Xie et al. Globalization and Health (2025) 21:30
https://doi.org/10.1186/s12992-025-01124-5

Globalization and Health

RESEARCH Open Access

Trends and cross-country inequalities of alcohol use disorders: findings from the global burden of disease study 2021

Zhaoyang Xie[1†], Gangliang Zhong[1†], Cheng Xu[1†], Tianzhen Chen[1], Zheyi Du[1], Yicheng Wei[1], Min Zhao[1,2*] and Jiang Du[1*]

Abstract

Background Alcohol use disorder (AUD) imposes a significant burden on individuals and society. With globalization, transnational alcohol corporations influence policy enforcement and consumer behavior, hindering cost-effective and evidence-based interventions such as reducing alcohol availability and restricting alcohol advertising, as recommended in the World Health Organization (WHO) Best Buys for the prevention and control of noncommunicable diseases (NCDs).This study utilizes the Global Burden of Disease Study 2021 dataset to examine global and regional disparities, offering key insights into the global trends of AUD and addressing critical research gaps.

Results The global age-standardised prevalence of alcohol use disorders among individuals aged 15 years and older decreased from 1,698 per 100,000 in 1990 to 1,335 per 100,000 in 2021, with an average annual percent change of -0.78%. Similarly, the average annual percent change for mortality and disability-adjusted life years were − 0.82% and − 0.83%, respectively. Importantly, the age-standardised decline in alcohol use disorders was more pronounced in females compared to males (prevalence: -0.82% versus − 0.75%; mortality: -1.22% versus − 0.73%; disability-adjusted life years: -0.95% versus − 0.79%). The age-standardised prevalence of alcohol use disorders may remain higher among males until the year 2040. For the older adult groups aged 55 to 74, there was no statistically significant decline in alcohol use disorders mortality rates ($Ps \geq 0.17$). Furthermore, countries characterized by a high sociodemographic index did not exhibit a significant reduction in mortality (average annual percent change: 0.02%). Between 1990 and 2021, high levels of alcohol consumption and experiences of childhood sexual abuse were identified as major risk factors for alcohol use disorders.

Conclusion Understanding the trends of AUD in the context of globalization is crucial. Given that certain populations continue to experience persistent alcohol-related issues, protecting these groups from the influence of transnational

†Zhaoyang Xie, Gangliang Zhong and Cheng Xu contributed equally to this work.

*Correspondence:
Min Zhao
drminzhao@smhc.org.cn
Jiang Du
dujiangdou@163.com

Full list of author information is available at the end of the article

alcohol corporations through effective policy measures such as strengthening regulations on alcohol advertising targeting older adults, and establishing independent regulatory agencies may be a key strategy for reducing the global health burden of AUD.

Keywords Alcohol use disorders, Mortality, Disability-adjusted life years, Globalization

Introduction

Alcohol use disorder (AUD) is one of the major disorders worldwide that seriously affects the quality of life of modern people [1, 2]. Globally, approximately 2.3 billion people consume alcohol [3], and according to a 2019 report, 109 million people have been diagnosed with AUD [2]. Alcohol is widely recognized as one of the major contributors to premature death and disability [4], especially for males aged 15–49 years [5]. Long-term adverse alcohol use poses a risk to organs and tissues, and short-term acute alcohol use may also be physically damaging [6, 7]. Additionally, AUD has been linked to more violent behaviours that endanger others [8].

Globalization and alcohol use disorder

As globalization advances, the increased circulation of alcohol products, driven by transnational alcohol corporations, may contribute to a rise in AUD. These transnational alcohol corporations leverage global trade networks, cultural globalization, and targeted marketing strategies to penetrate new markets, particularly in low- and middle-income countries [9]. Their influence extends to policy-making processes, where they often oppose global governance, advocate for industry self-regulation, which can lead to weaker public health interventions and exacerbate AUD prevalence [10]. The risks associated with alcohol consumption have prompted concerns within the World Health Organization (WHO) [11], the sole global intergovernmental body that consistently addresses alcohol-related issues and has developed comprehensive global strategies aimed at reducing alcohol use. According to the WHO [12], alcohol is the only psychoactive and dependency-inducing substance that significantly affects public health, yet it lacks a legally binding regulatory framework at the international level. The implementation of this global strategy is impeded by industry stakeholders, particularly transnational alcohol corporations, who support industry self-regulation [10]. These corporations often promote narratives that distinguish between "moderate" and "harmful" alcohol consumption, thereby undermining global efforts to regulate alcohol [10]. These perspectives highlight the significant role played by the alcohol industry in obstructing alcohol policy-making. Studies have shown that in some sub-Saharan countries, the international alcohol industry uses its influence to participate in the policy-making process in these developing countries and to minimise the provision of public health programmes for alcohol problems [9]. This suggests that alcohol policies shaped under the influence of the alcohol industry involvement may yield limited public health benefits while disproportionately advancing the interests of transnational alcohol corporations. At the same time, these commercial factors exacerbate social and health inequalities, given the strong links between alcohol and poverty and other health burdens [13].

In addition to politics, the transnational alcohol industry can also expand its influence internationally and seek many benefits through other strategies such as cultural globalization and trade globalization [14]. According to a report by the WHO, the alcohol industry will not only use online platforms to collect and analyse user data to target specific groups, especially young people and individuals with AUD. For example, the alcohol industry exploits young people's curiosity about new things and their desire for social recognition to encourage excessive drinking and promote its products [15]. It also sponsors global sporting events and cultural activities to enhance brand awareness [16]. By creating emotional connections with audiences, the alcohol industry precisely targets consumer groups and subtly shapes consumer behaviour. As globalization advances, the increased circulation of alcohol products, driven by the expansion of transnational alcohol corporations, may contribute to shifting patterns of alcohol use [17]. Investigating the prevalence of AUD within this context not only can provide deeper insights into its underlying dynamics and associated risks but also aids in the formulation of more targeted policy measures.

Evidence before this study

To best of our knowledge, while some studies have attempted to use Global Burden of Disease (GBD) study data to understand the current status of alcohol use [2, 18], few have systematically investigated the burden of disease imposed by AUD across various regions globally over the past three decades, with limited consideration of either extensive temporal coverage or broad geographic scope. Considering the persistent and significant variations in alcohol use [19, 20], a simultaneous examination of both global and regional trends in AUD is more comprehensive and essential.

In addition to geographical limitations, previous studies have lacked adequate focus on the age demographics of alcohol users, which may have hindered the development of more precise policy-making tailored to specific

populations [2]. So far, only GBD 2020 Alcohol Collaborators [5] investigated the population risk level of *alcohol consumption*, rather than focusing on AUD, by taking into account the amount of alcohol consumed, geographic location, age, gender, and year. This study found that nearly 60% of individuals consuming alcohol in 2020 were 15–39 year olds and about 77% were male. It is important to note that, this study focused primarily on *alcohol consumption*, which is not directly comparable to AUD [21]. In addition, the study did not discuss *trends* in alcohol use by age. Considering that the global population is facing a number of crises (e.g., wars and epidemics) since 2020, which may affect people's alcohol use, there is a need to conduct a global survey using the most recent data. Overall, there remains a significant deficiency in critical evidence necessary to comprehend the current status and trends of AUD across different regions, age groups, and genders on a global scale. Enhancing these data and findings would support the formulation of comprehensive policies for global and regional AUD prevention and interventions.

Global Burden of Disease study (GBD) is a systematic scientific project that quantifies the severity, risk factors, and intermediate clinical outcomes of major disorders in a highly standardised manner, which helps researchers to compare data related to the disease across time, populations, and sites [22]. Given the more distinct geographic and economic characteristics of alcohol use [2], and in order to contribute to the worldwide understanding of AUD, we used GBD data for the period 1990–2021 to provide an up-to-date comprehensive assessment of the burden of AUD. The results of this study will help us understand the development trend of AUD and provide key evidence for the formulation of alcohol policies in specific countries and regions. Effective policy regulation may reduce the crisis caused by commercial forces and promote health and well-being in this region [23]. Specifically, this study included (1) descriptive analyses of AUD at the global level; (2) incorporation of gender, age, and sociodemographic index(SDI) information to further explore the global burden of AUD; (3) analyses of the burden of AUD at the regional/national level; (4) exploration of risk factors for AUD; and (5) population-based analyses of the different gender, age subgroups, and economic regions and economic regions; and (5) to develop projections of AUD prevalence to 2040 for different gender subgroups.

