

ORIGINAL ARTICLE

Disease burden of depressive disorders in China and global populations (1990–2021): Comparative trend analysis and future projections

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ABSTRACT

Objectives: Understanding China's burden of depressive disorders in the context of global trends is essential for guiding mental health policy. This study sought to evaluate the evolving trajectories of depressive disorders in China over an extended period, while concurrently examining their alignment with—and divergence from—global epidemiological trends through 2050. **Methods:** Data from the Global Burden of Disease Study were used to estimate age-standardized incidence, prevalence, and disability adjusted life years (DALYs) rates for depressive disorders in China and globally from 1990 to 2021, stratified by sex and age. Temporal trends were evaluated using estimated annual percentage changes. Projections from 2022 to 2050 were generated using a Bayesian age-period-cohort model with population forecasts. **Results:** In 2021, China exhibited lower incidence, prevalence, and DALY rates for depressive disorders relative to global average levels. Females consistently experienced a higher burden across all age groups. From 1990 to 2021, China showed a declining burden, particularly among individuals aged 10–54 years. However, increasing trends were observed among children under 10 and adults aged 55 years and older. Globally, the burden remained stable overall but increased among adolescents and older adults. Projections suggest that China's burden will continue to decline, while the global burden is expected to rise markedly. **Conclusions:** While China has advanced in alleviating depressive disorders, rising trends in younger/older demographics demand urgent action. Globally, depression poses a growing public health challenge. Age/gender-sensitive mental health policies are crucial for mitigating future burdens and disparities.

Keywords: depressive disorders, disease burden, China, global health

INTRODUCTION

Depressive disorders are prevalent and serious mental health disorders, characterized by persistent low mood, diminished interest, impaired cognitive function, and a range of physical symptoms, including sleep and appetite disturbances (GBD 2019 Mental Disorders Collaborators, 2022; Çökmüş *et al.*, 2021; Maier *et al.*, 2021). As one of the most burdensome mental disorders

worldwide, it constitutes a significant percentage of the disease burden among mental disorders (Pearce *et al.*, 2022; Hu *et al.*, 2023). Evidence indicates that depressive disorders significantly reduce quality of life, increase the risk of chronic physical conditions, and are a leading contributor to suicidal behavior, imposing a substantial burden on families, communities, and healthcare systems (Hu *et al.*, 2023; Pearce *et al.*, 2022; Adriani *et al.*, 2024). Currently, depressive disorders rank among the

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top three leading causes of non-fatal health loss worldwide (Adriani *et al.*, 2024; Corral *et al.*, 2022; Proudman *et al.*, 2021). An estimated 350 million individuals are affected annually, and this figure continues to rise (Smith, 2014). By 2030, depressive disorders are projected to become the primary cause of global disease burden (GBD 2019 Mental Disorders Collaborators, 2022; Malhi & Mann, 2018; Smith, 2014). In the Chinese context, as of 2025, approximately 95 to 100 million people are estimated to be living with depressive disorders, accounting for nearly one-third of global cases, according to estimates from the World Health Organization (Ren *et al.*, 2020; Wang *et al.*, 2025). This underscores the urgent need for a comprehensive assessment of the burden of depressive disorders.

Current research on the disease burden of depressive disorders has explored various aspects, including quantitative estimations of disease burden, comorbidity examinations (e.g., with anxiety or chronic diseases), and identification of key social and environmental determinants, such as socioeconomic status, gender inequality, and urbanization (GBD 2019 Mental Disorders Collaborators, 2022; Wang *et al.*, 2025). Most of these investigations focus on global, regional, and national scales, or specific subpopulations. In China, a growing body of research has highlighted the rising recognition of mental health issues and the substantial societal impact of depression. However, comparative analyses between China and the global average remain limited, particularly regarding long-term trends and predictive research. Therefore, conducting a comprehensive comparative analysis that not only examines the current burden but also incorporates predictive modeling to project long-term trends of depressive disorders between China and the global context holds significant research importance. Such comparisons can reveal unique epidemiological patterns, inform culturally tailored intervention strategies, and address disparities in mental health resource allocation.

