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Research Article

JOURNAL OF PSYCHIATRY AND PSYCHIATRIC DISORDERS

ISSN: 2572-519X

Global, Regional, and National Burden of Substance Use Disorders, 2013–2023: Insights from the Global Burden of Disease Study 2023 with Projections to 2050

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Abstract

Background: Substance use disorders (SUDs) remain an escalating growing global public health challenge. This study analyses the global, regional, and U.S. state-level SUD burden from 2013–2023 using Global Burden of Disease (GBD) 2023 estimates and projects trends through 2050.

Methods: We analyzed data from the GBD 2023 database. SUDs were defined using ICD-10 codes F10–F19, including alcohol (AUD), opioid (OUD), cannabis (CUD), cocaine, amphetamine, and other drug use disorders. Age-standardized incidence rate (ASIR), prevalence (ASPR), disability-adjusted life years (ASDR), and mortality (ASMR) per 100,000 population were analyzed by sex, age, region, and income group, with emphasis on High-Income North America (HINA). Temporal trends (2013–2023) and DALY projections to 2050 were assessed.

Results: In 2023, high-income (HI) regions recorded the highest ASPR, ASDR, and ASMR, while ASIR peaked in Central and Eastern Europe and Central Asia (CEECA), followed by HI regions. Within HI regions, HINA showed the greatest overall burden. In HINA, AUD had the highest ASIR and ASPR, while OUD accounted for the highest ASDR and ASMR. Between 2013 and 2023, all SUD metrics increased significantly in HINA. Males and individuals aged 25–44 years showed peak prevalence. Across the U.S., rates were highest in West Virginia (9,163.16 per 100,000). Projections indicate continued increases in global DALYs, particularly in the U.S.

Conclusions: HI regions particularly HINA experienced the largest and fastest-growing SUD burden, predominantly driven by AUD and OUD. Rising impacts among younger adult males emphasize the urgent need for targeted, integrated, and state-specific evidence-based interventions.

Keywords: Substance use disorders; Global Burden of Disease; Opioid use disorder; Alcohol use disorder; and High-Income North America.

Introduction

Substance use disorders (SUDs) are among the leading causes of preventable morbidity and mortality worldwide and impose a profound burden on healthcare systems, families, and societies through their medical, psychological, and socioeconomic consequences [1]. According to the *United Nations Office on Drugs and Crime (UNODC) World Drug Report 2023*,

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Citation: Anandalakshmi Ponnaluri, Emon Javadi, Anisha Sharma, Patrick Mingledorff, Emily Ng, Mitali Wadekar, Anil Sharma, Ahmad Khedraki. Global, Regional, and National Burden of Substance Use Disorders, 2013–2023: Insights from the Global Burden of Disease Study 2023 with Projections to 2050. Journal of Psychiatry and Psychiatric Disorders. 10 (2026): 34-42.

Received: January 31, 2026
Accepted: February 09, 2026
Published: February 12, 2026

Ponnaluri A, et al., J Psychiatry Psychiatric Disord 2026
DOI:10.26502/jppd.2572-519X0269

an estimated 296 million individuals used drugs in 2021, an increase of 23% from 2011 and approximately 39.5 million people were affected by drug use disorders [2]. Alcohol and illicit drug use together contribute to more than 5% of the total global burden, exerting profound impacts on mental health, infectious diseases, injuries, and chronic non-communicable diseases [3]. In 2021 alone, approximately 22 million people used cocaine, 36 million used amphetamines, and 5 million used opium, underscoring the complex and evolving global interplay between substance use and chronic disease [3].

Over the past decade, the global epidemiology of SUDs has shifted markedly. While alcohol use disorder (AUD) remains the most prevalent, opioid and stimulant use disorders have surged, particularly across North America and parts of Europe [4, 5]. Opioid-related overdose deaths have surged dramatically in high-income (HI) countries, with synthetic opioids such as fentanyl driving a marked increase in mortality rates [6, 7]. In parallel, cannabis use has risen among adolescents and young adults in HI regions, coinciding with policy liberalization and changing social attitudes [8, 9].

However, the global distribution of SUDs remains highly uneven. HI regions including North America, Western Europe, and Australasia report the highest prevalence, mortality, and disability-adjusted life years (DALYs) associated with SUDs [10, 11]. In contrast, low- and middle-income regions in South Asia (SA), Sub-Saharan Africa (SSA), and the Middle East exhibit lower but rising incidence, reflecting ongoing demographic and economic transitions [12-14]. These disparities are shaped by multiple determinants; socioeconomic inequality, healthcare access, cultural norms, and evolving drug markets that collectively influence substance use patterns and disease outcomes [13-15].

