects on motor vehicle accident and on intentional injury rates.<sup>1,9,10</sup> However, some of the decreases in life expectancy have also been attributed to causes of mortality seen later in the life course, which are less likely to be related to substance use.<sup>5,11</sup>

This publication aims to clarify trends in substance-attributable mortality and years of life lost (YLL) between 2010 and 2016 for the WHO European Region, and for important sub-regions. The period between 2010 and 2016 was selected as it includes the first part of the time period covered by recent international efforts in reducing mortality in non-communicable diseases and their major risk factors as outlined by the WHO and the United Nations.<sup>12,13</sup> In addition, we will report on disease burden as measured in disability-adjusted life years (DALYs).

**Table 1** Composition of regions within WHO European Region described in this report

Regions	Countries	Characteristics with respect to drinking and other drug use patterns
WHO European Region	Albania, Andorra, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Luxembourg, Malta, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Republic of Moldova, Romania, Russian Federation, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tajikistan, the former Yugoslav Republic of Macedonia, Turkey, Turkmenistan, Ukraine, United Kingdom of Great Britain and Northern Island, Uzbekistan	Wealthy WHO region with proportionally highest use of psychoactive substances globally
EU	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom	All high-income countries, <sup>37</sup> with different levels and patterns of alcohol use (see sub-regions); relatively low tobacco use rates on the decline in most countries; high levels of drug use globally (about the same as WHO European region)
Central-western EU	Austria, Belgium, Denmark, France, Germany, Luxembourg, Netherlands and Switzerland	High-income countries <sup>37</sup> with highest <i>per capita</i> gross domestic product at purchasing power parity (GDP PPP) in the region
Central-eastern EU	Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia	High-income countries, but with GDP PPP lower than in other parts of the EU; traditional drinking style of high spirits, but recently replaced largely by beer and wine; frequent episodes of heavy drinking outside of meals; relatively high tobacco consumption; lower than average illicit drug consumption
Mediterranean	Cyprus, France, Greece, Israel, Italy, Malta, Portugal, Spain and Turkey	High-income countries; traditionally predominant consumption of (moderate) amounts of alcohol with meals on an almost daily basis; <sup>38</sup> Slightly higher than EU average for tobacco, average EU illicit drug consumption
Eastern WHO European Region	Belarus, Republic of Moldova, Russian Federation and Ukraine	Lower GDP PPP than countries in the EU; mostly in middle-income categories; <sup>37</sup> heavy episodic drinking occasions, with both longer duration and higher volume of alcohol consumed per occasion than in other parts of the WHO European Region; <sup>25,39</sup> high tobacco and illicit drug use, including injection drug use <sup>40</sup>
South-eastern WHO European Region	Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey, Turkmenistan and Uzbekistan	Lower than average GDP PPP, relatively low level of alcohol use, in part due to the fact that in many countries the majority is of Muslim faith. High prevalence of tobacco use, relatively low level of illicit drug use

## Methods

The current study is based on data from the Institute for Health Metrics and Evaluation's (IHMEs) 2016 Global Burden of Disease (GBD) study, more specifically from the 2016 Comparative Risk Assessment Study (part of the 2016 GBD Study),<sup>1,14</sup> with alcohol exposure as measured in adult *per capita* consumption in the WHO Global Information System on Alcohol and Health.<sup>15</sup> All data were extracted by country, year, age and sex.

### *Psychoactive substances included*

Legal (tobacco and alcohol) and illicit psychoactive substances (cannabis, opioids, cocaine, amphetamines, other) were included.

### *Countries and regions included*

In addition to showing results for the European Union and WHO European Region as a whole, based on the current drinking patterns and economic wealth of countries, five regional clusters were separated based on alcohol use. For better comparability with other empirical analyses on substance use, we used the regions and descriptions of Shield et al.<sup>2</sup> (see table 1 below). Please note that these clusters were not intended to cover all countries of the WHO European Region, nor were they intended to be disjunctive.