Based on this, this study utilizes data from the Global Burden of Disease 2021 (GBD 2021) to analyze and compare the burden of depressive disorders in China and globally from 1990 to 2021. Furthermore, it projects trends in disease burden from 2022 to 2050. This 32-year continuous observation window further captures pivotal social transitions unique to China, including rapid urbanization, demographic shifts, and sustained mental health impacts following the COVID-19 pandemic from 2020 onward, enabling robust tracking of secular depressive disorder burden trends across national and global populations. By 2050, China will face severe population aging, which will substantially elevate depressive disorder burden among older adults due to chronic comorbidities, social isolation, and insufficient elderly mental healthcare. Meanwhile, adolescent

depressive burden will remain a persistent crisis over the next three decades. Projections to 2050 deliver forward-looking evidence for tiered mental health resource allocation, age-targeted intervention policies, and long-term mental health system planning for both China and other countries worldwide. These findings aim to inform the development of targeted and evidence-based mental health policies.

METHODS

Data source

Data for this study were extracted from the Global Burden of Disease Study 2021 (GBD 2021), which systematically evaluates the disease burden of 369 diseases/injuries and 87 risk factors across 204 countries and territories worldwide (GBD 2021 Diseases and Injuries Collaborators, 2024). The publicly available dataset includes standardized metrics on disease prevalence and burden, allowing for quantification of health impact through frequency-based indicators and disability-adjusted life years (DALYs)—a composite metric reflecting both premature mortality and disability. The use of age-standardized rates (ASRs) enables the control of demographic age structure variations and enhances the comparability of disease burden across regions and over time.

We supplemented step-by-step procedures for extracting GBD 2021 raw datasets, including screening criteria for incidence, prevalence, years lived with disability (YLDs) and DALYs, data cleaning protocols for missing and outlier observations, and standardized cross-population burden aggregation rules aligned with GBD analytical frameworks. By applying "China" and "global" as geographic filters, we compiled depressive disorders-related disease burden data from 1990 to 2021 for comparative analysis.

Indicators

This study accessed the burden of depressive disorders based on three core indicators: incidence, prevalence, and DALYs, stratified by region, sex, age, and year. To evaluate temporal trends, we calculated the Estimated Annual Percentage Change (EAPC) for each age-standardized indicator. EAPC was interpreted as follows: Upward if $EAPC > 0$ & $95\%CI \text{ lower} > 0$; Downward if $EAPC < 0$ & $95\%CI \text{ upper} < 0$; Stable if $95\%CI$ includes 0.

Statistical analysis

Firstly, we described the depressive disorder burden in 2021 across sexes and age groups for both China and global population. Age-standardized rates for specific age brackets were calculated using the direct standardization method. Secondly, we analyzed temporal trends in depressive disorder burden from 1990 to 2021, and

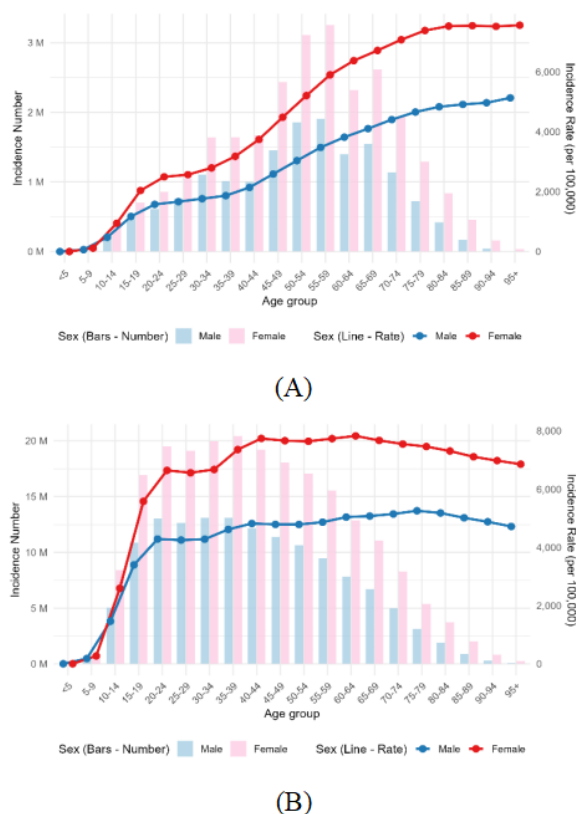


Figure 1. The Incidence of Depressive Disorders in China (A) and Global (B) in 2021

