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Global, regional, and national burdens of alcohol-related cirrhosis among women from 1992 to 2021 and its predictions

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Alcohol-Related Cirrhosis (AC) has become a growing global health issue, particularly affecting women. This study provides a comprehensive analysis of the global, regional, and national burden of AC in women from 1992 to 2021, addressing a research gap by focusing on long-term trends specific to women. Using data from the Global Burden of Disease (GBD) 2021 database, we assessed trends in age-standardized incidence rates (ASIR), mortality rates (ASMR), and disability-adjusted life years (DALYs) for AC in women across 204 countries. Temporal trends were examined using the estimated annual percentage change (EAPC) method, and future projections to 2030 were generated using the Nordpred model. Between 1992 and 2021, the global ASIR of AC in women showed a slight decrease, from 3.10 to 2.42 per 100,000, with an EAPC of -1.02. A significant variation was observed across Socio-Demographic Index (SDI) regions, with the highest ASIR (3.77 per 100,000) reported in low-SDI regions in 2021. Mortality and DALYs also declined globally but remained disproportionately high in lower-SDI regions. The age distribution analysis revealed distinct gender-specific trends, with women experiencing a marked increase in AC burden in older age groups. Predictions indicate a further decline in AC burden by 2030, although the disease remains a significant public health concern. The findings highlight both global progress and persistent regional disparities in the burden of AC among women. Targeted public health interventions, particularly in lower-SDI regions, are essential to address the ongoing burden of this preventable disease.

Keywords Women's health, Estimated annual percentage change, Socio-Demographic index, Global burden of disease GBD study, Nordpred model

Abbreviations

AC	Alcohol-related cirrhosis
ASIR	Age-standardized incidence rate
EAPC	Estimated annual percentage change
ASMR	Age-standardized mortality rate
DALYs	Disability-adjusted life years
ASDR	Age-standardized disability-adjusted life years
SDI	Socio-Demographic Index
CI	Confidence interval
UI	Uncertainty Interval
GBD	Global Burden of Disease
YLDs	years lived with disability
HALE	healthy life expectancy
ICD-10	International Classification of Diseases, 10th Revision

Alcohol-related liver diseases, especially cirrhosis, have emerged as a significant global public health concern, with disease burden varying among demographic groups. In recent decades, the rising impact of alcohol-

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related cirrhosis(AC) in women has garnered significant attention[1–3]. Patients with AC face significantly higher mortality rates compared to non-AC patients, with Jain et al. reporting a mortality rate of 42.3% for AC cases versus 27.3% for non-AC cases[4].

Traditionally viewed as more prevalent in males, emerging research indicates a shifting trend: the incidence and mortality rates of AC in women are stabilizing or rising in various regions, especially among younger women and vulnerable populations, such as Native Americans[1]. This trend is particularly concerning due to the unique biological and hormonal vulnerabilities of women to alcohol-induced liver damage. Metabolic differences, such as lower gastric alcohol dehydrogenase activity, result in higher blood alcohol levels in women than in men after equivalent alcohol consumption. For example, women consuming 40 g/day of alcohol have a relative risk (RR) of 9.35 for liver cirrhosis, compared to 2.82 for males. Additionally, estrogen exacerbates liver inflammation and accelerates fibrosis progression, making women more susceptible to alcohol-related liver injury. These risks are further amplified with age, particularly after menopause, when the loss of protective hormonal effects increases the liver's vulnerability to the cumulative effects of long-term alcohol consumption.

Beyond biological factors, societal influences also contribute to this growing burden. Targeted alcohol advertising across various media channels often conflates the women's liberation movement with heavy drinking alongside male peers. The "wine mom" persona, widely normalized in popular culture, further perpetuates excessive alcohol consumption among women[5,6]. Together, these gender-specific biological, hormonal, and societal factors underscore the urgent need for targeted interventions[7,8]. Despite this, literature focusing on women-specific long-term trends remains limited, particularly regarding the global burden of the disease.

This study aims to fill this gap by providing a comprehensive analysis of the global, regional, and national burden of AC in women from 1992 to 2021. Leveraging data from the Global Burden of Disease (GBD) study, this analysis will highlight historical trends and provide future projections. This study aims to inform policymakers and healthcare providers of the urgent need for targeted interventions to reduce the disease burden in this vulnerable population.

Methods

Data source and study population

This study utilized data from the GBD 2021 database to assess the global, regional, and national burden of AC in women from 1992 to 2021. The GBD 2021 study is a systematic analysis that provides comprehensive estimates of incidence, prevalence, years lived with disability (YLDs), disability-adjusted life years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries[9,10].

It spans 204 countries and territories, 21 geographic regions, and 5 Socio-Demographic Index (SDI) regions. Data sources include civil registration systems, hospital and clinical records, household surveys, and other population-based datasets. Advanced modeling techniques, such as the DisMod-MR 2.1 model, are employed to ensure consistent and comparable estimates across locations, age groups, and time. Additionally, the GBD estimation framework utilizes a hierarchical Bayesian model, which allows for the simultaneous estimation of global, regional, and national burden while ensuring internal consistency across all levels[11,12]. This study focuses on AC in women, defined by the International Classification of Diseases, 10th Revision (ICD-10), code K70.3. Estimates for age-standardized incidence rates (ASIR), age-standardized mortality rates (ASMR), and disability-adjusted life years (ASDR) were obtained from the Global Health Data Exchange (GHDx) platform. All data acquisition and analysis adhered to the standardized protocols established by the GBD study.