This study provides a comprehensive assessment of the global, regional (HI regions), and national (United States of America (USA)) burden of SUDs using the most recent Global Burden of Disease (GBD) 2023 estimates. We analysed trends in incidence, prevalence, DALYs, and mortality from 2013 to 2023, examined age-, sex-, and region-specific patterns, and projected the global burden of SUDs through 2050. By characterising temporal trends and geographic disparities, this study aims to inform evidence-based policy decisions and guide global strategies to reduce the escalating burden of SUDs.

Methods

Study Design and Data Source

This study utilized data from the *GBD 2023* project, conducted by the *Institute for Health Metrics and Evaluation (IHME)*. The GBD 2023 framework estimates the burden of 371 diseases and injuries across 204 countries and territories from 1990 to 2023. Quantitative indicators analyzed included age-standardized incidence rate (ASIR), prevalence (ASPR), DALYs (ASDR), and mortality (ASMR) per 100,000 population. Data were retrieved from the *Global Health Data Exchange (GHDx)* portal using the GBD Results Tool https://ghdx.healthdata.org/gbd-results-tool. SUD burden was examined by sex, age groups, regions, and Sub-regions, in accordance with the GBD regional classification. Data on SUDs, including alcohol, opioid, cannabis, cocaine, amphetamine, and other drug use disorders, were extracted from this database. Estimates were presented globally, regionally, and nationally for the year 2023, along with temporal trends from 2013 to 2023. Additionally, projections of DALY burden up to 2050 were reviewed using the GBD forecast data.

Case Definition and Classification

SUDs were defined according to the *International Classification of Diseases, 10th Revision* (ICD-10) codes F10–F19, encompassing mental and behavioral disorders due to psychoactive substance use [16]. Each category was analyzed separately: F10 (AUD), F11 (opioid use disorder, OUD), F12 (cannabis use disorder, CUD), F14 (cocaine use disorder), F15 (amphetamine use disorder), and F13, F16–F19 (other drug use disorders).

Regional and Subregional Grouping

For comparative analyses, countries were grouped according to GBD regional classifications. The following regions included: Central Europe, Eastern Europe, and Central Asia (CEECA); HI regions; Latin America and the Caribbean (LAC); North Africa and the Middle East (NAME); SA; SSA; and Southeast Asia and Oceania (SEAO).

Within HI regions, subregional analyses were conducted for Australasia, HI Asia Pacific (HI Asia Pacific), HI North America (HINA), Southern Latin America, and Western Europe.

Analysis

A descriptive analytic approach was employed to summarize variations in SUD burden globally and regionally. Trends from 2013–2023 were evaluated, and projections through 2050 were reviewed.

Results

Global and Regional Burden in 2023

In 2023, the global SUD burden showed striking regional disparities (Figure 1). The ASIR was highest in CEECA (1621.96 per 100,000), followed by HI regions (1387.86 per 100,000) and LAC (1232.23 per 100,000).

Similarly, the ASPR reached its peak in HI regions (4013.16 per 100,000), followed by CEECA (3438.47 per 100,000) and LAC (2811.07 per 100,000). The ASDR and ASMR reflected similar regional patterns. HI regions

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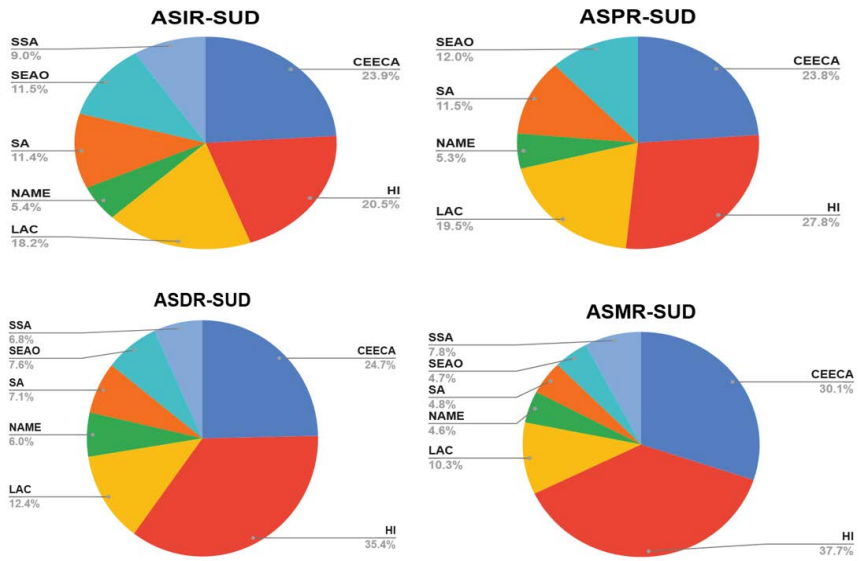