estimated EAPCs for each indicator using least squares linear regression. Finally, projections of the depressive disorder burden from 2020 to 2050 were performed separately for China and the global population, stratified by sex. These projections were based on: the GBD 2017-2100 global population forecasts and the global standard population structure (GBD 2019 Mental Disorders Collaborators, 2022; Malhi & Mann, 2018).

The GBD study employs a standardized set of approximately 20 age groups, covering ages from under 5 years to 95 years and older. To enable equitable comparisons across regions or time periods, it also reports ASRs, which adjust for differences in population age structure using a standard reference population. Age-disaggregated estimates can be accessed via the GBD Results Tool. This systematic classification supports rigorous cross-country and temporal analyses of health burden, free from confounding by age composition.

A Bayesian age-period-cohort (BAPC) model incorporating the Integrated Nested Laplace Approximation (INLA) algorithm was used, which addresses parameter estimation limitations commonly encountered in classical APC models. Weakly informative normal priors were assigned to age, period, and cohort random effects

to avoid over-shrinking long-term secular burden fluctuations. Fixed effect intercepts received flat normal priors with wide variance to preserve data-driven estimation. Markov Chain Monte Carlo (MCMC) sampling was implemented with four independent chains, each running 8,000 iterations with a 2,000-iteration burn-in period to eliminate initial sampling bias. Convergence diagnostic procedures were applied to validate model stability: all model parameters required an R-hat convergence statistic below 1.05; trace plots of each sampling chain were visually inspected to confirm stable, well-mixed distributions without divergent sampling paths. Models failing either convergence criterion were re-run with adjusted prior variances and extended iteration counts until full convergence was achieved.

All statistical analyses were performed using R software (version 4.5.1), with a significance threshold of $P < 0.05$. Core packages included tidyverse for data wrangling and subgroup stratification, brms for BAPC model fitting, ggplot2 for burden trend visualization, and epiR for standardized disease burden rate adjustment. The workflow was streamlined into distinct stages: meticulous raw data import and cleaning, comprehensive national and global pooled aggregation, precise stratified age-sex subgroup calculation, sophisticated BAPC model parameterization, projected burden estimation for 2050, and final visualization output.

RESULTS

Comparison of disease burden levels between China and the global population in 2021

In 2021, the age-standardized incidence rate (ASIR) of depressive disorders in China was 2,345.1 per 100,000 population, substantially lower than the global ASIR of 4,333.6 per 100,000 population. A similar pattern was observed for ASPR and age-standardized DALY rate (ASDR): China's ASPR stood at 2,875.6 cases per 100,000 population, while the global rate reached 4,006.8 cases. China's ASDR was 430.6 per 100,000 population, compared to the global ASDR, which reached to 681.1 per 100,000 population. In both China and the global population, the age-related burden of depressive disorders increased monotonically with age, and females consistently exhibited a higher burden than males across all age groups, as substantiated by both incidence and DALY metrics.

In terms of incidence, the highest number of new cases in China occurred in the 55–59 years age group (Figure 1A). Notably, the highest incidence rate within each sex was observed in individuals aged 95 years and above, with rates of 5,133.2 per 100,000 in males and 7,559.6 per 100,000 in females. In contrast, globally, the

peak number of new cases was observed in the 35–39 years age group (Figure 1B). The highest prevalence rate among males was recorded in the 75–79 years age group (5,258.6 per 100,000), while females peaked in the 60–64 years group (7,829.8 per 100,000).