Methods

Study population and data collection

In our analyses of GBD 2021, we obtained repeated cross-sectional data from the Global Health Data Exchange, including 369 categories of globally burden diseases and injuries, 87 risk factors, 21 regions, and 204 countries from 1990 to 2021. GBD 2021 combines multiple data sources, each of which has a unique identifier and is included in the Global Health Data Exchange. The collected data were modelled using a spatiotemporal Gaussian process regression model [24] to allow for smoothing of age, time and location in the absence of a complete dataset. Bayesian meta-regression, regularisation and trimming (MR-BRT) procedures were used to adjust for data bias due to different case definitions and study methods in different countries. The methods of applying the GBD data are described in detail in previous studies [25, 26].

According to the DSM-5 [27], AUD is defined as a condition characterized by significant social, psychological, or physiological impairment caused by persistent alcohol consumption within the past 12 months, often accompanied by typical withdrawal symptoms and a loss of control over alcohol use [21]. Besides, in the GBD Study, AUD was defined as a disorder with a confirmed diagnosis identified through hospital records. Our study population was people ≥ 15 years of age with a diagnosis of AUD [20]. The reason we chose 15 + is because in the GBD data, there are missing data for under 15 in some countries. From the Global Burden of Disease 2021 Study, we extracted information on AUD in the study population; location, age, and sex-specific prevalence; mortality; number and rate of DALYs; and DALYs attributable to each risk factor (with corresponding 95% uncertainty intervals (UIs)). Attributable DALYs are an indicator that quantifies the contribution of specific risk factors to the burden of disease. DALYs imply changes and reductions in the current burden of disease if population-level exposure to specific risk factors changes. Years of life lost are calculated by multiplying the estimated number of deaths in AUD by the standard life expectancy at the age of death. DALYs were equal to the sum of years lived with disability and years of life lost. The terminology and methods used in the GBD Study have been consistently interpreted and used in other studies [26].

In this study, AUD data were collected from 21 regions that are geographically proximate and ave similar epidemiological characteristics, including 13 age groups (15–19 years, 20–24 years, 25–29 years, 30–34 years, 35–39 years, 40–44 years, 45–49 years, 50–54 years, 55–59 years, 60–64 years, 65–69 years, 70–74 years, 75 + years), including both males and females. In addition, the sociodemographic index (SDI), a composite indicator of the social and economic conditions that influence health outcomes in each region, was also included in this study. The SDI is categorised into five categories: low, low-middle, middle, high-middle, and high. Higher levels represent high levels of education, the highest per capita income and the lowest fertility rates.

Statistical analysis

A descriptive analysis of the global burden of AUD in people > 15 years was performed. We compared age-standardised prevalence (per 100,000 people), age-standardised mortality (per 100,000 people) and age-standardised DALYs (per 100,000 people) for AUD across different age groups, sexes, regions and countries. Based on AUD and associated risk factor data from the Global Burden of Disease Study, we further calculated age-standardised rate and corresponding 95% confidence intervals (CI) and compared them across Global Burden of Disease Study regions. It is important to note that we included annual average percentage changes (AAPCs) to describe temporal trends in link-point regression measures.

$$AAPC = \left(exp\left(\frac{\sum (\beta_i \times \omega_i)}{\sum \omega_i} \right) - 1 \right) \times 100\%$$

The average annual percentage change (AAPC) is a weighted average of the annual percentage changes over a specific time period and can be used to describe the average trend of change over the entire time period [28]. Where βi represents the regression coefficient for year i and ωi is the corresponding weight. the AAPC value represents the annual percentage change (increase, decrease, or no change). If both the annual percentage change estimate and the 95% CI are > 0 (or both < 0), we consider the corresponding rate to be in an increasing (or decreasing) trend.

We chose measures that were epidemiologically relevant, including prevalence, DALYs (one DALY represents the loss of one year of full health owing to premature death or disability), and mortality. For example, a decrease in mortality from a chronic disease may lead to an increase in prevalence and DALYs as more patients live longer with that disease [26]. An increase in the number of patients with morbidity or a prolonged course of the disease can lead to an increase in prevalence [26].

All statistical analyses were performed using GraphPad Prism (version 8.0.2), the joinpoint regression programme (version 5.2.0) and R (version 4.3.1).

Patient and public involvement

This study used data from the Global Burden of Disease Study. The authors did not directly interview participants. No patients were involved in the setting of the research questions or outcome measures, and they were not involved in the design or implementation of the study.

Projections from 2022 to 2040

The ARIMA(Autoregressive Integrated Moving Average) Model is one of the time series analysis methods [29], which is popular and widely used for time series forecasting. In this study, we use ARIMA model to predict trends in Prevalence of AUD for males and females aged ≥ 15 years globally from 2022 to 2040. In addition, we determined the optimal order parameters (p, d, q) of the ARIMA model using the Corrected AkaiChi Information Criterion (AICc), which is considered to provide more robust model selection criteria in small-sample conditions and avoids overcomplicated models from overfitting data with insufficient sample sizes [30]. In this study, the residuals of the model were diagnosed by the Ljung-Box test, with $P > .05$ indicating that the residuals were white noise, suggesting that the model had adequately fitted the systematic variations in the data, with the remainder being random fluctuations.

Results

Global trends

Globally, the number of people aged ≥ 15 years with AUD prevalence increased by 130% between 1990 and 2021, from 84.55 to 111.12 million. However, the age-standardised AUD prevalence decreased from 1,697.90 to 1,335.43 per 100,000 population, with an average annual percent of -0.78% (Table 1). In addition, the number of deaths from AUD also, although rising 158.47 thousand from 110.75 thousand in 1990, the age-standardised AUD mortality decreased from 2.47 to 1.84 per 100,000 population, with an average annual trend of -0.82% (see Supplementary Table S1). Similarly, DALYs from AUD show a similar development, in terms of numbers, from 12.99 million in 1990 to 16.98 million in 2021. But for the age-standardised rate, DALYs from AUD decreased from 266.11 per 100,000 to 202.39, with an average annual trend of -0.83% (see Supplementary Table S2). The declines in age-standardised AUD prevalence, mortality, and DALYs suggest that the global burden of AUD is on a declining trend.

Global trends by sex

From 1990 to 2021, the global prevalence of AUD among people aged ≥ 15 years increased (males: from 65.24 million to 86.20 million; females: from 19.31 million to 24.92 million), but the age-standardised AUD prevalence declined (males: from 2,168.80 to 2,077.27 per 100,000; females from 744.59 to 599.50). The decline in AUD was slightly larger in females (-0.82%Vs-0.75%) over the same period (see Table 1). Further, our results from ARIMA model projections indicated that in 2040, the age-standardised prevalence of AUD is projected to be 1782.33 per 100,000 for males and 452.23 per 100,000 for females (see Supplementary Figure S1). In addition, AUD-related age-standardised mortality and age-standardised DALYs declined between 1990 and 2021 for both males and females, with the decline being more pronounced for

Table 1 Age-standardised prevalence and AAPC of AUD at global and SDI level, 1990–2021