Abbreviations: Central Europe, Eastern Europe, and Central Asia; CEECA, High-Income; HI, Latin America and the Caribbean; LAC, North Africa and the Middle East; NAME, South Asia; SA, Southeast Asia, East Asia, and Oceania; SEAO, Sub-Saharan Africa; SSA

Figure 1: Age-Standardized Incidence Rate (ASIR), Age-Standardized Prevalence Rate (ASPR), Age-Standardized Disability-Adjusted Life Years Rate (ASDR), and Age-Standardized Mortality Rate (ASMR) for substance use disorders (SUDs) Across Global Regions in 2023.

contributed the highest global burden with ASDR of 1229.89 per 100,000 and ASMR of 12.64 per 100,000, followed by CEECA (ASDR: 856.61; ASMR: 10.1). In contrast, LAC, NAME, SA, SSA, and SEAO reported relatively lower but progressively increasing rates.

Subregional Variation in HI Regions

Marked subregional variation was evident within HI regions (Figure 2). The HINA subregion exhibited the highest ASIR at 1827.6 per 100,000, followed by Australasia (1383.96 per 100,000), Western Europe (1284.01 per 100,000), Southern Latin America (1134.07 per 100,000), and HI Asia Pacific (750.03 per 100,000). A similar trend was noted for the ASPR, which peaked in HINA (6229.83 per 100,000), substantially exceeding Australasia (3832.94 per 100,000), Western Europe (3113.62 per 100,000), Southern Latin America (2616.72 per 100,000), and HI Asia Pacific (1920.63 per 100,000). Furthermore, HINA recorded the highest ASDR of 2658.14 per 100,000 and ASMR of 30.11 per 100,000, surpassing all other HI subregions.

Comparative Burden by Substance Type (HINA, 2023)

In 2023, the comparative analysis of SUDs across substance categories in HINA revealed marked heterogeneity in incidence, prevalence, disability burden, and mortality (Figure 3). AUD demonstrated the highest ASIR at 1,255.58 per 100,000, followed by OUD (148.47 per 100,000), other drug use disorders (210.26 per 100,000), and CUD (141.89 per 100,000). Cocaine (28.52 per 100,000) and amphetamine use disorders (42.89 per 100,000) exhibited considerably lower incidence levels.

A similar trend was observed in ASPR. AUD remained the predominant contributor (2,537.39 per 100,000), followed by OUD (1,995.41 per 100,000) and CUD (967.48 per 100,000). In contrast, cocaine (585.66 per 100,000), amphetamine (343.33 per 100,000), and other drug use disorders (56.85 per 100,000) accounted for smaller proportions of the overall prevalence burden.

The ASDR demonstrated a clear divergence across substances. OUD contributed the highest DALY burden at 1,768.87 per 100,000, which was nearly four times higher than AUD (460.01 per 100,000). Cocaine (199.84 per 100,000) and amphetamine (122.9 per 100,000) use disorders also contributed appreciably to the overall disability burden, while CUD showed a lower DALY impact (27.75 per 100,000).

In alignment with these patterns, the ASMR was highest for OUD (19.08 per 100,000), followed by AUD (5.34 per 100,000). Mortality due to cocaine (2.6 per 100,000), amphetamine (1.65 per 100,000), and other drug use disorders (1.45 per 100,000) was relatively lower, whereas CUD showed a negligible contribution to mortality.

Temporal Trends (2013–2023)

Between 2013 and 2023, SUD indicators rise sharply in HI regions, particularly in HINA (Figure 4). The ASIR increased from 1,590.45 to 1,827.6 per 100,000. The ASPR nearly doubled, rising from 4,824.1 to 6,229.83 per 100,000. Correspondingly, the ASDR surged from 1,406.28 to 2,658.14 per 100,000, while the ASMR showed a dramatic increase from 13.73 to 30.11 per 100,000. Western Europe and Southern Latin America exhibited moderate increases, while HI Asia Pacific showed relative declines.