Trend analysis and statistical methods

To assess temporal trends, we calculated the estimated annual percentage change (EAPC) for ASIR, ASMR, and ASDR using a linear regression model on the natural logarithm of the rates, with 95% confidence intervals (CIs) for each estimate[13]. All rates were age-standardized to ensure comparability across populations with different age distributions. In addition to age-standardized rates, the following age groups were also defined: "<5 years," "5–9 years," "10–14 years," "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," "75–79 years," "80–84 years," "85–89 years," "90–94 years," and "95 + years." This stratification allowed for a detailed analysis of age-specific patterns in the burden of AC. Countries and territories were stratified into five SDI quintiles—Low, Low-Middle, Middle, High-Middle, and High—based on indicators of income, education, and fertility[14]. For each SDI group, we calculated ASIR, ASMR, and ASDR to examine differences in the burden of AC across development levels. Potential biases arising from incomplete data in lower-SDI regions were mitigated by the GBD database itself, which employs advanced statistical modeling techniques (e.g., DisMod-MR 2.1) to estimate missing data and adjust for underreporting.

Future projections and predictive

Future projections of AC burden up to 2030 were generated using the Nordpred model, which utilizes data from 1992 to 2021 to predict future trends for women. This model, commonly used in cancer epidemiology, incorporates age-period-cohort analysis to estimate future incidence and mortality rates based on historical data and demographic changes[15,16]. The Nordpred model was chosen for its robust implementation of the APC framework, which accounts for age-specific risks and demographic transitions[17]. The Nordpred model follows a frequentist framework and does not incorporate Bayesian methods. Instead, it employs maximum likelihood estimation to fit APC parameters, and predictions are derived through trend continuation under the assumption that recent patterns will persist into the forecast period[18]. This method provides interpretable and stable projections, aligning with long-term public health planning needs. All data analyses were conducted using the GBD Results Tool and R software (version 4.3.2), ensuring precision and reproducibility of the findings.

Result

Alcohol-related cirrhosis burden in women: incidence, mortality, and disability-adjusted life years, 1992–2021

Alcohol-related cirrhosis incidence burden in women

As shown in Fig. 1A, the ASIR of AC in Women exhibited a slight decline from 1992 to 2021. Globally, the ASIR decreased from 3.10 per 100,000 (95% UI: 2.48–3.75) in 1992 to 2.42 per 100,000 (95% UI: 1.91–2.90) in 2021,

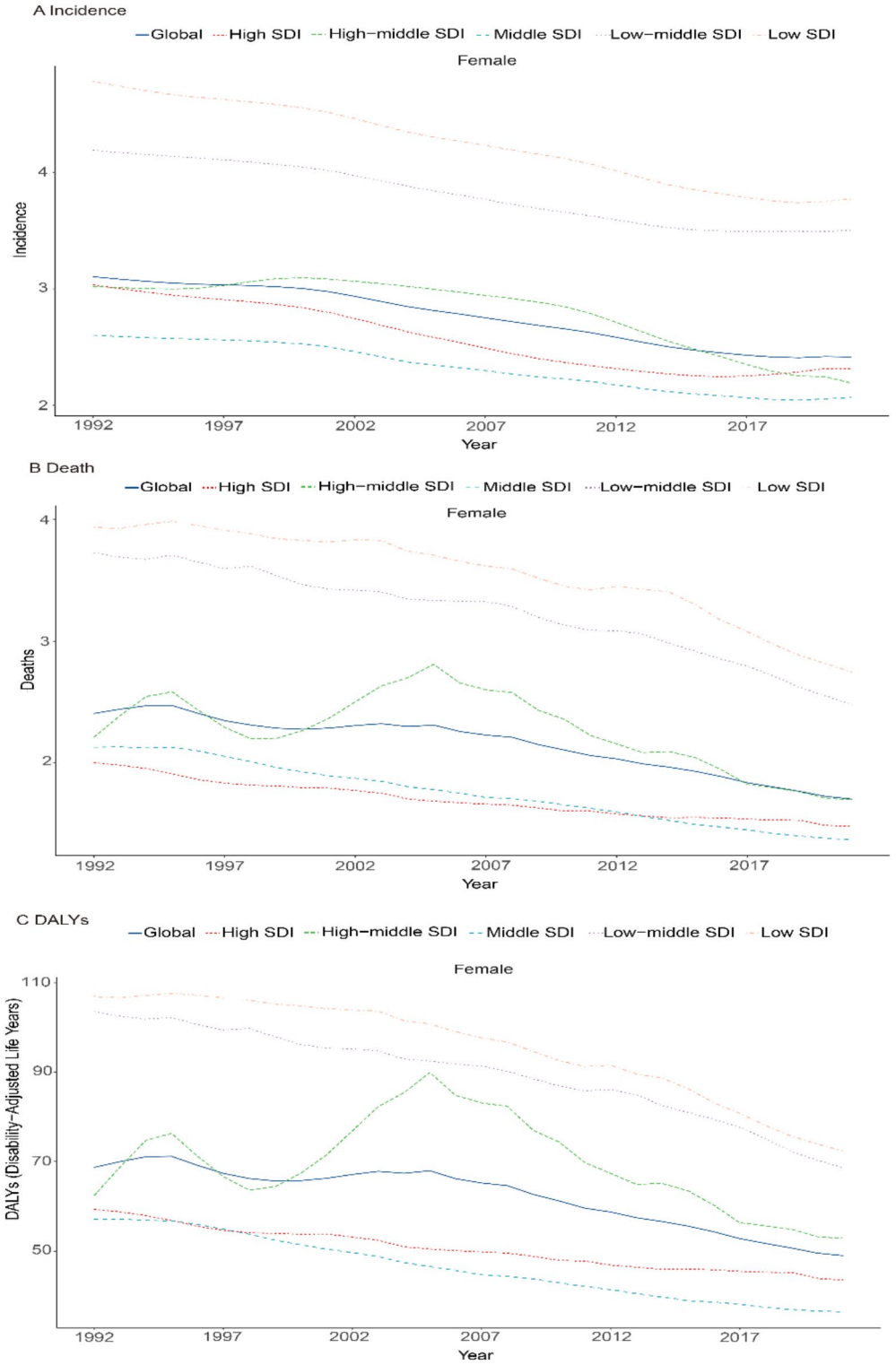

Fig. 1. Global Trends in Age-Standardized Incidence, Mortality, and DALYs of Alcohol-Related Cirrhosis in Women by SDI Level, 1992–2021.

with an EAPC of −1.02 (95% CI: −1.08 to −0.95)(Table 1). Among the five SDI regions, the ASIR was highest in Low SDI regions at 3.77 per 100,000 (95% UI: 2.88–4.81) in 2021, while Middle SDI regions had the lowest ASIR at 2.07 per 100,000 (95% UI: 1.65–2.48) (Fig. 1A). High SDI regions showed the greatest decline in incidence, with an EAPC of −1.18 (95% CI: −1.30–1.06) (Table 1).