	Prevalence (95% UI)					
	No of people with AUD in 1990 (million)	Age-standardised rate in 1990 (per 100,000)	No of people with AUD in 2021 (million)	Age-standardised rate in 2021 (per 100,000)	AAPC (95% CI)	*p*-value
Global	84.55(72.54 to 98.4)	1697.90(1459.91 to 1949.22)	111.12(96.36 to 127.9)	1335.43(1153.65 to 1539.75)	-0.78(-0.85 to -0.71)	*p* <.001
Sex:						
Female	19.31(16.31 to 22.94)	744.59(656.97 to 909.20)	24.92(21.17 to 29.29)	599.50(508.32 to 704.46)	-0.82(-0.85 to -0.78)	*p* <.001
Male	65.24(55.94 to 75.7)	2168.80(2253.28 to 3008.22)	86.2(75.34 to 98.86)	2077.27(1809.94 to 2388.21)	-0.75(-0.80 to -0.70)	*p* <.001
Age group:						
15–19 years	3.53(2.4 to 5.2)	679.92(461.11 to 1000.44)	3.26(2.17 to 4.78)	522.47(347.63 to 766.66)	-0.85(-0.92 to -0.77)	*p* <.001
20–24 years	9.97(6.81 to 14.2)	2026.03(1383.46 to 2886.22)	8.79(5.98 to 12.57)	1472.64(1001.72 to 2105.78)	-1.02(-1.11 to -0.93)	*p* <.001
25–29 years	12.51(9.3 to 16.47)	2826.12(2100.45 to 3721.66)	12.15(9.03 to 15.98)	2064.58(1535.52 to 2716.2)	-1.00(-1.03 to -0.98)	*p* <.001
30–34 years	12.09(8.94 to 15.8)	3136.21(2320.1 to 4099.45)	14.09(10.52 to 18.15)	2330.44(1739.56 to 3001.99)	-0.96(-1.04 to -0.87)	*p* <.001
35–39 years	10.99(8.53 to 13.8)	3120.72(2422.09 to 3918.66)	13.54(10.63 to 16.81)	2413.63(1895.02 to 2996.54)	-0.84(-0.93 to -0.75)	*p* <.001
40–44 years	8.79(6.43 to 11.75)	3067.19(2244.09 to 4101.48)	12.21(9.11 to 15.92)	2440.14(1821.4 to 3181.74)	-0.75(-0.78 to -0.71)	*p* <.001
45–49 years	6.74(5.17 to 8.36)	2901.05(2225.41 to 3602.24)	11.24(8.97 to 13.87)	2374.22(1894.9 to 2930)	-0.62(-0.76 to -0.48)	*p* <.001
50–54 years	6.17(4.66 to 7.92)	2900.71(2190.31 to 3724.93)	9.96(7.61 to 12.91)	2239.36(1710.9 to 2901.97)	-0.83(-1.00 to -0.66)	*p* <.001
55–59 years	4.67(3.69 to 5.74)	2523.83(1992.24 to 3100.9)	8.18(6.45 to 10.1)	2066.67(1630.41 to 2553.34)	-0.64(-0.72 to -0.57)	*p* <.001
60–64 years	3.63(2.74 to 4.73)	2258.63(1707.53 to 2942.22)	6.15(4.69 to 7.97)	1922.72(1466.7 to 2490.08)	-0.53(-0.62 to -0.44)	*p* <.001
65–69 years	2.21(1.74 to 2.82)	1787.16(1404.17 to 2279.1)	4.5(3.6 to 5.68)	1631.36(1304.15 to 2057.92)	-0.30(-0.39 to -0.22)	*p* <.001
70–74 years	1.23(0.92 to 1.63)	1451.25(1090.08 to 1930.82)	2.89(2.16 to 3.81)	1405.14(1050.6 to 1848.54)	-0.08(-0.20 to 0.04)	*p* =.210
75 + years	1.55(1.21 to 1.92)	1320.69(1031.98 to 1638.51)	3.63(2.87 to 4.41)	1257.77(993.8 to 1527.57)	-0.16(-0.18 to -0.14)	*p* <.001
SDI level:						
High	20.33(17.61 to 23.46)	2107.66(1824.14 to 2431.09)	22.71(20.09 to 25.56)	1847.63(1603.23 to 2115.44)	-0.41(-0.45 to -0.37)	*p* <.001
High-middle	23.27(20.27 to 26.54)	2111.15(1845.6 to 2401.33)	24.68(21.63 to 28.16)	1588.01(1373.31 to 1829.9)	-0.92(-0.98 to -0.85)	*p* <.001
Middle	21.58(17.94 to 25.48)	1364.51(1148.04 to 1594.00)	31.35(27.02 to 36.25)	1159.2(992.08 to 1343.29)	-0.54(-0.62 to -0.45)	*p* <.001
Low-middle	14.39(12.07 to 16.94)	1546.54(1314.08 to 1798.53)	22.24(19.13 to 25.77)	1208.59(1048.55 to 1386.76)	-0.80(-0.83 to -0.77)	*p* <.001
Low	4.89(4.12 to 5.81)	1369.8(1174.81 to 1589.26)	10.04(8.44 to 11.81)	1181.48(1011.32 to 1369.74)	-0.48(-0.50 to -0.45)	*p* <.001

Note: AAPC = average annual percentage change; P = P value for the significant test of AAPCs; CI = confidence interval; SDI = sociodemographic index; AUD = alcohol use disorders; UI = uncertainty interval

females than for males (AUD age-standardised mortality: -1.22%Vs-0.73%; AUD age-standardised DALYs: -0.95%Vs-0.79%) (see Supplementary Figure S2 and Supplementary Tables S1 and S2). These findings suggest that males are likely to remain the primary group affected by AUD globally, both currently and in the future.

In addition, age-standardised AUD prevalence, mortality and DALYs were higher for males than for females, irrespective of changes in sociodemographic indices (see Supplementary Fig. 4). However, the results were more complex for AAPCs. Globally, for AUD prevalence, mortality, and DALYs for AAPCs, the decline was more pronounced for females than for males (see Supplementary Figure S5). However, in high SDI regions (males: -0.55%; females: -0.17%), middle SDI regions (males: -0.52%; females: -0.45%), low-middle SDI regions (males: -0.82%; females: -0.33%), and low SDI regions (males: -0.47%; females: -0.32%), the age-standardised prevalence of AUD declined more significantly among males than females. Regarding AUD-related age-standardised mortality, there was an upward trend for females in high SDI regions (0.55%), in contrast to a downward trend for males (-0.19%). For AUD-related age-standardised DALYs, the decline was consistently smaller for females

than for males in high SDI regions (males: -0.50%; females: -0.01%), low-middle SDI regions (males: -0.72%; females: -0.47%), and low SDI regions (males: -0.47%; females: -0.44%). This evidence suggests that although the current state of AUD burden may be smaller for females than for males, this difference in AUD burden between males and females is diminishing in specific areas (e.g., high SDI areas) because the decline in AUD among males is occurring at a faster rate than that among females.

Global trends by age subgroup

Previous studies have rarely considered the status and trends of AUD in different age groups [2]. The results show that globally, people younger than 55 years of age have higher AUD-related prevalence, mortality and DALYs compared to older people after 55 years of age, but as the decline in this indicator is larger for people younger than 55 years of age, this suggests that the gap is narrowing(see Table 1, Supplementary Table S1 and Supplementary Table S2). Specifically, all age groups except the 70–74 age group showed decreasing trends in AUD prevalence, with the largest decreases of more than 1% in young adults aged 20–29 years (see Table 1). Furthermore, as the AAPCs were not statistically significant ($p > .05$), this implies that AUD mortality did not decline significantly in the 55–59, 60–64, 65–69, and 70–74 age groups (see Supplementary Table S1). For AUD DALYs, a decreasing trend was observed in all age groups except the 70–74 age group (see Supplementary Table S2). This evidence suggests that attention needs to be paid to the burden of AUD in relative older (e.g., 55 + years) adults.

Furthermore, we found that globally, the burden of AUD, as measured by prevalence, mortality and DALYs, declined significantly across all age subgroups, except for women 55–59 years, for whom the decline in AUD mortality was not statistically significant ($p = .094$) (see Supplementary Table S3). In contrast, older male adults did not show a significant trend of decreasing risk. Specifically, there was no significant decline in the prevalence of AUD in men aged 70 years or older; nor was there a significant decline in AUD mortality in males aged 55–74 years, nor in AUD DALYs in males aged 65–74 years (see Supplementary Table S3). Further, we found that in high SDI regions, adults aged 60 + were at risk of rising AUD-related prevalence, mortality, and DALYs, while adults aged 55–59 + years were also at risk of rising AUD mortality and DALYs. In addition, in the middle SDI, older adults aged 70 + faced rising AUD prevalence (see Supplementary Table S4 and Supplementary Figure S6). The results suggest that older populations (e.g., those aged over 55 years) may be facing an increasingly higher burden of alcohol use disorders.

Global trends by sociodemographic index

Globally, age-standardised prevalence due to AUD is declining significantly in all regions over the period 1990–2021, particularly in high-middle SDI regions, with an AAPC = -0.92%, and in high SDI regions, to a lesser extent, with an AAPC of -0.41% (see Table 1). In terms of age-standardised mortality due to AUDs, all regions showed a significant decline, except for high SDI regions (AAPC = 0.02%; see Supplementary Table S1). AUD-related age-standardised DALYs declined in all regions, particularly in the high-middle SDI regions, where the AAPC = -1.11%, compared with a smaller decline in the high SDI regions, where the AAPC = -0.34% (see Supplementary Table S2). Although high-middle SDI regions had higher AUD-related age-standardised prevalence, mortality and DALYs in 1990, high SDI regions already had the highest AUD-related age-standardised prevalence (1,847 per 100,000), mortality (2.58 per 100,000) and DALYs (278.84 per 100,000) in 2021, due to the slower decline in high SDI regions.