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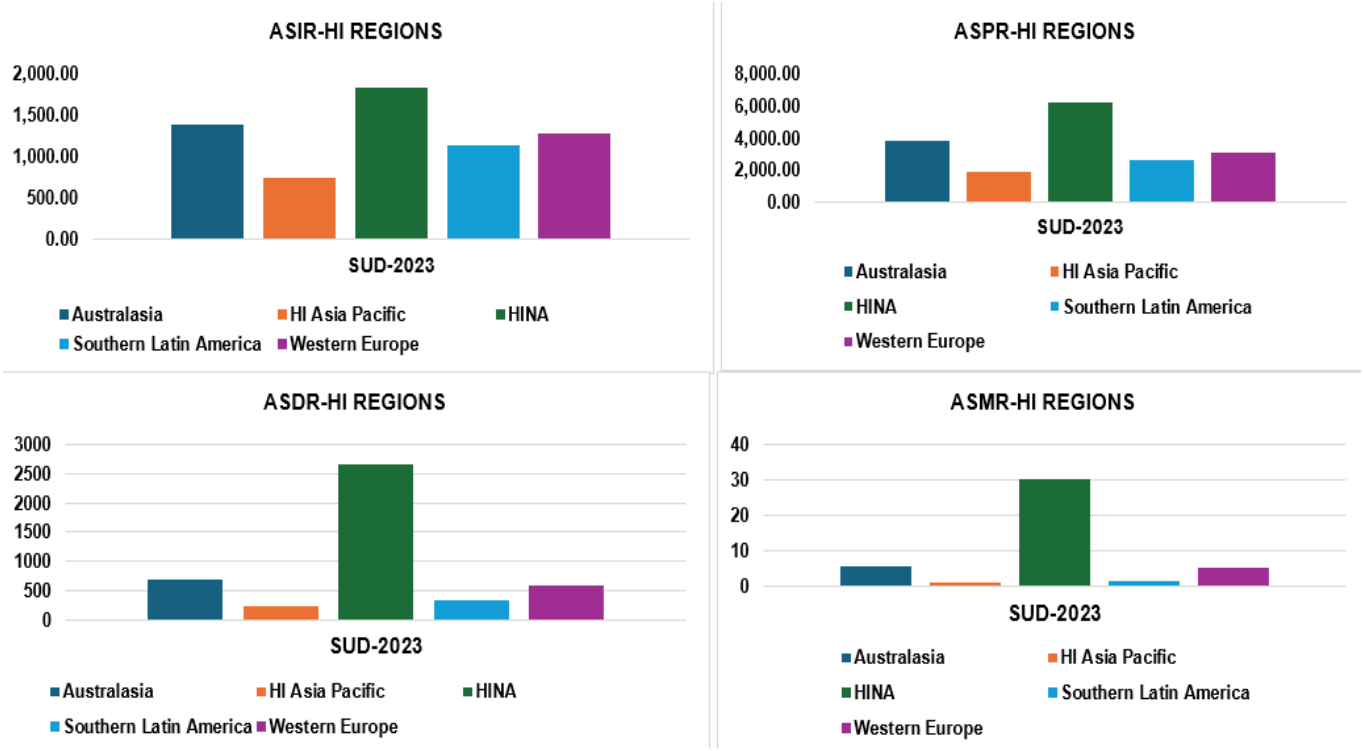

Abbreviations: High-Income Asia Pacific, HI Asia Pacific; High Income North America, HI NA.

Figure 2: Age-Standardized Incidence Rate (ASIR), Age-Standardized Prevalence Rate (ASPR), Age-Standardized Disability-Adjusted Life Years Rate (ASDR), and Age-Standardized Mortality Rate (ASMR) for substance use disorders (SUDs) Across High-Income Regions in 2023.