### *Mortality and burden of disease data*

Country-specific absolute numbers of death, YLL due to premature mortality and DALYs were obtained from the IHME by sex;<sup>14</sup> for definitions of burden of disease indicators.<sup>16</sup> Sex-specific YLL were defined by subtracting the age at death from the remaining life expectancy at that age, while DALYs lost represents a summary measure comprising YLL due to premature mortality and due to disability (years lived with disability). Causes of death were based on data from the vital registries of countries and then reassigned to account for ill-defined causes of death (i.e. 'garbage codes') and miscoding.<sup>17</sup>

### *Exposure data*

With the exception of alcohol use, exposure data were also obtained from the IHME.<sup>14</sup> We used use disorder prevalence as the exposure variable for drug use, as most of the burden was calculated based on use disorders rather than based on actual use.<sup>1</sup> In addition to alcohol use disorder, we provided alcohol *per capita* consumption from the Global Information System on Alcohol and Health,<sup>15</sup> which is the main indicator for measuring level of alcohol use in the international frameworks [i.e. non-communicable disease (NCD) framework,<sup>12</sup> Sustainable Development Goals].<sup>18</sup>

### *Tobacco-, alcohol- and illicit drug use-attributable mortality and burden of disease data*

We used the country-specific data from the GBD 2016 study, and aggregated country-specific data for the regions used. In the GBD

2016 study, the number of deaths, YLLs and DALYs attributable to alcohol and illicit drug use were estimated based on Levin's population-attributable fraction (PAF) methodology.<sup>19–21</sup> For tobacco, a smoking-impact ratio PAF methodology was used to estimate the burden of cancers, chronic obstructive pulmonary disease (COPD), interstitial lung disease, other chronic respiratory diseases and pneumoconiosis attributable to tobacco smoke. For all other tobacco-attributable diseases, a Levin-based PAF methodology with a 5-year lagged smoking prevalence was used.

The following causes of death were included as substance-attributable:<sup>1</sup> for 'tobacco': tuberculosis, cancers (lip and oral cavity, nasopharynx, oesophageal, colon and rectum, gastric, pancreatic, larynx, trachea, bronchus and lung, breast, cervical, prostate, kidney, bladder, leukemia), ischaemic heart disease, ischaemic stroke, haemorrhagic stroke, atrial fibrillation and flutter, peripheral vascular disease, COPD, asthma, other chronic respiratory diseases, peptic ulcer disease, gallbladder and biliary disease, Alzheimer's disease and other dementias, Parkinson's disease, multiple sclerosis, diabetes mellitus, rheumatoid arthritis, low back pain, cataract, macular degeneration, low bone mass-related fractures, hip fracture, abdominal aortic aneurysm, in addition to outcomes of second-hand smoke; for 'alcohol': alcohol use disorders, and alcoholic cardiomyopathy as 100% alcohol-attributable outcomes; tuberculosis, lower respiratory infections, cancers (lip and oral cavity, nasopharynx, other pharynx, oesophageal, colon and rectum, liver, larynx, breast), ischaemic heart disease, ischaemic stroke, haemorrhagic stroke, hypertensive heart disease, atrial fibrillation and flutter, cirrhosis, pancreatitis, epilepsy, diabetes mellitus, motor vehicle road injuries, unintentional injuries, self-harm, interpersonal violence; for 'illicit drug use': amphetamine-, cannabis-, cocaine-, opioid- and other drug use disorders as 100% drug-attributable outcomes, hepatitis B, hepatitis C, HIV, all due to injection drug use, self-harm as attributable to different substance.

The PAF for the combined burden of disease attributable to tobacco smoking, alcohol use and illicit drug use was estimated by summing the three attributable fractions and reducing this sum by 10%. This estimate is conservative. Collins and Lapsley estimated the overlap based on results from Australian epidemiological studies and estimated overlap only between alcohol and tobacco in 2–3% of the total [see p. 35 of Ref (22)]. However, since then a number of conditions based on interactions of different substances have been added, such as suicides and homicides (those related to alcohol and/or illicit drug use). We have thus followed other publications in modelling the overlap as 10% to be conservative.<sup>23</sup>