Regional trends

From 1990 to 2021, Australasia and Oceania demonstrated an increase in the age-standardised prevalence of AUD, with AAPCs of 0.6% and 0.12%, respectively. With the exception of East Asia (AAPC=-0.19, $p = .168$), all regions significantly showed a significant decrease in the age-standardised prevalence of AUD (see Supplementary Table S5).

From 1990 to 2021, Caribbean (AAPC = 0.11%), East Asia (AAPC = 0.22%), and High-income North America (AAPC = 1.28%) demonstrated an upward trend in AUD-related age-standardised mortality. Moreover, no significant changes were observed in the AUD-related age-standardised mortality rates for Australasia (AAPC = 0.11%, $p = .824$), Central Europe (AAPC = -0.22%, $p = .678$), and Eastern Europe (AAPC = -0.19%, $p = .813$). Further, the rest of the regions showed significant decreases in age-standardised mortality for AUD (see Supplementary Table S6).

From 1990 to 2021, Australasia (AAPC = 0.42%, $p < .001$) showed a significant increase in age-standardised DALYs dut to AUD. In contrast, the Caribbean (AAPC=-0.08%, $p = .613$), Central Europe (AAPC=-0.39%, $p = .089$), East Asia (AAPC=-0.12%, $p = .167$), Eastern Europe (AAPC=-0.41%, $p = .394$), and High-income North America (AAPC=-0.04%, $p = .627$) did not exhibit statistically significant changes in AUD-related age-standardised DALYs. All other regions showed significant declines in AUD-related age-standardised DALYs (see Supplementary Table S7).

In addition, after stratifying by sex, Eastern Europe males had the highest age-standardised prevalence, mortality and DALYs due to AUD in 2021. Similarly, Eastern

Europe females had the highest AUD-related age-standardised prevalence, mortality and DALYs (see Supplementary Table S8).

National trends

At the national level, from 1990 to 2021, Mongolia, United Kingdom, and New Zealand had the highest age-standardised AUD prevalence increases of 2.04%, 1.12%, and 1.06%, respectively. Furthermore, Cuba, United Kingdom, and Paraguay had the highest increases in age-standardised AUD mortality of 2.78%, 2.42%, and 1.97%, respectively. Finally, Mongolia, the United Kingdom, and New Zealand witnessed the highest age-standardised AUD DALYs increases, at 1.79%, 1.22%, and 0.92%, respectively (see Figs. 1 and 2, and 3; see Supplementary Table S9).

Risk factors

Detailed analyses of global data from 1990 to 2021 show that the two main risk factors associated with AUD among people ≥ 15 years of age are high alcohol use and childhood sexual abuse (Table 2). In 2021, globally, the age-standardised DALYs from high alcohol use were 202 per 100,000 people and 15.83 per 100,000 for childhood sexual abuse. In addition, from 1990 to 2021, these factors correspond to an AAPC of -0.83% and −0.87%, respectively.

High alcohol use DALYs declined fastest in high-middle SDI regions (AAPC = -1.11%) and slowest in high SDI regions (AAPC = -0.34%). Similarly, childhood sexual abuse DALYs declined most rapidly in high-middle SDI regions (AAPC = -1.48%) and most slowly in high SDI regions (AAPC = -0.04%).

Discussion

In order to better understand the global trends of AUD in the context of globalization, we conducted detailed analysis and research using GBD 2021 data. Our study not only systematically investigated the current status of AUD in terms of region, age, gender, and year dimensions, but also examined its trends. Our results indicate that the global burden of AUD is gradually declining, although males remain at a higher risk for AUD burden compared to females. Additionally, older populations (aged over 55 years) may face a higher risk of AUD, making them a population requiring further attention in the future. The global inequality in AUD deserves attention, as high-SDI countries/regions, unlike in the case of conventional diseases, may face a higher risk of AUD, highlighting the need for stricter alcohol use policies in some countries. Lastly, high alcohol use and childhood sexual abuse are identified as significant risk factors for AUD among individuals aged 15 years and older. Our study extends the current understanding of AUD by highlighting its global trends and the role of globalization in shaping these patterns. The findings underscore the significant public health impact of AUD, particularly in regions where the

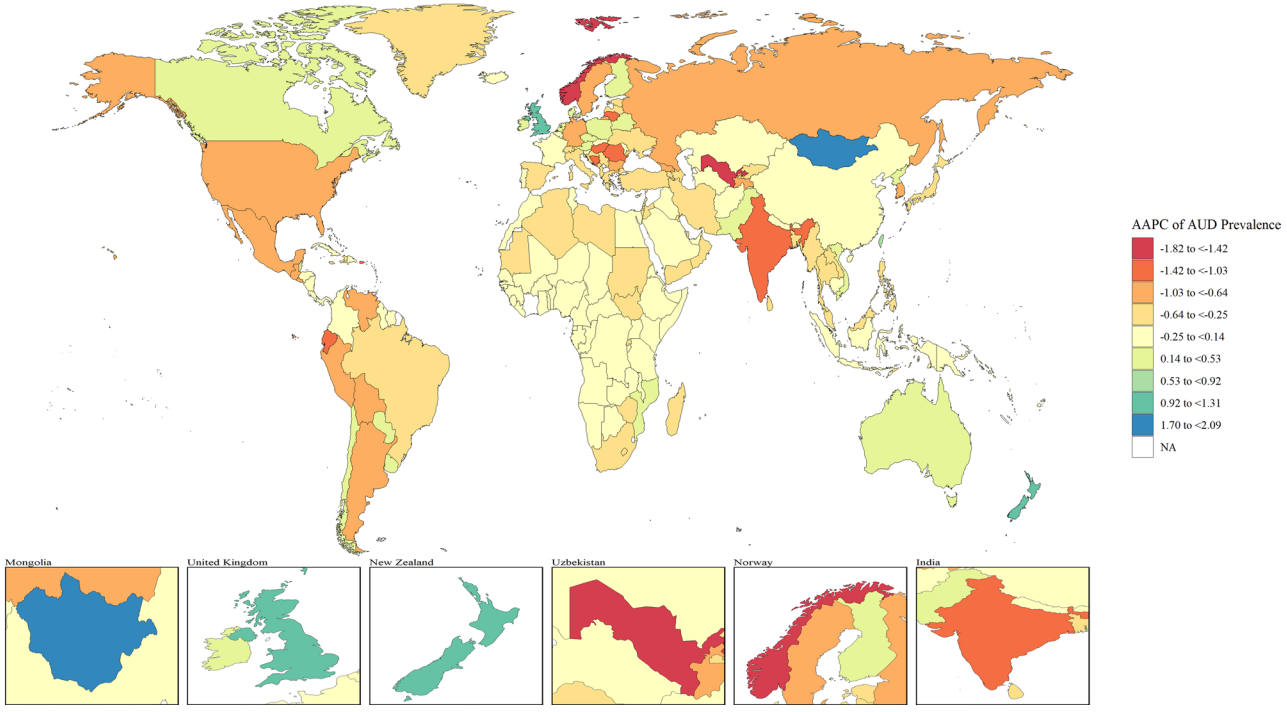

Fig. 1 Map showing average annual percentage change in global prevalence of alcohol use disorders in adults, 1990–2021. Note: AAPCs = average annual percent changes; AUD = alcohol use disorders