At the regional level, Central Asia reported the highest ASIR in 2021, at 11.50 per 100,000 (95% UI: 8.63–14.52), while East Asia had the lowest, at 0.34 per 100,000 (95% UI: 0.26–0.42). Eastern Europe exhibited the largest positive trend, with an EAPC of 1.49 (95% CI: 0.93–2.05), while Central Latin America showed the steepest decline, with an EAPC of −2.02 (95% CI: −2.19 to −1.85) (Table 1). At the country level, Mongolia recorded the highest ASIR in 2021 at 21.85 per 100,000 (95% UI: 16.11–27.40), whereas Kuwait had the lowest rate at 0.18 per 100,000 (95% UI: 0.12–0.27) (Fig. 2A).

Alcohol-related cirrhosis mortality burden in women

As shown in Fig. 1B, the global ASMR for AC in Women exhibited a noticeable decline from 1992 to 2021. Globally, the ASMR decreased from 2.41 per 100,000 (95% UI: 1.96–2.96) in 1992 to 1.70 per 100,000 (95% UI: 1.36–2.09) in 2021, with an EAPC of −1.22 (95% CI: −1.37–1.08)**(Supplement Table 1)**. Among the five SDI regions, Low SDI had the highest ASMR in 2021, at 2.75 per 100,000 (95% UI: 1.91–3.67), while Middle SDI had the lowest ASMR at 1.37 per 100,000 (95% UI: 1.08–1.66)(Fig. 1 B). The region with the greatest change in mortality rate was the Middle SDI, with an EAPC of −1.64 (95% CI: −1.68–1.59)**(Supplement Table 1)**.

In 2021, the region with the highest ASMR for AC in Women was Central Asia, with a rate of 6.57 per 100,000 (95% UI: 4.76–8.54). The lowest ASMR was observed in East Asia, with 0.17 per 100,000 (95% UI: 0.12–0.22). Eastern Europe had the largest positive EAPC in ASMR at 1.95 (95% CI: 1.02–2.89), while East Asia showed the largest negative EAPC, at −3.25 (95% CI: −3.42 to −3.08)**(Supplement Table 1)**. In 2021, the country with the highest ASMR for AC in Women was Mongolia, with a rate of 12.97 per 100,000 (95% UI: 10.12–16.45), while the country with the lowest ASMR was Kuwait, at 0.08 per 100,000 (95% UI: 0.06–0.10)(Fig. 2) .

location	Incidence per 100 000 population (95%UI)		EAPC (95%CI)
	1992	2021	1992–2021
Global	3.1(2.48–3.75)	2.42(1.91–2.9)	−1.02(−1.08–−0.95)
SDI			
Low SDI	4.78(3.62–6.07)	3.77(2.88–4.81)	−0.93(−0.98–−0.89)
Low-middle SDI	4.19(3.28–5.18)	3.5(2.78–4.29)	−0.76(−0.81–−0.71)
Middle SDI	2.6(2.07–3.14)	2.07(1.65–2.48)	−0.98(−1.04–−0.92)
High-middle SDI	3.02(2.46–3.57)	2.19(1.77–2.61)	−1.14(−1.37–−0.91)
High SDI	3.03(2.48–3.6)	2.32(1.85–2.77)	−1.18(−1.30–−1.06)
Regions			
Andean Latin America	7.52(5.35–9.60)	6.34(4.45–8.21)	−0.51(−0.57–−0.44)
Australasia	0.43(0.30–0.57)	0.37(0.26–0.49)	−0.29(−0.47–−0.11)
Caribbean	5.07(3.76–6.33)	4.19(3.11–5.26)	−0.75(−0.91–−0.60)
Central Asia	8.23(6.06–10.40)	11.50(8.63–14.52)	**1.11(0.79–1.42)**
Central Europe	5.53(4.49–6.58)	4.30(3.52–5.15)	−1.00(−1.10–−0.91)
Central Latin America	6.43(5.14–7.71)	3.96(3.09–4.78)	−2.02(−2.19–−1.85)
Central Sub-Saharan Africa	3.07(2.05–4.21)	2.66(1.78–3.66)	−0.59(−0.63–−0.55)
East Asia	0.52(0.39–0.66)	0.34(0.26–0.42)	−1.61(−1.72–−1.50)
Eastern Europe	4.48(3.55–5.39)	6.76(5.39–8.15)	**1.49(0.93–2.05)**
Eastern Sub-Saharan Africa	6.07(4.43–7.89)	4.34(3.18–5.61)	−1.31(−1.37–−1.25)
High-income Asia Pacific	3.03(2.43–3.66)	1.89(1.52–2.26)	−1.72(−1.87–−1.56)
High-income North America	2.49(1.97–3.00)	2.72(2.13–3.30)	−0.24(−0.54–0.07)
North Africa and Middle East	0.77(0.49–1.11)	0.55(0.35–0.78)	−1.13(−1.17–−1.08)
Oceania	0.72(0.47–1.03)	0.63(0.41–0.90)	−0.48(−0.52–−0.44)
South Asia	4.34(3.39–5.30)	3.54(2.82–4.27)	−0.86(−0.91–−0.80)
Southeast Asia	4.08(3.09–5.19)	3.32(2.57–4.20)	−0.92(−1.01–−0.82)
Southern Latin America	2.64(1.82–3.51)	2.07(1.40–2.79)	−0.71(−0.81–−0.62)
Southern Sub-Saharan Africa	1.90(1.45–2.39)	1.48(1.15–1.87)	−0.92(−1.12–−0.71)
Tropical Latin America	4.60(3.86–5.39)	2.91(2.40–3.45)	−1.70(−1.82–−1.58)
Western Europe	4.24(3.45–5.03)	2.52(2.01–3.04)	−1.92(−1.98–−1.87)
Western Sub-Saharan Africa	4.42(3.31–5.66)	3.54(2.67–4.52)	−0.87(−0.92–−0.83)

Table 1. Global and regional Age-Standardized incidence rates (ASIR) and estimated annual percentage change (EAPC) of Alcohol-Related cirrhosis in women, 1992–2021.