## Results

### Level of substance-attributable burden of mortality and disease in the WHO European Region 2016

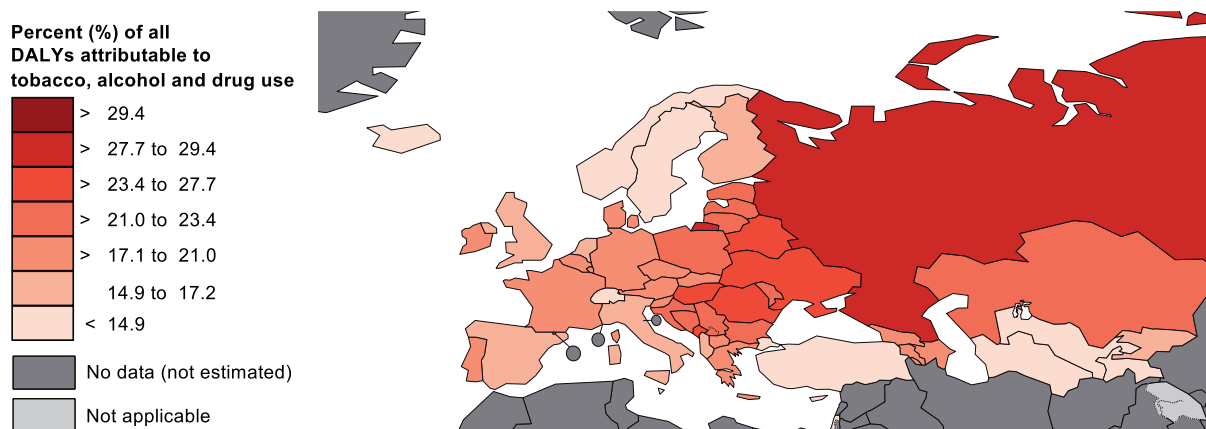
Substance-attributable burden of disease in the WHO European Region was high in 2016 (see Supplementary table S1 for details). About 22% of the 9.4 million deaths in adults in the WHO European Region were due to substance use, amounting to 2.1 million deaths, mostly in men (1.5 million deaths, representing 33% of all deaths in men); 0.6 million deaths, representing 12% of all deaths in women). As indicated above, these numbers are less than the sum of the deaths due to all substances, as they take into consideration the overlap (see Methods section above). Most of these deaths were attributable to tobacco (61%), with about one-third attributable to alcohol (34%) and the fewest to illegal drugs (5%).

With respect to YLL, overall in 2016, 48.6 million out of 167.4 life years lost were due to substance use. At 29%, the proportion of YLL due to substance use to all YLL is higher than the proportion of substance-attributable deaths to all deaths (22%), indicating that, on average, substance-attributable deaths happen prematurely. This is mainly due to alcohol and illegal drugs, as the more even distribution between substance classes compared with the distribution of deaths show (tobacco: 54%; alcohol: 39%; illegal drugs: 8%). 57.9 million life years are lost due to substances either because of premature mortality or because of disability (20% of all 284.1 million DALYs in the region; 29% in men and 11% in women). Fifty-two percent or these DALYs are due to tobacco, 39% due to alcohol and 10% due to illegal drugs.

Figures 1 and 2 give an overview of substance-attributable YLL and DALYs by country. There is a West–East gradient within the WHO European Region, with higher substance-attributable burden in the Eastern parts.

### Trends in substance-attributable mortality and burden of disease 2010–16

While the level of substance-attributable mortality was high in the WHO European Region, the trends point downward for most regions on all indicators (see figure 3). Since 2010, the number of substance-attributable deaths decreased by 3.3%, YLLs by 7.0% and DALYs by 5.9% (see also Supplementary table S1 for select sub-regions), while all-cause deaths increased by 4.0%, and YLLs and DALYs decreased by 3.3% and 0.4%, respectively. In other words, the decreases in substance-attributable burden of disease indicators were much larger than the general trends, and thus the general trend cannot explain the results.