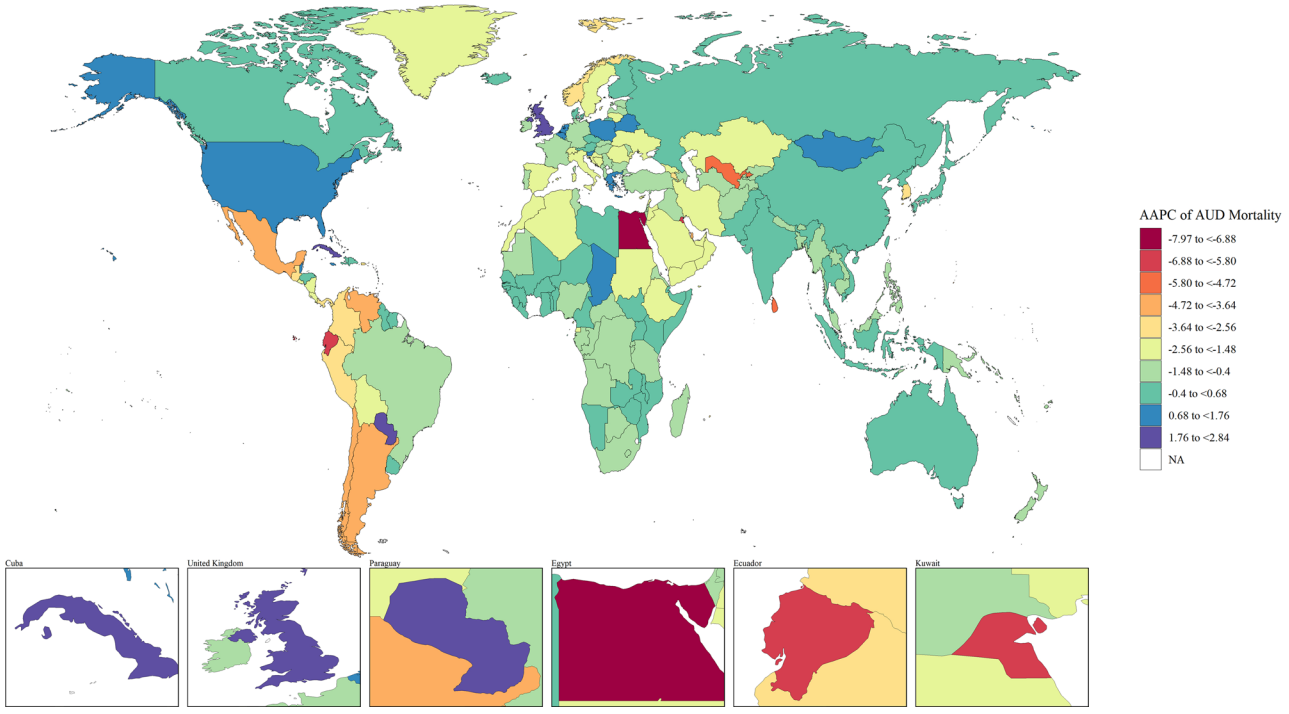

Fig. 2 Map showing average annual percentage change in global mortality of alcohol use disorders in adults, 1990–2021. Note: AAPCs = average annual percent changes; AUD = alcohol use disorders

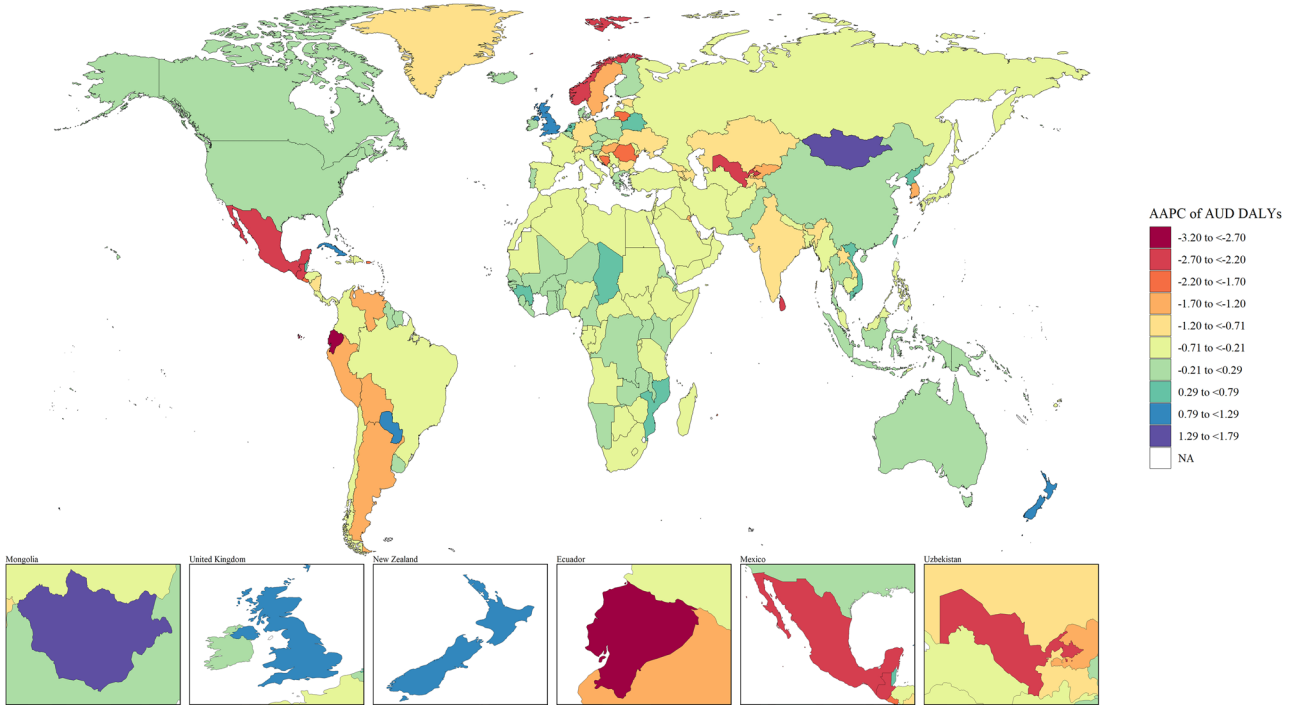

Fig. 3 Map showing average annual percentage change in global disability adjusted life years of alcohol use disorders in adults, 1990–2021. Note: AAPCs = average annual percent changes; AUD = alcohol use disorders; DALYs = disability adjusted life years

Table 2 Main risk factors for age-standardised AUD related dalys, and AAPC,1990–2021

	Age-standardised DALYs(per 100,000)(95%UI)			
Risk factors by SDI	1990	2021	AAPC(95%CI)	*p*-value
High Alcohol use				
Global	266.09(212.45 to 335.01)	202.38(161.02 to 253.18)	-0.83(-1.01 to -0.66)	*p* <.001
High	309.61(241.72 to 395.64)	278.84(222.22 to 350.09)	-0.34(-0.46 to -0.21)	*p* <.001
High-middle	366.69(300.4 to 451.04)	251.78(202.58 to 313.31)	-1.11(-1.76 to -0.46)	*p* =.001
Middle	201.11(154.16 to 255.94)	163.01(125.7 to 208.32)	-0.7(-0.8 to -0.6)	*p* <.001
Low-middle	240.11(184.56 to 303.46)	190.42(150.81 to 243.13)	-0.76(-0.86 to -0.66)	*p* <.001
Low	194.86(145.95 to 246.93)	166.68(128.47 to 214.93)	-0.5(-0.54 to -0.47)	*p* <.001
Childhood sexual abuse				
Global	21.03(3.76 to 48.52)	15.83(2.9 to 36.87)	-0.87(-1.06 to -0.68)	*p* <.001
High	23.8(4 to 54.12)	23.54(4.05 to 53.4)	-0.04(-0.15 to 0.07)	*p* =.479
High-middle	24.96(4.17 to 58.62)	15.19(2.73 to 35.12)	-1.48(-2.11 to -0.85)	*p* <.001
Middle	15.73(2.94 to 35.99)	11.29(2.06 to 26.9)	-1.08(-1.14 to -1.02)	*p* <.001
Low-middle	23.09(4.45 to 54.13)	18.09(3.39 to 41.85)	-0.79(-0.85 to -0.74)	*p* <.001
Low	20.1(3.48 to 47.37)	16.82(3 to 38.96)	-0.57(-0.6 to -0.54)	*p* <.001

Note: AAPC = average annual percentage change; CI = confidence interval; DALYs = disability adjusted life years; SDI = sociodemographic index; AUD = alcohol use disorders; UI = uncertainty interval

regulatory environment has been exploited by transnational alcohol corporations.

Previous studies have highlighted that the global goal of reducing harmful alcohol use is elusive [20]. Our results appear inconsistent, which may be partially explained by the distinction between alcohol use and a diagnosis of AUD. With AUD, there is more emphasis on clinical diagnostic criteria and the negative impact on an individual's life [31]. In addition, several countries and regions with high levels of alcohol use have implemented key alcohol control measures such as increasing alcohol prices and restricting availability [15, 32, 33]. The WHO's recommended "best buy" interventions for the prevention and control of noncommunicable diseases (NCDs) include measures targeting alcohol use, such as restricting alcohol advertising and reducing sales hours [34]. These strategies may have contributed to the reduction in the prevalence of AUD. Moreover, young people are more likely to benefit from these alcohol control policies. Specifically, alcohol pricing policies and the establishment of a legal minimum drinking age may have contributed to the decline of AUD among younger populations [15, 32, 33]. However, it is important to emphasize that efforts to develop and implement alcohol policies at the global level remain insufficient. To sustainably reduce the health burden associated with alcohol use, governments should allocate more resources and take stronger action [35, 36].