Regarding prevalence, the age group with the largest number of cases in China was 65–69 years (Figure 2A). Within each sex, the highest prevalence rates occurred among individuals aged 95 years and above, reaching 5,317.1 per 100,000 in males and 7,994.0 per 100,000 in females. Globally, the prevalence peak was observed in the 60–64 years age group (Figure 2B). Among males, the highest rate was also recorded in the 60–64 years group (5,211.2 per 100,000), whereas females reached their peak in the 55–59 years group (7,682.1 per 100,000).

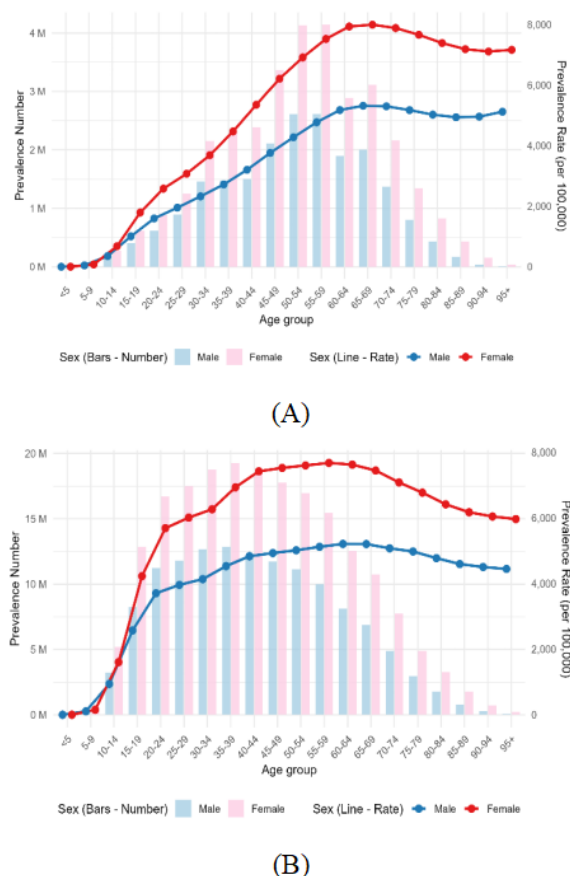


Figure 2. The Prevalence of Depressive Disorders in China (A) and Global (B) in 2021

With respect to disease burden measured by DALYs, in China, the 55–59 years age group had the highest DALY value, which contributed the largest share of total DALYs due to depression. Among males, the highest ASDR was observed in the 70–74 years group (773.2 per 100,000) (Figure 3A), whereas females peaked in the 65–69 years group (1,186.7 per 100,000). Globally,

however, the disease burden peaked earlier, in the 35–39 years age group (Figure 3B). The highest ASDR among males occurred in the 60–64 years group (829.9 per 100,000), and among females in the 55–59 years group (1,248.8 per 100,000).

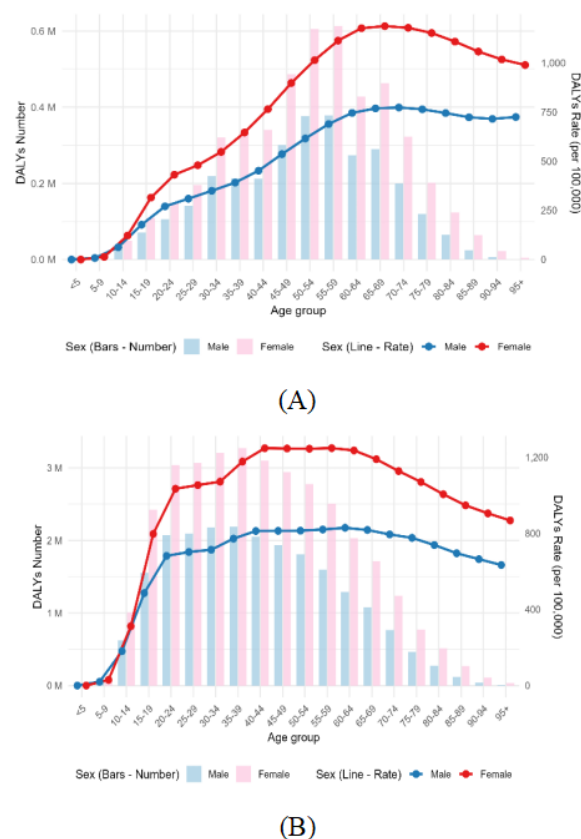


Figure 3. The DALYs of Depressive Disorders in China (A) and Global (B) in 2021. DALYs, Disability-adjusted life years