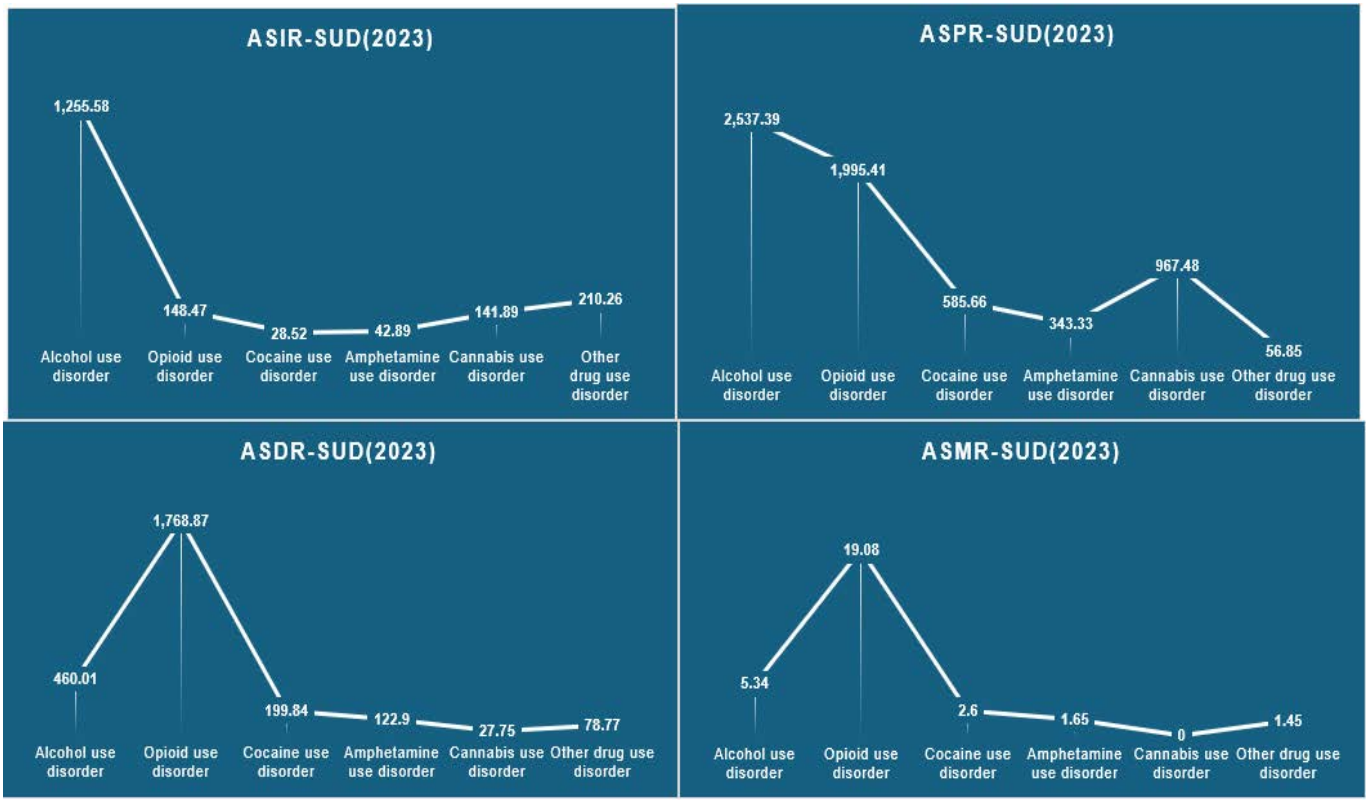

Figure 3: Comparative Burden of Substance Use Disorders (SUDs) in High-Income North America (HINA) in 2023.

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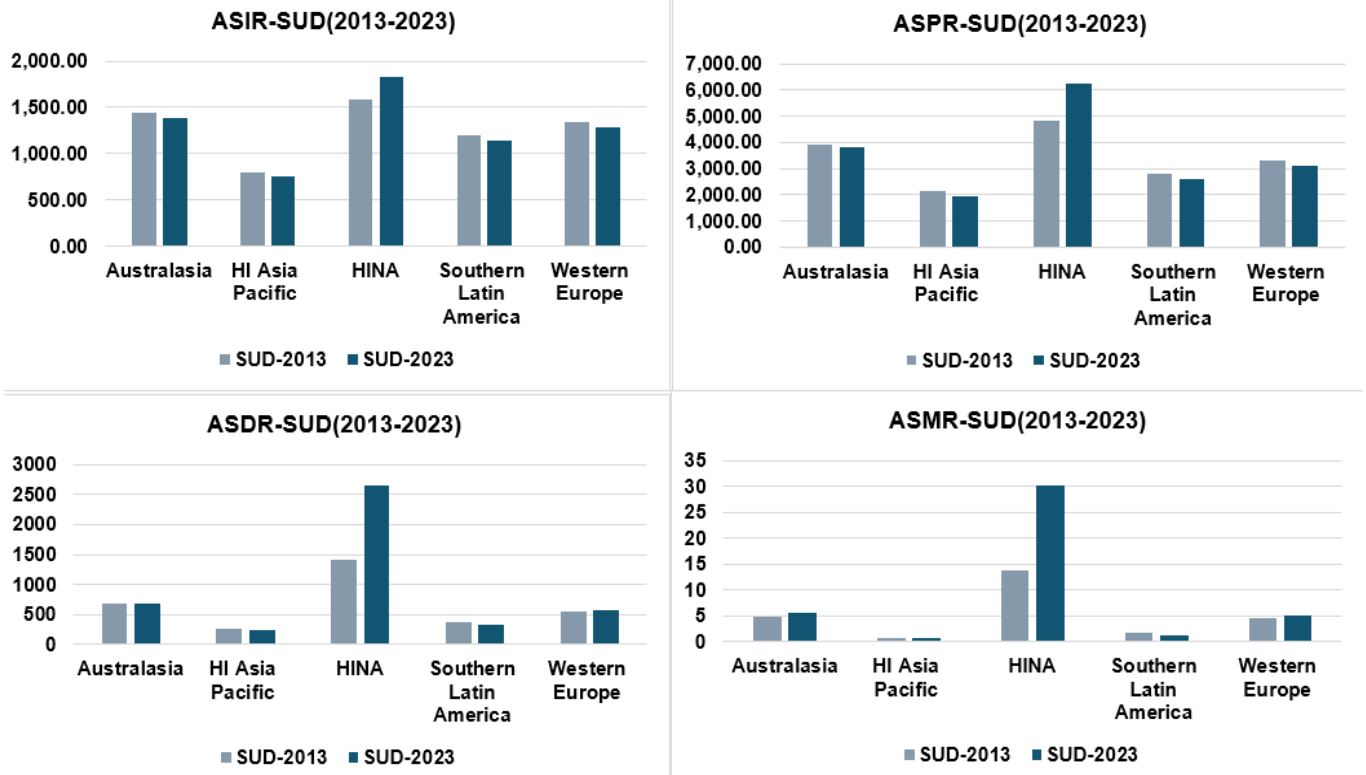
Age- and Sex-Specific Patterns