A report based on GBD 2019 found that younger people are more likely to die from AUD than older people [37]. However, as our study focused on long-term trends, and given the significant decline in AUD-related deaths among younger populations, more attention should be paid to AUD mortality among older adults, which has shown no significant decrease [37]. Specifically, in contrast to younger populations, globalization may lead to more negative alcohol-related outcomes for older populations. With the acceleration of global population ageing [38, 39], researchers should place greater emphasis on exploring the psychosocial drivers of alcohol use among older adults. In parallel, policymakers should consider implementing stricter regulations on alcohol advertising specifically targeted at this demographic [40]. While globalization accelerates the flow of knowledge information [41], not all messages align with the narrative that alcohol is harmful. Some information, including industry-sponsored scientific research, has historically highlighted potential health benefits of moderate alcohol consumption, particularly for older adults [5]. However, recent systematic reviews and the WHO Alcohol Policy Playbook have debunked the myth of "moderate" alcohol consumption, emphasizing that any level of alcohol use carries health risks [6, 7]. These misleading narratives, often centred around notions of "moderate" or "responsible" drinking, are frequently promoted by the alcohol industry to normalise alcohol use among older adults, thereby increasing their risk of developing AUD. It should be added that these studies are often based on observations, in which residual confounding factors (such as the specific amount of alcohol consumed, the individual's risk of cardiovascular disease [42]) may affect the reliability of the results and have caused more and more challenges to researchers [43–45], particularly in drawing valid causal inferences and avoiding the misinterpretation of findings in public health recommendations. However, the alcohol industry's use of flawed research and misleading narratives—such as the claim that alcohol is beneficial to health—combined with the lack of effective governmental regulation, has made it increasingly difficult to reduce the burden of AUD [46]. For example, advertisements

often highlight potential health benefits of moderate alcohol consumption, particularly targeting older adults, while downplaying the risks of AUD. This selective messaging, combined with cultural globalization, has normalized alcohol consumption among older populations, increasing their vulnerability to AUD. Furthermore, in regions like Asia, the alcohol industry promote red wine as a "healthy" choice, capitalizing on cultural perceptions and health-conscious trends among aging populations. A qualitative study showed that Chinese consumers believe that red wine is healthier than other alcoholic beverages, and tend to choose French brands due to long-term marketing [47]. Considering that one of the important needs of Chinese elderly people is to maintain their health, transnational alcohol corporations may influence public perception through various commercial channels and maximize market profits [48]. Moreover, globalization has facilitated migration flows but has also led to loneliness, a known risk factor for AUD [49, 50], among middle-aged and elderly migrants [51]. Given the global trend of population ageing, greater attention should be paid to alcohol consumption among older adults and the promotion of their physical and mental well-being. This is especially critical for policymakers, as most governments worldwide have yet to implement effective public health policies to mitigate AUD [46].

Furthermore, consistent with previous studies, males have a higher risk of AUD, particularly in low- and middle-income regions [5, 37]. However, in specific high SDI regions, women may have an increasing risk of AUD. This disparity may be linked to globalization-driven shifts in cultural norms and social values. In high SDI regions, female drinking has become more socially accepted and recognized, reflecting changes in societal perceptions of gender roles and individual independence [52]. Globalization, facilitated by the transnational alcohol industry, has accelerated cultural shifts in drinking norms [53–55]. For instance, in high SDI regions, female drinking is increasingly marketed as a symbol of independence, professionalism, and social mobility [52]. The alcohol industry strategically target women through advertisements that align with these cultural narratives, thereby normalizing and increasing alcohol consumption among this demographic [52]. This highlights the need for stricter regulations on alcohol marketing to mitigate the growing health burden of AUD among women. Additionally, the growth of female alcohol use may also be linked to transnational alcohol corporations' targeted marketing strategies directed at female consumers [56]. For example, with the rapid economic growth in Asia, the European alcohol industry has aimed its sights towards Asia as well, particularly towards females [57]. This highlights the potential risk of increased AUD among women in the future. In addition, as current research has found that females tend to be more reactive, addictive and neurotoxic after using addictive substances, the so-called 'telescope effect' [58], future research needs to further investigate the close link between globalisation and regional female drinking, and focus on the potential risks of AUD for females.

Finally, our study highlights the need for Mongolia, the United Kingdom, New Zealand, Cuba, and Paraguay to address the continuing rise in the burden of AUD. While some of these countries may not rank among the highest in per capita alcohol consumption globally [20], the ongoing increase in AUD cases suggests significant future risks. Previous data suggest that the number of people with AUD in Mongolia has almost quadrupled between 1990 and 2021, much higher than in other countries [59]. This evidence suggests that AUD in Mongolia require additional attention from the international community. For example, researchers may conduct further investigations to better understand the reasons behind the increasing AUD among the Mongolian population, in order to inform the development of targeted interventions. Research suggests that the widespread availability of alcohol, a favourable environment for the sale of alcohol products, strong marketing of alcohol and general public acceptance of alcohol have all contributed to the continued increase in AUD [60]. Given the influence of multinational alcohol corporations in developing countries, where alcohol policies are often less stringent, there is an urgent need for stronger regulatory frameworks [61]. These transnational alcohol corporations exploit weak regulations to expand their markets, often through aggressive marketing and pricing strategies that target vulnerable populations, such as low-income groups and women [62, 63]. Governments must implement stricter controls on alcohol advertising, pricing, and availability, while also collaborating with international organizations like the WHO to develop binding global alcohol policies. Such measures are essential to counteract the commercial forces driving AUD and to promote public health equity. In high SDI countries, such as the UK and New Zealand, the alcohol industry should be restricted from diversifying its market strategies, such as partnering with sporting events for promotional purposes [43]. In addition, the alcohol industry also targets low-income groups through pricing strategies, promotional activities, and other means [63]. For example, discounts or bulk packaging are regularly launched to attract low-income families to buy. Due to economic pressure and social environmental factors, these groups are more susceptible to the temptation of alcohol consumption, which increases their risk of developing AUD [15, 64]. Considering that despite the significant risks to public health, the marketing of alcohol is far less controlled than that of other psychoactive substances [12]. This lack of regulation has allowed the alcohol industry to freely promote

its products around the world, further exacerbating the prevalence of AUD. Therefore, further customized and more proactive strategies may be necessary to ameliorate the growth of AUD in these countries [16]. Since industry-led self-regulation has shown limited effectiveness in protecting public health [65], the establishment of independent regulatory agencies may strengthen enforcement and facilitate meaningful, long-term progress, particularly in settings with high alcohol consumption. Moreover, high alcohol consumption and childhood sexual abuse were identified as critical risk factors. Heavy continuous drinking, which can impair individuals' cognitive and emotional functions, places them at a higher risk of developing AUD [66, 67]. Childhood sexual abuse, in particular, is a unique risk factor. Survivors of childhood sexual abuse are not only more likely to be exposed to alcohol at an earlier age but are also more inclined to use alcohol as a coping mechanism for their trauma, significantly increasing their risk of developing AUD later in life [68]. Our study further revealed that these two risk factors contributed the highest number of age-standardised DALYs in high-SDI regions. This underscores the urgent need for targeted policy development to address potential risk factors for AUD in these high-SDI regions.

Strengths and limitations of this study

To the best of our knowledge, our study is the first detailed survey of AUD to include gender, age, region, and country, and we provide predictive modelling as support for the evidence, which is reliable and detailed data that can help government and policymakers around the world to develop effective intervention for AUD. Our study contributes to identifying specific populations at risk of AUD in the context of globalization, providing critical evidence for the formulation of relevant global and regional policies.

This study has several limitations. Firstly, the data were extrapolated from countries with existing epidemiological data. The results are dependent on the modelling process and caution is needed in interpreting the findings. Second, despite the rigorous statistical methods used in our study, differences in health information systems and reporting mechanisms across countries and regions, particularly in low- and middle-income countries and regions experiencing conflict, can lead to incomplete and biased data that may affect the accuracy of the results. In addition, we call for future research to understand the link between increased globalisation (e.g., strategic coordination among transnational alcohol corporations) on the growth of AUD through more detailed methods. Finally, data on the burden of disease include a time lag. Therefore, further studies with more recent epidemiological data are needed to extend the results of this study.