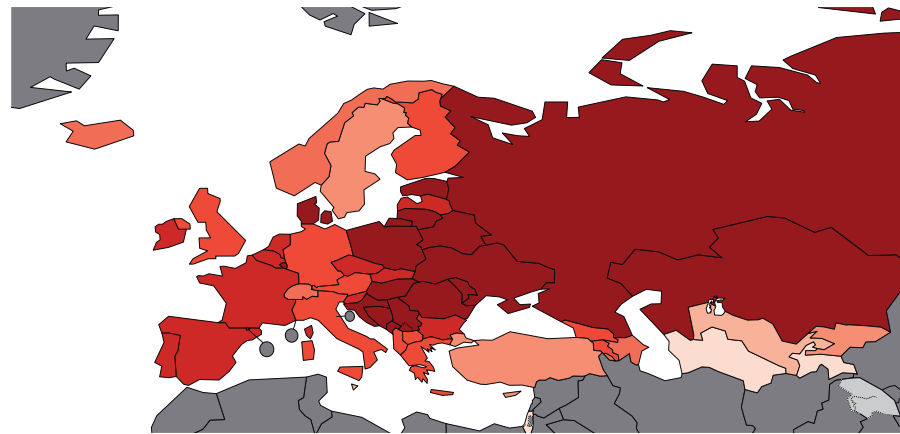


**Figure 1** Percent of all years of life lost attributable to tobacco, alcohol and illicit drug use in 2016

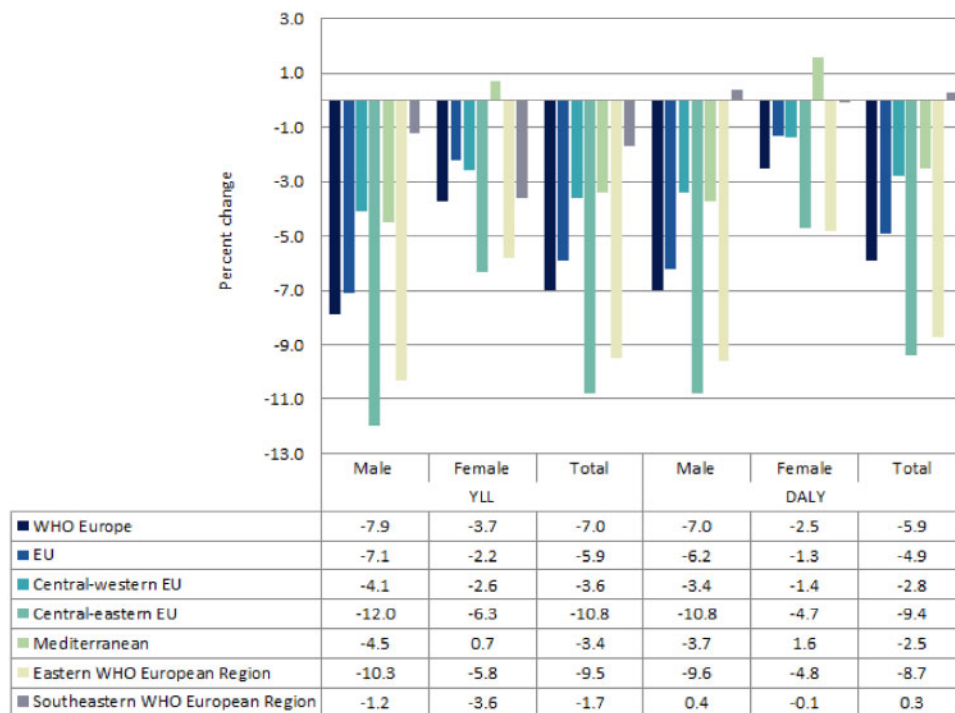
Percent (%) of all YLL attributable to tobacco, alcohol and drug use

> 29.4  
> 27.7 to 29.4  
> 23.4 to 27.7  
> 21.0 to 23.4  
> 17.1 to 21.0  
14.9 to 17.2  
< 14.9

No data (not estimated)  
Not applicable



**Figure 2** Percent of burden of disease in DALYs attributable to tobacco, alcohol and illicit drug use in 2016



**Figure 3** Changes in % in substance-attributable years of life lost and disability-adjusted life years between 2010 and 2016

Declines were most pronounced in men, and in the Northern and Eastern regions. In men, substance-attributable YLLs were proportionally reduced about 3–4-fold, and DALYs were reduced by a factor of 4–5, compared with women.

### *Trends in substance use and reaching the non-communicable disease target goals for alcohol and tobacco use*

Given the substantial overall reductions in substance-attributable burden of disease indicators, it is no surprise that substance use indicators also decreased substantially (for details see Supplementary table S2). Decreases were highest for alcohol use, and mainly in the eastern parts of the WHO European Region, where alcohol has long been a key risk factor for mortality and disease burden.<sup>24–26</sup> While the decreases for other parts of the WHO European Region were proportionally smaller, with a 12% reduction of alcohol use between 2010 and 2016, the WHO European Region has already reached the target

of a 10% reduction as set out in the NCD framework for 2025 (Supplementary table S2). While tobacco use also decreased between 2010 and 2016 (–7%), with the current pace of reductions the tobacco use target of a 30% reduction by 2025 will not be reached.

### **Discussion**

Overall, almost all indicators for substance use and attributable mortality in the WHO European Region improved between 2010 and 2016. This clearly makes this region different from other WHO regions and from the USA, a high-income country similar to the central-western EU countries, currently experiencing increases in substance-attributable burden of mortality and disease.<sup>6,27</sup> The improvement in substance-attributable disease burden in the WHO European Region seems to be driven by two groups which previously had the highest burden of substance-attributable burden: (i) countries in the northeastern part of the region and (ii) men. Over the entire WHO European Region, alcohol- and

tobacco-attributable burden of disease had similar magnitudes of downward trends relative to the 2010 level, with drug-attributable mortality not showing the same level of improvement. For women, and in some regions such as the south-eastern region, there were increases in illicit drug-attributable burden. The current analyses can only give trends, and not explanations, for why burden of disease indicators for illicit drugs did not follow the trends of legal drugs, especially for women. However, these differential trends speak against some root causes, such as increases in social inequalities, as they would apply similarly to all substances and both sexes.