In 2023, males exhibited consistently higher prevalence rates across all regions and age groups. The global prevalence peaked among individuals aged 25–44 years and remained notably elevated among adults and older adults in HI regions. (Figure 5)

Geographic Distribution in the U.S.A

SUD prevalence varied markedly by state (Figure 6) in 2023. The highest SUD prevalence was observed in West Virginia (9,163.16 per 100,000), followed closely by New Mexico (9,015.60 per 100,000). In contrast, states such as Nebraska (5,003.65 per 100,000) and Texas (5,134.56 per 100,000) reported comparatively lower prevalence rates.



Abbreviations: High-Income Asia Pacific, HI Asia Pacific; High Income North America, HINA.

Figure 4: Change in Age-Standardized Incidence Rate (ASIR), Age-Standardized Prevalence Rate (ASPR), Age-Standardized Disability-Adjusted Life Years Rate (ASDR), and Age-Standardized Mortality Rate (ASMR) for substance use disorders (SUDs) Across High-Income Regions Between 2013 and 2023.

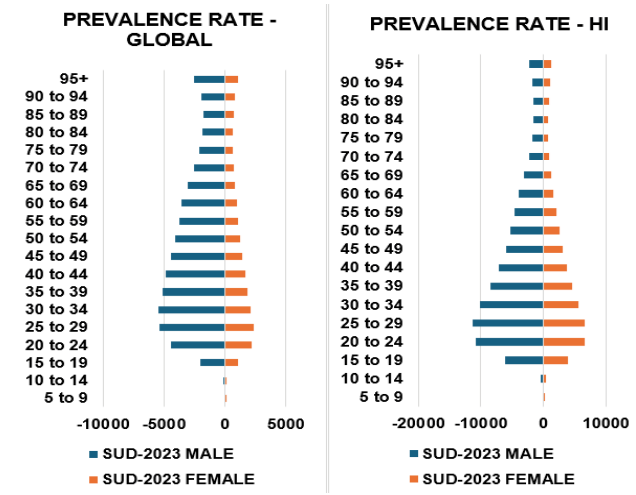


Figure 5: Age-Standardized Prevalence Rates (ASPR) of substance use disorders (SUDs) Across Global Regions and High-Income (HI) Regions in 2023.

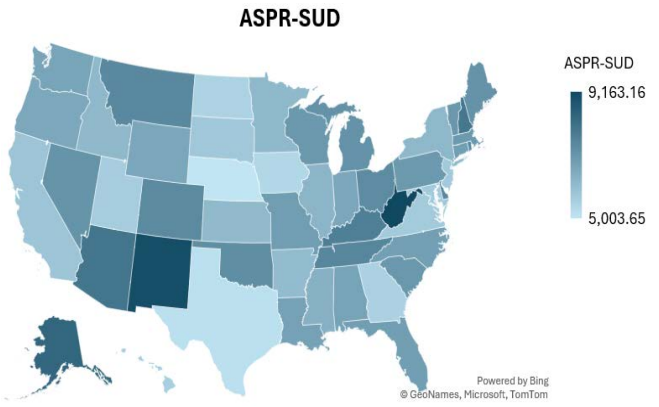


Figure 6: Geographic Disparities in Substance Use Disorders (SUDs) Across U.S. States in 2023.

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Projected Global DALY Burden to 2050

The GBD 2023 projections indicate a substantial rise in DALYs attributable to SUDs by 2050 (Figure 7). HI countries, particularly the USA, are projected to sustain the highest DALY rates globally (2,731.76 per 100,000; 95% UI: 2,339.48–3,164.16), surpassing most European and Asian counterparts.

Regions in *North America and Northern Europe* are expected to remain in the highest quintile of DALY rates, whereas *Africa and SA* will continue to experience comparatively lower but growing burdens.