Conclusions

We found that populations in specific regions and countries still face a high burden of AUDs. We call on key stakeholders, including researchers and media communicators, to actively engage in reframing AUD as a public health issue, with greater attention to how it is defined, portrayed, and socially constructed [69]. In particular, policymakers should adopt a public health- first approach when designing interventions, recognizing the importance of addressing structural and societal factors rather than placing emphasis solely on individual responsibility. To achieve meaningful reductions in AUD, governments and international organizations should integrate effective policies and interventions, including tightening regulations on alcohol advertising aimed at older adults and establishing independent regulatory bodies to address AUD on a global scale.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12992-025-01124-5.

Supplementary Material 1

Author contributions

ZX: conceptualization, methodology, writing-original draft, writing-review & editing; GZ: conceptualization, methodology, writing-review & editing; CX: conceptualization, methodology, writing-original draft, validation; TC: writing-review & editing, data collection;; ZD: writing-review & editing, data collection; YW: writing-review & editing, data collection; MZ: supervision, writing-review & editing; JD: conceptualization, supervision, writing-review & editing, project administration, funding acquisition. All authors revised the report and approved the final version before submission. MZ and JD are the guarantor and attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Funding statement

This study was funded by the National Key R&D Program of China (2023YFC3304204; 2019HY320001; 2023YFC3304200), the National Natural Science Foundation (82130041; 82171484; 81871045) and the Medical-Engineering Interdisciplinary Research Foundation of Shanghai Jiao Tong University "Jiao Tong Star" Program (YG2023ZD25). The funder of the study had no role in the study design, data collection, data analysis, data interpretation, or the writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Data availability

The data used for analyses are publicly available at https://ghdx.healthdata.org/gbd-results-tool. All data will be made available on request to the corresponding author. Proposals will be reviewed and approved by the sponsor, investigator, and collaborators based on scientific merit. After approval of a proposal, data will be shared through a secure online platform after the signing of a data access agreement.

Declarations

Ethics approval

Not required as this study used secondary data aggregated at both country and global level.

Data transparency
All data and materials as well as software application comply with field standards. The lead authors (MZ and JD) affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Equity and inclusion statement
The authors declared to value all individuals regardless of age, national origin, race, ethnicity, gender, sexual orientation, ability status, among other identities.

AI-assisted technologies
To enhance readability and language, AI-assisted technologies were utilized in this study. These technologies were not employed for any other purposes. The authors remain ultimately responsible and accountable for the originality, accuracy, and integrity of the work.

Transparency
The lead authors affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Competing interests
The authors declare no competing interests.

Author details
[1]Shanghai Mental Health Center, Shanghai Jiao Tong University School of Medicine, Shanghai 200030, China
[2]Shanghai Key Laboratory of Psychotic Disorders, Shanghai Mental Health Center, Shanghai 200030, China

Received: 21 November 2024 / Accepted: 14 May 2025
Published online: 24 May 2025

References

1. Rehm J, Imtiaz S. A narrative review of alcohol consumption as a risk factor for global burden of disease. Subst Abuse Treat Prev Policy. 2016;11. https://doi.org/10.1186/s13011-016-0081-2.
2. Danpanichkul P, et al. Socio-economic association of alcohol use disorder and cardiovascular and alcohol-associated liver disease from 2010 to 2019. Aliment Pharmacol Ther. 2024;60(3):340–9. https://doi.org/10.1111/apt.18095.
3. Huang DQ, et al. Global epidemiology of alcohol-associated cirrhosis and HCC: trends, projections and risk factors. Nat Rev Gastroenterol Hepatol. 2023;20(1):37–49. https://doi.org/10.1038/s41575-022-00688-6.
4. Rehm J, et al. The relationship between different dimensions of alcohol use and the burden of disease-an update. Addiction. 2017;112(6):968–1001. https://doi.org/10.1111/add.13757.
5. Collaborators GA. Population-level risks of alcohol consumption by amount, geography, age, sex, and year: a systematic analysis for the global burden of disease study 2020. Lancet. 2022;400(10347):185–235. https://doi.org/10.1016/s0140-6736(22)00847-9.
6. Brennan SE, et al. Long-term effects of alcohol consumption on cognitive function: a systematic review and dose-response analysis of evidence published between 2007 and 2018. Syst Rev. 2020;9(1):33. https://doi.org/10.1186/s13643-019-1220-4.
7. Gunn C, et al. A systematic review of the next-day effects of heavy alcohol consumption on cognitive performance. Addiction. 2018;113(12):2182–93. https://doi.org/10.1111/add.14404.
8. Collaborators GAaDU. The global burden of disease attributable to alcohol and drug use in 195 countries and territories, 1990–2016: a systematic analysis for the global burden of disease study 2016. Lancet Psychiatry. 2018;5(12):987–1012. https://doi.org/10.1016/s2215-0366(18)30337-7.
9. Bakke Ø, Endal D. Vested interests in addiction research and policy alcohol policies out of context: drinks industry supplanting government role in alcohol policies in sub-Saharan Africa. Addiction. 2010;105(1)22– 8. https://doi.org/10.1111/j.1360-0443.2009.02695.x.
10. O'Brien P, et al. Influencing the global governance of alcohol: alcohol industry views in submissions to the WHO consultation for the alcohol action plan 2022–2030. Int J Drug Policy. 2023;119:104115. https://doi.org/10.1016/j.drugpo.2023.104115.
11. Leggio L, Lee MR. Treatment of alcohol use disorder in patients with alcoholic liver disease. Am J Med. 2017;130(2):124–34. https://doi.org/10.1016/j.amjmed.2016.10.004.
12. WHO. Global status report on alcohol and health 2018. Editor: WHO; 2018.
13. Gilmore AB, et al. Defining and conceptualising the commercial determinants of health. Lancet. 2023;401(10383):1194–213. https://doi.org/10.1016/s0140-6736(23)00013-2.
14. Carah N, Brodmerkel S. Alcohol marketing in the era of digital media platforms. J Stud Alcohol Drugs. 2021;82(1):18–27.
15. Babor TF, et al. Alcohol: no ordinary Commodity-a summary of the third edition. Addiction. 2022;117(12):3024–36. https://doi.org/10.1111/add.16003.
16. WHO. *Reducing the harm from alcohol– by regulating cross-border alcohol marketing, advertising and promotion: a technical report*, WHO, Editor. 2022.
17. Jernigan DH, et al. Towards a global alcohol policy: alcohol, public health and the role of WHO. Bull World Health Organ. 2000;78(4):491–9.
18. Qu X, et al. Burden of alcohol use disorders in China and the regions with different income levels over the world. J Glob Health. 2021;11:08011. https://doi.org/10.7189/jogh.11.08011.
19. Farrell M, et al. Responding to global stimulant use: challenges and opportunities. Lancet. 2019;394(10209):1652–67. https://doi.org/10.1016/S0140-6736(19)32230-5.
20. Manthey J, et al. Global alcohol exposure between 1990 and 2017 and forecasts until 2030: a modelling study. Lancet. 2019;393(10190):2493–502. https://doi.org/10.1016/s0140-6736(18)32744-2.
21. McPheeters M, et al. Pharmacotherapy for alcohol use disorder: A systematic review and Meta-Analysis. JAMA. 2023;330(17):1653–65. https://doi.org/10.1001/jama.2023.19761.
22. Murray CJL. The global burden of disease study at 30 years. Nat Med. 2022;28(10):2019–26. https://doi.org/10.1038/s41591-022-01990-1.
23. Friel S, et al. Commercial determinants of health: future directions. Lancet. 2023;401(10383):1229–40. https://doi.org/10.1016/s0140-6736(23)00011-9.
24. Foreman KJ, et al. Modeling causes of death: an integrated approach using codem. Popul Health Metr. 2012;10:1. https://doi.org/10.1186/1478-7954-10-1.
25. Cao F, et al. Trends and cross-country inequalities in the global burden of osteoarthritis, 1990–2019: A population-based study. Ageing Res Rev. 2024;99:102382. https://doi.org/10.1016/j.arr.2024.102382.
26. Yang K, et al. Global burden of type 1 diabetes in adults aged 65 years and older, 1990–2019: population based study. BMJ. 2024;385:e078432. https://doi.org/10.1136/bmj-2023-078432.
27. American Psychiatric Association, D. and, American Psychiatric D, Association. Diagnostic and statistical manual of mental disorders: DSM-5. Volume 5. American psychiatric association Washington, DC; 2013.
28. Kim HJ, et al. Permutation tests for joinpoint regression with applications to cancer rates. Stat Med. 2000;19(3):335–51. https://doi.org/10.1002/(sici)1097-0258(20000215)19:3%3C;335::aid-sim336%3E;3.0.co;2-z.
29. Box GE, et al. Time series analysis: forecasting and control. Wiley; 2015.
30. Hurvich CM, Tsai C-L. Regression and time series model selection in small samples. Biometrika. 1989;76(2):297–307.
31. Kranzler HR, Soyka M. Diagnosis and pharmacotherapy of alcohol use disorder: A review. JAMA. 2018;320(8):815–24. https://doi.org/10.1001/jama.2018.11406.
32. Dyer O. Minimum alcohol pricing delivers health benefits without penalising moderate drinkers, finds analysis. BMJ. 2013;346:f2939. https://doi.org/10.1136/bmj.f2939.
33. Kolosnitsyna M, Sitdikov M, Khorkina N. Availability restrictions and alcohol consumption: A case of restricted hours of alcohol sales in Russian regions. Int J Alcohol Drug Res. 2014;3(3):193–201. https://doi.org/10.7895/ijadr.v3i3.154.
34. WHO. Tackling NCDs: best buys and other recommended interventions for the prevention and control of noncommunicable diseases. World Health Organization; 2024. p. 31.
35. McCambridge J, Lesch M. Are we moving into a new era for alcohol policy globally? An analysis of the global alcohol action plan 2022-30. BMJ Glob Health. 2024;9(2). https://doi.org/10.1136/bmjgh-2023-014246.
36. Robin R. Global intergovernmental initiatives to minimise alcohol problems: some good intentions, but little action. Eur J Risk Regul. 2021;12(2):419–32. https://doi.org/10.1017/err.2020.53.