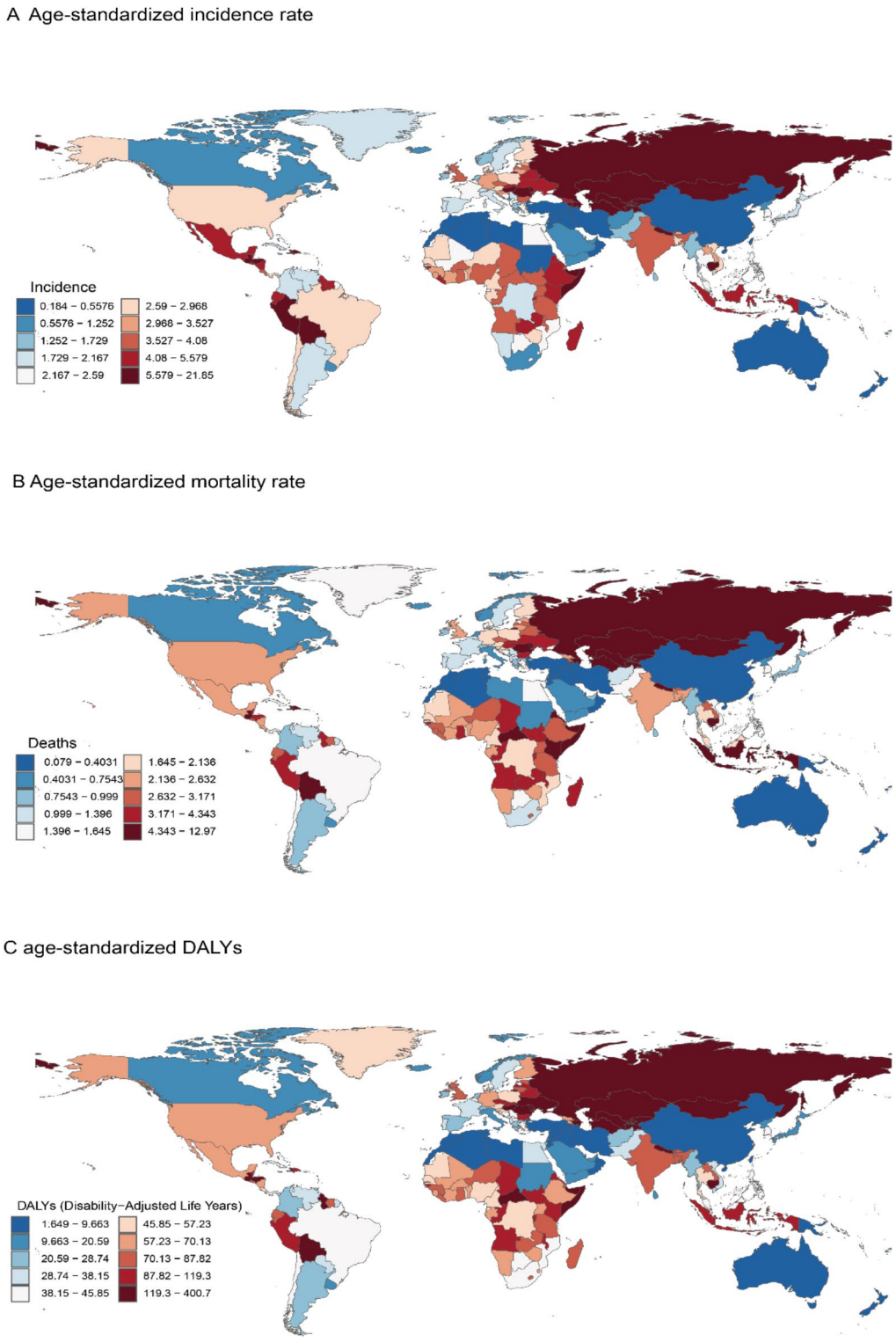

Fig. 2. Global Distribution of Age-Standardized Incidence, Mortality, and DALYs of Alcohol-Related Cirrhosis in Women by Country in 2021.

Alcohol-related cirrhosis dalys burden in women

As shown in Fig. 1C, the global age-standardized DALYs rate for AC in women consistently decreased from 1992 to 2021. Globally, the DALYs rate fell from 68.7 per 100,000 (95% UI: 55.7–83.05) in 1992 to 48.98 per 100,000 (95% UI: 39.29–60.51) in 2021, with an EAPC of −1.22 (95% CI:−1.40–1.05)**(Supplement Table 2)**. Among the five SDI regions, Low SDI had the highest DALYs rate in 2021, at 72.37 per 100,000 (95% UI: 51.18–97.25), while Middle SDI exhibited the lowest DALYs rate at 36.43 per 100,000 (95% UI: 28.65–44.51)

(Fig. 1C). The region with the greatest change in DALYs rate was the Middle SDI, with an EAPC of −1.72 (95% CI: −1.77–1.67)**(Supplement Table 2)**.