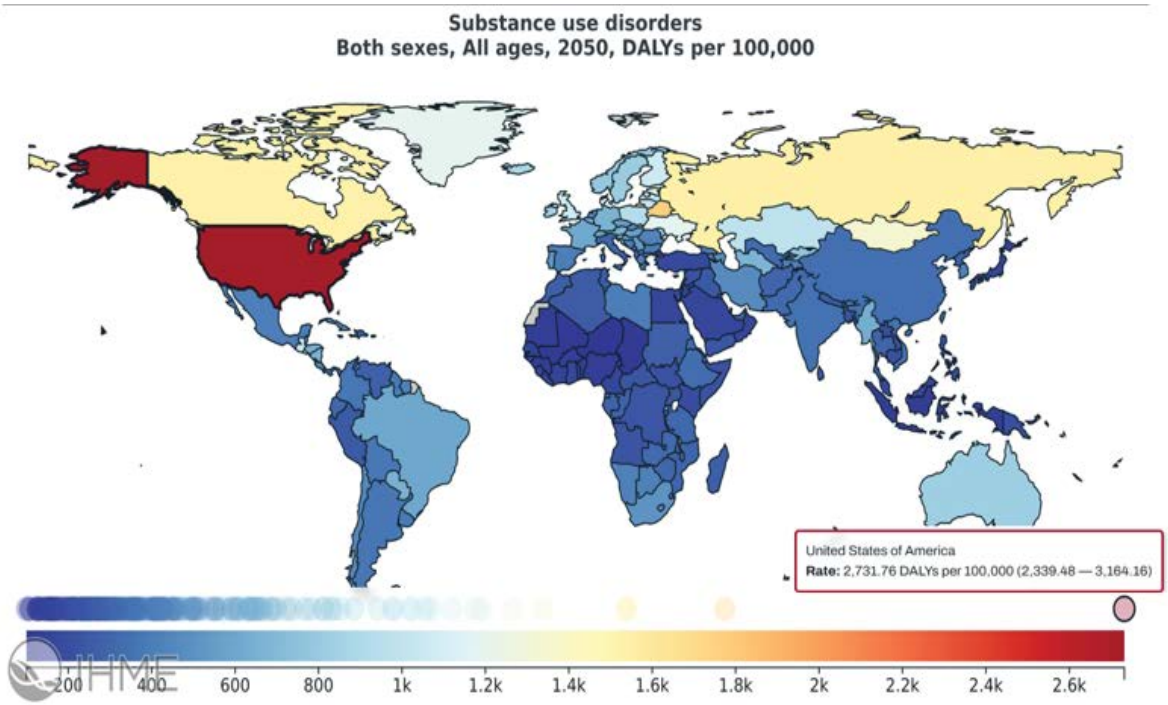

Figure 7: Projected global distribution of disability-adjusted life years (DALYs) due to substance use disorders (SUDs) in 2050, both sexes, all ages.

Discussion

This comprehensive analysis of SUDs using the GBD 2023 unpublished data estimates reveal a persistently escalating public health challenge, with pronounced regional, sex-, and age-specific disparities. The findings underscore an urgent need for targeted, evidence-based interventions to mitigate the growing morbidity, mortality, and disability burden associated with SUDs worldwide. Our analysis highlights that the global burden of SUDs remains disproportionately concentrated in HI and CEECA regions. In 2023, CEECA recorded the highest ASIR (1621.96 per 100,000), while HI regions exhibited the greatest prevalence (4013.16 per 100,000), DALY and mortality burden. This pattern is consistent with previously reported higher burdens in high-Socio-demographic Index (SDI) regions and longstanding alcoholic or drug use patterns in Eastern Europe [17, 18]. The fact that HI regions have the highest ASDR and ASMR underscores how high availability, complex polysubstance use, synthetic compounds and entrenched service gaps continue to drive harm despite greater resources [19].

Our findings reveal marked subregional heterogeneity in the burden of SUDs. HINA shows the highest ASIR, ASPR, ASDR, and ASMR. This reinforces that even among wealthy regions, social context, health-care access, regulatory regimes, and drug supply dynamics differ substantially. The U.S. and Canada have been at the forefront of the opioid epidemic, with synthetic opioids driving overdose deaths and disability [20-22]. This pattern aligns with prior GBD-based evaluations, indicating that higher socioeconomic regions, despite greater healthcare access, often face elevated substance-related morbidity due to widespread availability, social permissiveness, and chronic substance dependence patterns [23, 24].

Within HINA, AUD remains the most prevalent disorder, yet OUD drives the majority of disability and deaths. This is consistent with multiple analyses indicating that while alcohol remains the commonest substance-use problem globally, the most lethal and disabling disorders are those relating to opioids and other illicit drugs [25, 26]. The growing importance of stimulants (cocaine, amphetamines) in disability burden, even if not yet matching opioid mortality, points to a shifting landscape of substance use that

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demands attention [27]. Despite increased AUD prevalence during the past decade, a previous study showed that AUD largely goes untreated. Rather than lack of insurance, fears of stigmatization and beliefs that treatment is ineffective explain the lack of AUD treatment in the U.S [28].