37. WHO. Global status report on alcohol and health and treatment of substance use disorders. Editor: WHO; 2024.
38. Han BH, et al. Demographic trends of binge alcohol use and alcohol use disorders among older adults in the united States, 2005–2014. Drug Alcohol Depend. 2017;170:198–207. https://doi.org/10.1016/j.drugalcdep.2016.11.003.
39. Lutz W, Sanderson W, Scherbov S. The coming acceleration of global population ageing. Nature. 2008;451(7179):716–9. https://doi.org/10.1038/nature06516.
40. Kelly S, et al. Alcohol and older people: A systematic review of barriers, facilitators and context of drinking in older people and implications for intervention design. PLoS ONE. 2018;13(1):e0191189. https://doi.org/10.1371/journal.pone.0191189.
41. Lind N, Ramondo N. Innovation, knowledge diffusion, and globalization. National Bureau of Economic Research; 2018.
42. Oppenheimer GM, Bayer R. Is moderate drinking protective against heart disease?? The science, politics and history of a public health conundrum. Milbank Q. 2020;98(1):39–56. https://doi.org/10.1111/1468-0009.12437.
43. WHO. Empowering public health advocates to navigate alcohol policy challenges: alcohol policy playbook. Editor: WHO; 2024.
44. Im PK, et al. Alcohol consumption and risks of more than 200 diseases in Chinese men. Nat Med. 2023;29(6):1476–86. https://doi.org/10.1038/s41591-023-02383-8.
45. Zhao J, et al. Alcohol consumption and mortality from coronary heart disease: an updated Meta-Analysis of cohort studies. J Stud Alcohol Drugs. 2017;78(3):375–86. https://doi.org/10.15288/jsad.2017.78.375.
46. Anderson P. The impact of alcoholic beverages on human health. Nutrients. 2021;13(12). https://doi.org/10.3390/nu13124417.
47. Liu F, Murphy J. A qualitative study of Chinese wine consumption and purchasing: implications for Australian wines. Int J Wine Bus Res. 2007;19(2):98–113. https://doi.org/10.1108/17511060710758669/full/html.
48. Deadman P. How to be Healthy: Traditional Chinese Health Preservation Teachings and Modern Research. Journal of Chinese Medicine (JCM), 2005(78).
49. Haighton K. Thinking behind alcohol consumption in old age: psychological and sociological reasons for drinking in old age. Springer International Publishing; 2016. https://doi.org/10.1007/978-3-319-47233-1_1.
50. Akerlind I, Hörnquist JO. Loneliness and alcohol abuse: a review of evidences of an interplay. Soc Sci Med. 1992;34(4):405–14. https://doi.org/10.1016/0277-9536(92)90300-f.
51. Hossen A. Social isolation and loneliness among elderly immigrants: the case of South Asian elderly living in Canada. J Int Social Issues. 2012;1(1):1–10.
52. Dermody SS, Hendershot CS. A critical review of the effects of nicotine and alcohol coadministration in human laboratory studies. Alcohol Clin Exp Res. 2017;41(3):473–86. https://doi.org/10.1111/acer.13321.
53. Zerbe Enns C, Díaz LC, Bryant-Davis T. Transnational feminist theory and practice: an introduction. Women Therapy. 2021;44(1–2):11–26. https://doi.org/10.1080/02703149.2020.1774997.
54. Savic M, et al. Defining drinking culture: A critical review of its meaning and connotation in social research on alcohol problems. Drugs: Educ Prev Policy. 2016;23(4):270–82. https://doi.org/10.3109/09687637.2016.1153602.
55. Gordon R, Heim D, MacAskill S. Rethinking drinking cultures: a review of drinking cultures and a reconstructed dimensional approach. Public Health. 2012;126(1):3–11. https://doi.org/10.1016/j.puhe.2011.09.014.
56. Fullwood MD, et al. An advertisement analysis of alcohol products in popular women's magazines. Front Womens Health. 2016;1(1). https://doi.org/10.15761/fwh.1000102.
57. Wang C. Contemporary culture of wine consumption in Japan: women's leading role in creating the market in an Asia's post-industrial context. Territoires Du Vin, 2021(13).
58. Maxwell AM, Brucar LR, Zilverstand A. A systematic review of sex/gender differences in the multi-dimensional Neurobiological mechanisms in addiction and their relevance to impulsivity. Curr Addict Rep. 2023;10(4):770–92. https://doi.org/10.1007/s40429-023-00529-9.
59. IHME GB. o.D., Number with an alcohol use disorder. 2024.
60. Chimed-Ochir O, et al. Mongolia health situation: based on the global burden of disease study 2019. BMC Public Health. 2022;22(1):5. https://doi.org/10.1186/s12889-021-12070-3.
61. Casswell S, et al. How the alcohol industry relies on harmful use of alcohol and works to protect its profits. Drug Alcohol Rev. 2016;35(6):661–4. https://doi.org/10.1111/dar.12460.
62. Saffer H, Dave D. Alcohol advertising and alcohol consumption by adolescents. Health Econ. 2006;15(6):617–37. https://doi.org/10.1002/hec.1091.
63. Wilson RT, Till BD. Targeting of outdoor alcohol advertising: A study across ethnic and income groups. J Curr Issues Res Advertising. 2012;33(2):267–81. https://doi.org/10.1080/10641734.2012.700800.
64. Mulia N, Zemore SE. Social adversity, stress, and alcohol problems: are Racial/ethnic minorities and the poor more vulnerable? J Stud Alcohol Drugs. 2012;73(4):570–80. https://doi.org/10.15288/jsad.2012.73.570.
65. Noel J, et al. Alcohol industry self-regulation: who is it really protecting? Addiction. 2017;112(Suppl 1):57–63. https://doi.org/10.1111/add.13433.
66. Greenfield TK, et al. Risks of alcohol use disorders related to drinking patterns in the U.S. General population. J Stud Alcohol Drugs. 2014;75(2):319–27. https://doi.org/10.15288/jsad.2014.75.319.
67. Bogg T, et al. Cognitive control links alcohol use, trait disinhibition, and reduced cognitive capacity: evidence for medial prefrontal cortex dysregulation during reward-seeking behavior. Drug Alcohol Depend. 2012;122(1–2):112–8. https://doi.org/10.1016/j.drugalcdep.2011.09.018.
68. Tomás CC et al. Proceedings of the 3rd IPLeiria's International Health Congress: Leiria, Portugal. 6–7 May 2016. BMC Health Serv Res, 2016. 16(Suppl 3): 200. https://doi.org/10.1186/s12913-016-1423-5
69. Morris J, Boness CL, Burton R. (Mis)understanding alcohol use disorder: Making the case for a public health first approach. Drug Alcohol Depend, 2023. 253: 111019. https://doi.org/10.1016/j.drugalcdep.2023.111019

Publisher's note