In 2021, the region with the highest age-standardized DALYs rate for AC in Women was Eastern Europe, with a rate of 204.03 per 100,000 (95% UI: 166.58–246.24). The lowest DALYs rate was observed in East Asia, with 3.97 per 100,000 (95% UI: 2.89–5.40). Eastern Europe also exhibited the greatest positive EAPC in DALYs rate at 2.38 (95% CI: 1.31–3.47), while East Asia had the largest negative EAPC, at −3.48 (95% CI: −3.66 to −3.29)**(Supplement Table 2)**. In 2021, the country with the highest age-standardized DALYs rate for AC in Women was Mongolia, with a rate of 400.7 per 100,000 (95% UI: 305.6–512.1). The country with the lowest DALYs rate was Kuwait, at 1.65 per 100,000 (95% UI: 1.21–2.20)(Fig. 2C).

Age distribution of alcohol-related cirrhosis in women

As shown in Fig. 3A, the global incidence rate of AC in women in 2021 followed a clear age-dependent pattern. Incidence was negligible in women under 15 years of age and remained extremely low at 0.0037 per 100,000 (95% UI: 0.0007–0.0108) among those aged 15–19 years. Incidence began to rise in women aged 20–24 years, reaching 0.04 per 100,000 (95% UI: 0.02–0.10), and increased steadily with age. By 40–44 years, the incidence had risen to 2.20 per 100,000 (95% UI: 1.32–3.46), and it reached 7.99 per 100,000 (95% UI: 4.89–11.84) in women aged 55–59 years. The highest incidence was recorded in women aged 95 + years, with a rate of 22.46 per 100,000 (95% UI: 11.55–36.87). These findings highlight the rising vulnerability of older women to AC.

As shown in Fig. 3B, AC mortality in women in 2021 followed a similar age-related trend, with minimal mortality in younger women. Among women aged 15–19 years, the mortality rate was only 0.0030 per 100,000 (95% UI: 0.0008–0.0074), rising gradually to 0.04 per 100,000 (95% UI: 0.02–0.06) in women aged 20–24 years. A sharper increase was observed from the 30–34 age group, with a mortality rate of 0.29 per 100,000 (95% UI: 0.19–0.41). Mortality rose substantially in women aged 55–59 years, reaching 5.08 per 100,000 (95% UI: 3.45–7.11). The highest mortality rate was observed in women aged 95 + years, at 14.17 per 100,000 (95% UI: 8.03–22.57). These figures highlight the elevated mortality risk associated with AC in older age groups.

As shown in Fig. 3C, the DALYs burden of AC in women in 2021 also demonstrated a pronounced age-related increase. Among women aged 15–19 years, the DALYs rate was minimal at 0.22 per 100,000 (95% UI: 0.06–0.56) but increased notably in women aged 20–24 years to 2.47 per 100,000 (95% UI: 1.31–4.42). A sharp increase was observed in the 30–34 age group, with a DALYs rate of 16.93 per 100,000 (95% UI: 10.98–23.88). The burden peaked in women aged 55–59 years, reaching 171.88 per 100,000 (95% UI: 116.68–240.45). Although the DALYs rate declined slightly in older age groups, it remained elevated, with women aged 95 + years showing a rate of 116.56 per 100,000 (95% UI: 66.53–185.61). This pattern underscores the significant health burden of AC in mid-to-late adulthood, with older women experiencing a disproportionately high impact.

Incidence, mortality, and dalys of Alcohol-Related cirrhosis in women in relation to SDI (2021)

As illustrated in Fig. 4A, the ASIR of AC in women showed a significant negative correlation with the SDI (r = −0.3055, p = 9.776e-06). Countries and territories with lower SDI values generally exhibited higher incidence rates. Notably, Mongolia, Republic of Moldova, Uzbekistan, Azerbaijan, and Turkmenistan reported ASIRs exceeding 10 per 100,000.

As shown in Fig. 4B, the ASMR of AC in women also demonstrated a significant negative correlation with the SDI (r = −0.4097, p = 1.652e-09). Lower SDI regions generally experienced higher mortality rates, with Turkmenistan, Cambodia, Indonesia, the Russian Federation, and Guatemala reporting ASMRs above 5 per 100,000.

As depicted in Fig. 4C, the DALYs rate for AC in women exhibited a significant negative correlation with the SDI (r = −0.3661, p = 9.022e-08). Countries and territories with lower SDI values typically had higher DALYs rates. Several regions, including Mongolia, Turkmenistan, Kazakhstan, the Russian Federation, and Haiti, reported DALYs rates exceeding 200 per 100,000.

Prediction analysis

These projections, as shown in Fig. 5, indicate a continued reduction in the global burden of AC in women, with consistent decreases across key metrics. By 2030, the global ASIR of AC in women is projected to decrease to 2.23 per 100,000, compared to 2.42 per 100,000 in 2021. Similarly, the global ASMR is expected to decline from 1.70 per 100,000 in 2021 to 1.44 per 100,000 by 2030. The age-standardized DALYs rate is forecasted to drop from 48.98 per 100,000 in 2021 to 41.18 per 100,000 by 2030.

Discussion

Our analysis of global trends in AC among women from 1992 to 2021 reveals significant variability in disease burden across regions and SDI groups. Over 30 years, the global ASIR of AC in Women showed a slight decline, with notable differences across SDI levels. The global ASIR decreased from 3.10 per 100,000 in 1992 to 2.42 per 100,000 in 2021, reflecting an EAPC of −1.02. However, this decline was not consistent across regions. High-SDI regions saw the greatest reductions in incidence, mortality, and DALYs, likely due to advanced healthcare systems and stricter alcohol control policies. Interventions like alcohol taxation and minimum unit pricing, implemented in countries such as Scotland, have proven effective in reducing alcohol consumption and related deaths, particularly from liver disease[19,20]. The World Health Organization's "best buys" for alcohol policy, including taxation and availability restrictions, have also reduced alcohol-related harm in countries like the Baltic states, further supporting the effectiveness of these measures[21]. In contrast, lower-SDI regions, especially low and low-middle SDI countries, saw a slower decline or stagnation in rates. These regions remain disproportionately affected, with consistently higher DALYs (90–110 per 100,000), ASIR (3–4 per 100,000), and