Between 2013 and 2023, HINA shows a dramatic rise in all key indicators of SUD burden, ASPR nearly doubling and ASMR more than doubling. These trends align with documented increases in drug-related deaths, especially involving synthetic opioids such as fentanyl [5, 29] Our analysis demonstrates a clear male predominance in SUD prevalence across all adult age groups globally and within HI regions, with peak burden among individuals aged 25–44 years and a sustained, though lower, burden in older adults. These trends align with previous GBD findings, emphasizing that SUDs extend beyond young adulthood into midlife and aging populations [30, 31]. In older adults, SUDs present distinct challenges, including polypharmacy, altered metabolism, multiple comorbidities, and under-recognition [32]. The pronounced state-level variation in SUD prevalence (e.g., West Virginia vs Nebraska) underscores how socioeconomic conditions, health-care infrastructure, prescribing practices, substance supply, and harm-reduction policies differ within a single country. This mirrors findings that the opioid overdose mortality epidemic has clustered in areas with socioeconomic decline, limited treatment access and high rural composition [33]. Projections through 2050 suggest that SUDs will continue to expand as leading contributors to global DALYs, particularly in HI regions. This trajectory aligns with GBD forecasts, indicating that, as infectious diseases decline and populations age, non-communicable and behavioral disorders, including SUDs, will dominate the global health landscape [34].

Limitations

This study has several limitations. First, GBD estimates rely on modeled data with variable primary data quality across countries, potentially leading to underreporting, especially in low- and middle-income regions [35]. Seconds, variations in diagnostic criteria, stigma, and under-recognition may bias estimates, particularly among women and marginalized groups. Third, model uncertainty, demographic assumptions, and comorbidity adjustments may affect precision, especially in countries with sparse data. Finally, contextual factors such as social determinants, comorbid mental illness, and policy interventions were beyond the scope of this quantitative analysis.

Despite these limitations, the GBD framework remains the most comprehensive and standardized source of global health data, offering valuable insights into the evolving burden of SUDs and guiding future prevention and intervention strategies.

Conclusion

In conclusion, this updated analysis of SUD remains a leading and growing contributor to global morbidity and mortality, with the heaviest burden concentrated in HI regions. The disproportionate rise in disability and death from opioid and stimulant use, particularly in HINA, underscores the urgent need for integrated, evidence-based approaches that combine prevention, early intervention, harm reduction, and long-term treatment. Addressing SUDs requires coordinated global and national strategies that transcend healthcare tackling social determinants, strengthening surveillance systems, and reducing stigma. Without sustained investment and policy reform, the projected trajectory indicates a continued and widening global toll from SUDs through 2050.

Declarations

Ethics Approval and Consent to Participate

This study did not involve human participants, clinical samples, or live animals and is based entirely on literature review and secondary data analysis. Accordingly, institutional review board approval and written informed consent were not required. All data were obtained from publicly accessible sources and analysed in aggregate form, ensuring no individual person's privacy or welfare was affected.

Clinical trial number: not applicable.

Consent to Publish

All participants involved in this study provided written consent for the publication of the research findings, including any associated data, images, and personal details presented in anonymized form.

Data Availability

Data is provided within the manuscript. This study used publicly available data from the Global Burden of Disease Study 2023, accessible at https://ghdx.healthdata.org/gbd-results-tool.

Competing Interests

The authors declare no competing interests.

Acknowledgement

The authors thank the Institute for Health Metrics and Evaluation (IHME) for providing access to the Global Burden of Disease 2023 data.

Author Contributions

Dr. Anandalakshmi Ponnaluri participated in the study concept and design, acquisition, analysis, and interpretation of the data, and drafting of the manuscript. Dr. Emon Javadi and Dr. Anisha Sharma participated in the data acquisition,

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DOI:10.26502/jppd.2572-519X0269

analysis and interpretation, and drafting of the manuscript. Dr. Patrick Mingledorff participated in critical revision of the manuscript. Dr. Emily Ng and Dr. Mitali Wadekar participated in data acquisition, and drafting of the manuscript. Dr. Anil Sharma participated in the critical revision of the manuscript and study supervision. Dr. Ahmad Khedraki participated in the critical revision of the manuscript and study supervision. All authors reviewed and approved the final manuscript.

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Citation: Anandalakshmi Ponnaluri, Emon Javadi, Anisha Sharma, Patrick Mingledorff, Emily Ng, Mitali Wadekar, Anil Sharma, Ahmad Khedraki. Global, Regional, and National Burden of Substance Use Disorders, 2013–2023: Insights from the Global Burden of Disease Study 2023 with Projections to 2050. Journal of Psychiatry and Psychiatric Disorders.10 (2026): 34-42.