Before discussing the implications of this research, we would like to list the limitations of the current study. First, while not perfect, exposure estimates are less biased for legal psychoactive substances than for illicit drugs. By their very nature, illicit drugs' prevalence must be estimated with indirect methods based on many assumptions,<sup>28</sup> and comparisons with more direct methodology such as wastewater analyses<sup>29</sup> show that estimates can be inaccurate. Second, no methodology exists to date to model the impact of illicit drug use on many diseases which are known to be causally affected.<sup>30</sup> Therefore, the total burden of disease attributable to illicit drug use which is presented in this paper is likely a conservative estimate. Third, for all substances and all countries, except for alcohol in Russia and surrounding countries,<sup>1</sup> the risk relations were often based on global meta-analyses which may not reflect the risk relationships in specific countries due to different patterns of substance use<sup>31</sup> and differences in the respective environments; this issue is especially important with respect to the risk relations between substance use and injury.<sup>31,32</sup> Finally, the overlap between the impact of different substances on burden has been based on only one study,<sup>22</sup> as there is surprisingly little research available on the overlap between different substances included in substance-attributable mortality estimates.

Although current trends in substance use and the resulting burden of disease are positive for the WHO European Region, especially for men, the proportional share (i.e. attributable fraction) of substance-attributable health burden is still at a high level—among the highest globally.<sup>1</sup> In the year 2016, 2.1 million deaths were due to tobacco, alcohol and illicit drug use, corresponding to 22% of all deaths in the region, many of them occurring prematurely. Thus, there is an urgent need to continue efforts to reduce substance-attributable deaths. Specifically, with respect to tobacco, efforts to prevent use should not only be continued, but intensified, since the current level of efforts will not result in the targeted reduction in prevalence by 2025 being reached in either the entire WHO European Region, or in any of its sub-regions. To date, interventions agreed upon in the Framework Convention on Tobacco Control have insufficiently been implemented in the WHO European Region,<sup>33</sup> and better implementation would likely lead to greater reductions.

With respect to alcohol use, although the NCD target of a 10% reduction for the WHO European Region has been achieved, EU countries were not the drivers of that accomplishment, with only a 1.5% reduction in total use in those countries in the past 6 years. It should also be noted that the alcohol reduction target was much less ambitious than the other NCD targets, such as the one for tobacco use.

There are proven effective and cost-effective policies for those legal substances which cause the majority of the burden,<sup>34–36</sup> but these policies have to be implemented and, despite some successes, there are still notable gaps in implementation in most countries of the WHO European Region. As for illicit drugs, policies are more controversial and, although their effectiveness and cost-effectiveness are less well established, treatment of drug use disorders and some harm reduction measures have shown promise in reducing the resulting burden of disease.<sup>30,34</sup> Finally, a more integrated approach to prevent substance use attributable burden across all psychoactive substances based on public health considerations should be adopted.<sup>34</sup> Thus, countries need to further implement

these policies if the substance-attributable burden in Europe is to be reduced.

## Supplementary data

Supplementary data are available at *EURPUB* online.

## Disclaimer

Carina Ferreira-Borges is a staff member of the WHO Regional Office for Europe. The author alone is responsible for the views expressed in this publication and they do not necessarily represent the decisions or the stated policy of the World Health Organization.

*Conflicts of interest:* None declared.

## Key points

- In 2016, mortality and the attributable disease burden due to the use of psychoactive substances were high in the WHO European Region, with more than every fifth death and every fourth year of life lost prematurely caused by the use of these substances.
- In the case of the lawful substances of tobacco and alcohol, reductions of use and their attributable harms were achieved from 2010 to 2016.
- The situation is less clear for illicit drugs, where despite overall decreases in use and attributable harms, there have been increases in use and harms by certain groups of the population or in certain regions.
- Given current trends, the non-communicable disease (NCD) framework goal for alcohol reduction has already been achieved in the European Region, but despite reductions in use, the tobacco reduction target prescribed by the NCD goals will likely be missed.
- Thus, policy efforts should be increased to achieve a reduction in the use and attributable disease burden of psychoactive substances.

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