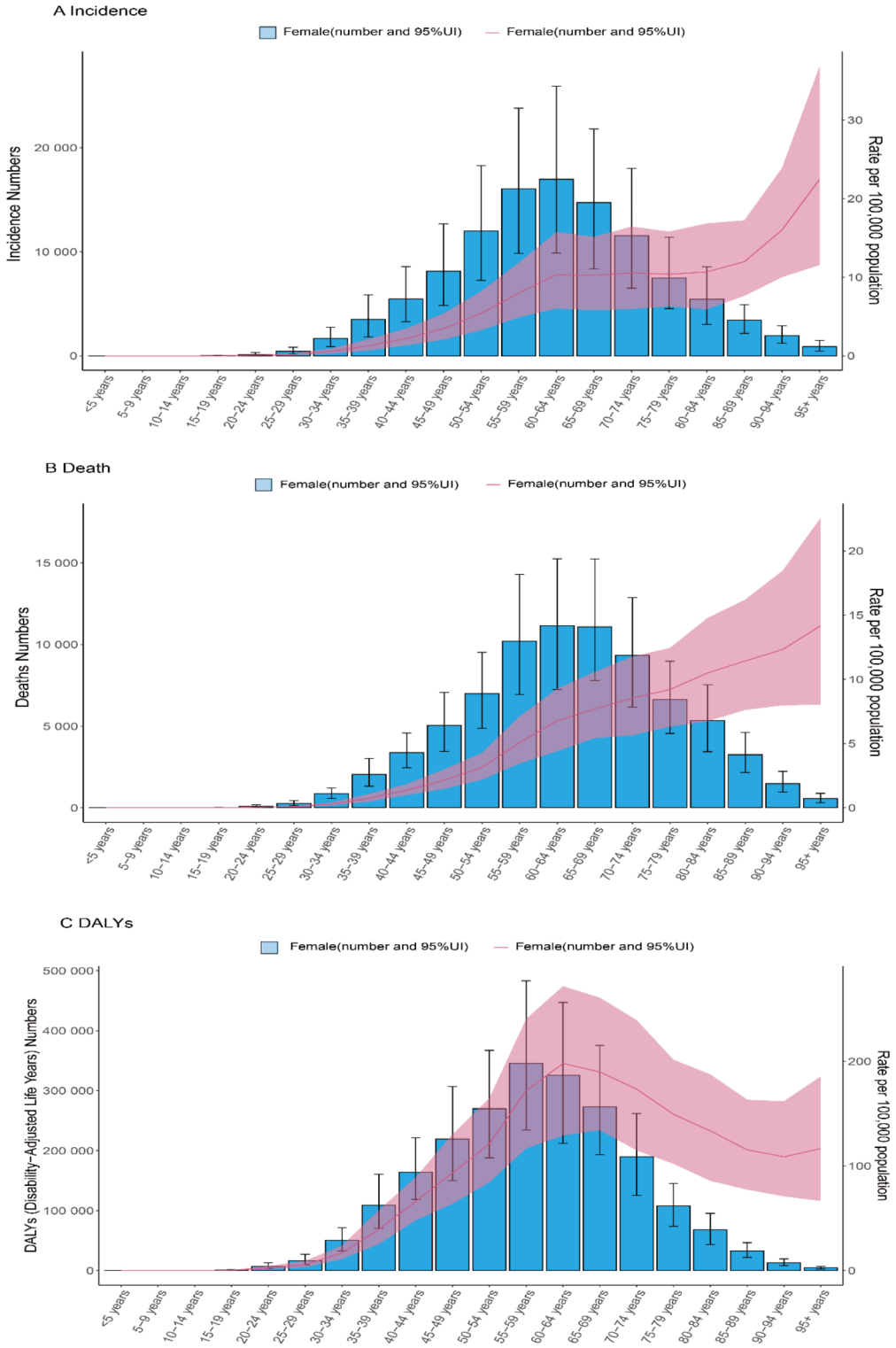

Fig. 3. Age-Specific Incidence, Mortality, and DALYs of Alcohol-Related Cirrhosis in Women in 2021.

ASMR (around 3–4 per 100,000). These findings highlight the persistent challenges in managing AC in low-SDI regions, where limited healthcare infrastructure and insufficient public health interventions perpetuate the disease burden.

The overall global decline in AC incidence, mortality, and DALYs among women conceals pronounced disparities between regions and countries. Central Asia remains a significant concern, reporting the highest ASIR in 2021 at 11.50 per 100,000, alongside the highest ASMR at 6.57 per 100,000, and the second-highest DALYs at 184.65 per 100,000. This substantial burden is also reflected in individual countries such as Mongolia,

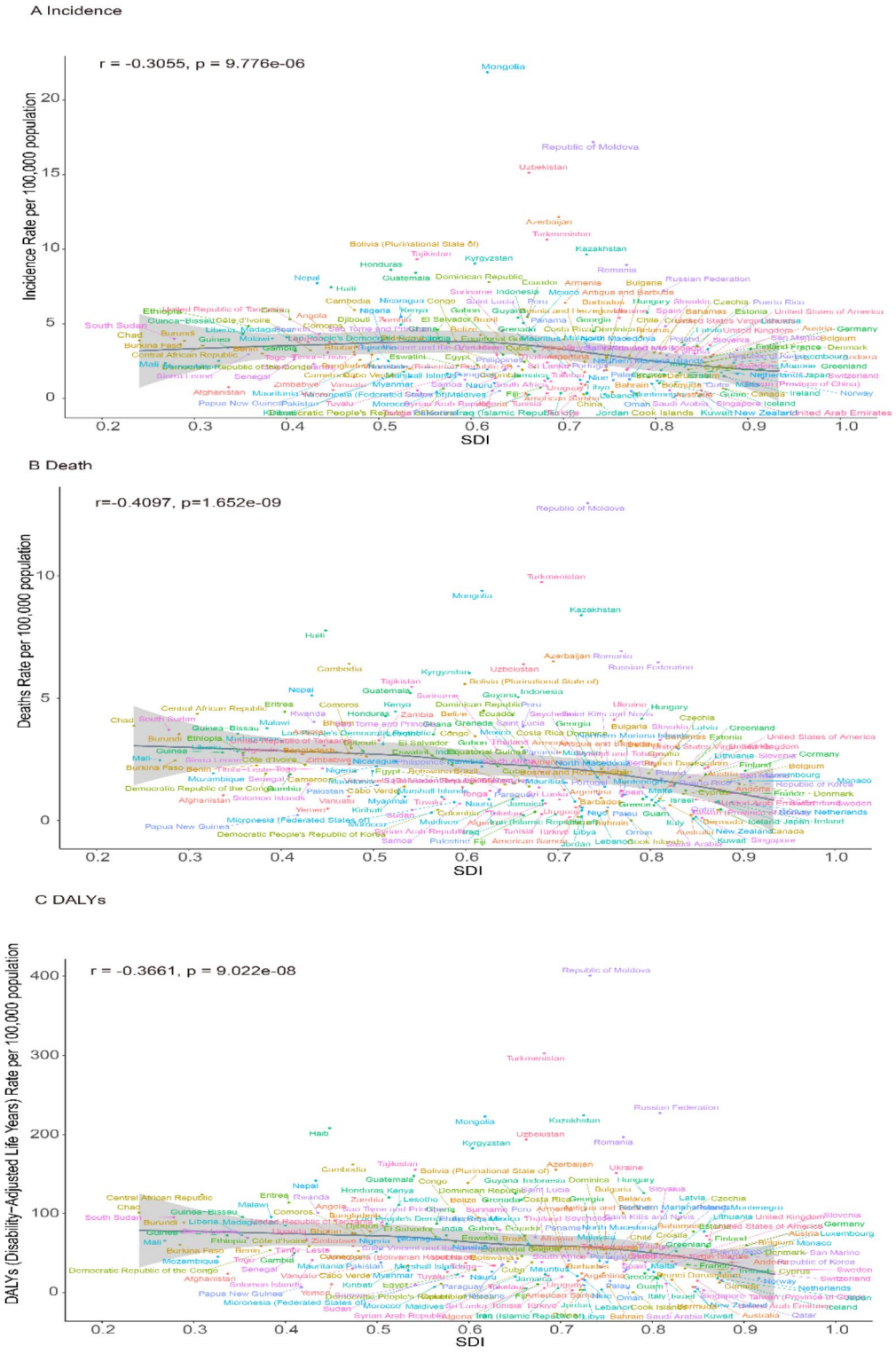

Fig. 4. Correlation Between Socio-Demographic Index (SDI) and Age-Standardized Incidence, Mortality, and DALYs of Alcohol-Related Cirrhosis in Women Across Countries in 2021.

where the ASIR reached 21.85 per 100,000 in 2021. The high burden in Mongolia is driven by a combination of socio-economic challenges, cultural norms, and insufficient regulatory oversight[22]. Economic instability and high poverty rates have contributed to excessive alcohol consumption, particularly among vulnerable populations[23]. Moreover, alcohol is deeply embedded in Mongolian culture, often consumed during social gatherings and celebrations, further normalizing its use[24]. Weak regulatory frameworks and enforcement, along with the alcohol industry's influence on public health policies, have exacerbated the issue, leading to significant

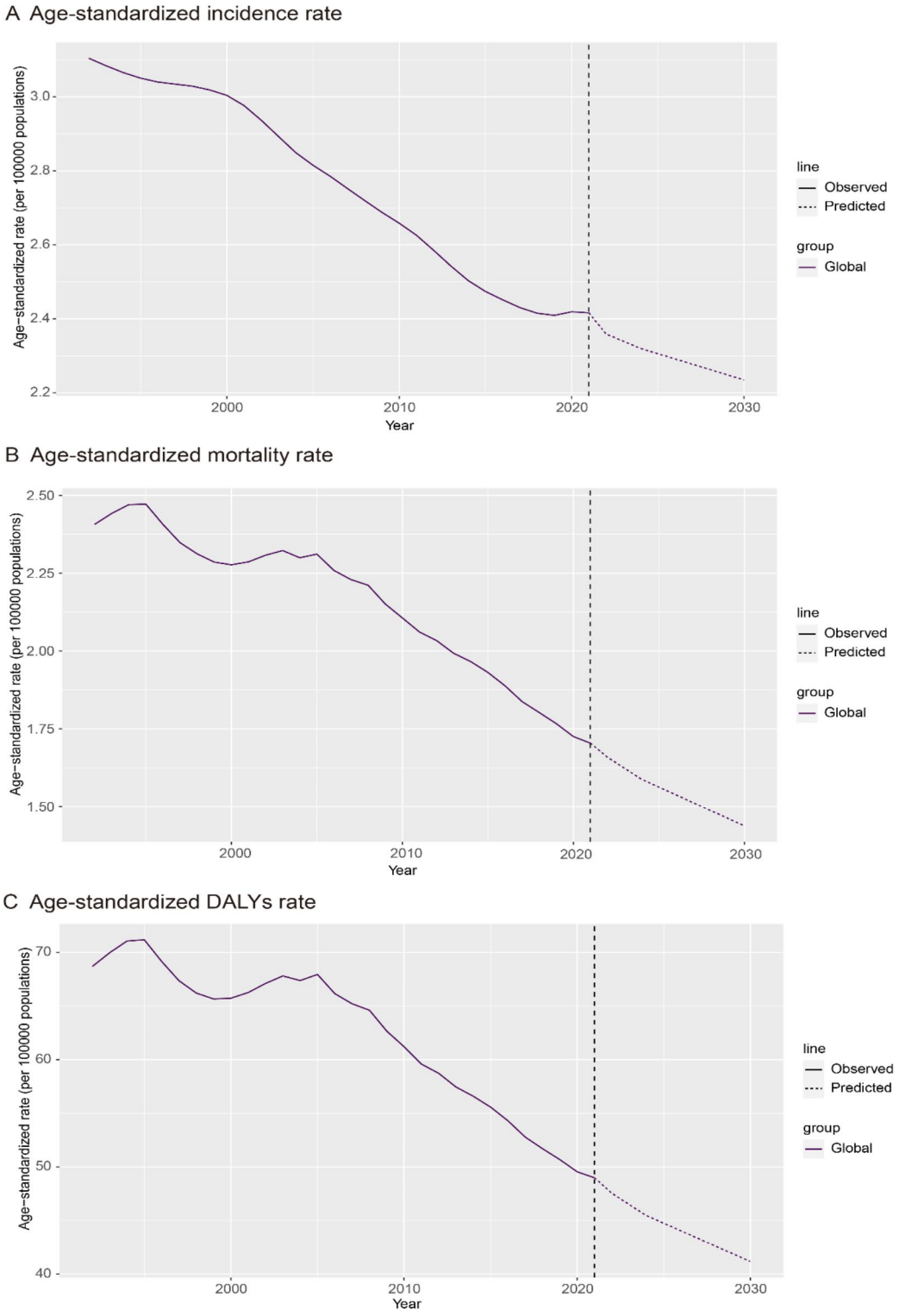

Fig. 5. Global Age-Standardized Incidence, Mortality, and DALYs of Alcohol-related Liver Disease in Women: Trends and Predictions, 1990–2030.

health and social consequences[25,26]. In contrast, Kuwait's ASIR in 2021 was just 0.18 per 100,000, largely due to strict Islamic laws prohibiting the production, sale, and consumption of alcohol, deeply rooted in the country's cultural and religious norms[27,28]. These national differences underscore the pivotal role that cultural practices and public health policies play in shaping the burden of disease.

The analysis of AC reveals both an age-dependent pattern and significant gender differences. Women are biologically more vulnerable to alcohol-induced liver damage than men due to lower gastric alcohol

dehydrogenase activity, resulting in higher blood alcohol levels after consumption[30–32]. Hormonal factors, particularly estrogen, exacerbate liver inflammation and increase susceptibility to damage[32]. This vulnerability becomes more pronounced with age, especially post-menopause, when protective hormonal effects decline[33]. Younger women experience low rates of AC, but the risk accelerates significantly in middle-aged and older women due to the cumulative effects of long-term alcohol consumption[34,36]. The gender-specific burden is also evident in years of life lost, as women tend to experience more severe health impacts from alcohol at lower consumption levels than men. These findings highlight the need for public health interventions targeting alcohol use reduction in midlife, while also addressing the unique physiological risks women face to prevent severe AC in older age.

The findings show a negative correlation between the burden of AC in Women and the SDI, with lower-SDI countries disproportionately affected. These observations align with previous research, which shows that lower-SDI regions bear a higher burden of liver cirrhosis, including alcohol-related cases[3,36]. This disparity stems from a complex interplay of cultural, healthcare, and socioeconomic factors that heighten vulnerability to the disease. Poverty, a predominant challenge in lower-SDI regions, restricts access to essential health education, preventive measures, and timely healthcare services, increasing the susceptibility to and severity of alcohol-related liver damage[37,38]. Limited healthcare infrastructure further exacerbates this burden, as inadequate medical resources and a lack of trained professionals delay early detection and effective management of AC[39]. Additionally, cultural norms in some lower-SDI regions may normalize or even encourage alcohol consumption, particularly in social or community settings, increasing exposure to long-term risks[40].

Projections from this study suggest a slight decrease in the global burden of AC in Women between 2021 and 2030. Forecasts indicate that ASIR, ASMR, and DALYs will experience modest reductions, signaling a gradual decline in the disease burden. Nonetheless, AC will continue to pose a significant global health challenge for women. Effective public health measures, such as reducing alcohol consumption, raising awareness about associated risks, and improving access to treatment for alcohol use disorders, remain essential. Moreover, policies that limit alcohol availability and enhance educational efforts aimed at high-risk populations will be crucial in further reducing the disease burden. In regions facing a higher burden, tailored interventions will be vital to mitigating the impact of AC among women.

Limitations

This study has several limitations. First, although the GBD database is comprehensive, it may underreport AC in lower-SDI regions due to data gaps and inconsistencies. Second, the Nordpred model used for future projections assumes that historical trends will continue, potentially overlooking unforeseen changes in alcohol policies or healthcare access. Finally, the study does not fully explore gender-specific factors, such as hormonal differences or cultural influences, which could influence disease progression.

Conclusion

The burden of AC in women remains a significant global health challenge. While some regions have seen improvements, others, particularly lower-SDI countries, continue to experience rising incidence and mortality rates. Gender-specific vulnerabilities to alcohol highlight the need for targeted public health interventions, particularly for older women and those in regions with high alcohol consumption. Tailored strategies that address both alcohol consumption and healthcare infrastructure are critical to reducing the future burden of this preventable disease.

Data availability

The data can be obtained from a public, open-access database. Information regarding data access policies and procedures can be found at https://ghdx.healthdata.org/gbd-2021.

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Author contributions

ZZ contributed to the conceptualization, methodology, software, formal analysis, and writing of the original draft. CMX contributed to the methodology, data collection, formal analysis, and reviewing and editing. WC contributed to the software, data analysis, and visualization. KTY contributed to project administration, super-

vision, and reviewing and editing. TS contributed to data curation, validation, formal analysis, and reviewing and editing. JHW contributed to the conceptualization, supervision, project administration, and reviewing and editing.

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The authors declare no competing interests.

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