Comparison of trends in disease burden between China and the global population, 1990–2021

From 1990 to 2021, China's depressive disorder burden showed an overall downward trend, contrasting global stability. Incidence (ASIR) in China declined overall (EAPC = -0.06; 95%CI: -0.23 – 0.12) (Figure 4), with males (EAPC = -0.59; -0.75 – -0.43) slightly exceeding females (EAPC = -0.57; -0.76 – -0.38). Globally, ASIR remained stable (EAPC = -0.53; -0.62 – -0.43) (Figure 5), with minor female decline (EAPC = -0.09; -0.26 – 0.08) and male stability. Prevalence (ASPR) in China decreased significantly (EAPC = -0.44; -0.50 – -0.37), while globally it remained stable (EAPC = -0.03; -0.15 – 0.09), with slight non-significant female decline (EAPC = -0.05; -0.18 – 0.07) and male stability. DALYs (ASDR) in China declined overall (EAPC = -0.53; -0.62 – -0.43), with males (EAPC = -0.55; -0.67 – -0.43) slightly exceeding females (EAPC = -0.53; -0.64 – -0.42).

Globally, ASDR remained stable (EAPC = -0.04; -0.19 – 0.10), with minor female decline (EAPC = -0.07; -0.22 – 0.07) and male stability.

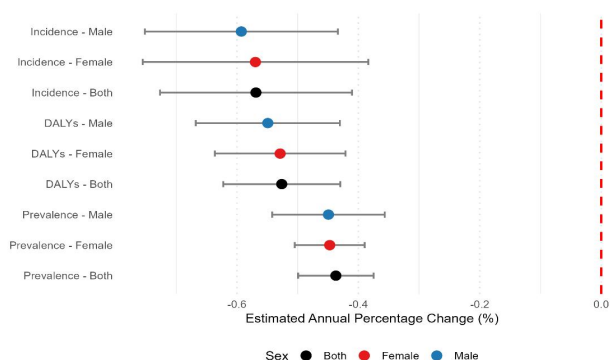


Figure 4. EAPC of Depressive Disorders Burden in China from 1990 to 2021

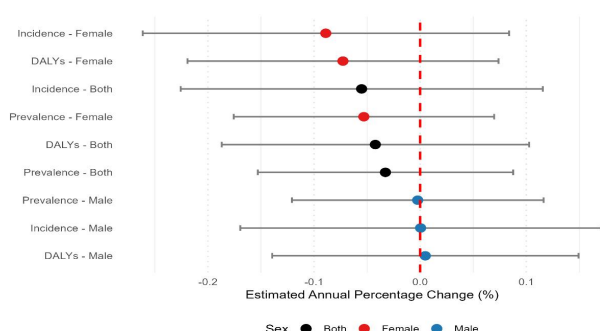


Figure 5. EAPC of Depressive Disorders Burden in Global from 1990 to 2021.

Age-and sex-specific burden of depressive disorders

From 1990 to 2021, age-specific trends in depressive disorder burden showed heterogeneous patterns in China vs globally.

China: Downward trends dominated ages 10–54 (ASIR/ASPR/DALYs), but the burden increased in < 9 and ≥ 55 (Figure 6). The 20–24 age group had the largest reductions, with females showing greater decline than males. Incidence rose in < 9 and ≥ 55 (both sexes), fell in 10–49, and was mixed in 50–54 (males declined, females increased). Prevalence increased in < 9 and ≥ 60, decreased in 15–54. DALYs rose in < 9 and ≥ 55, fell in 15–54.

Global: Burden increased in < 19 and 65–84, decreased in 20–54 and ≥ 85 (Figure 7). The 10–14 age group had the largest increases, with females showing slightly greater rises. Incidence rose in < 19 and 65–84, fell in

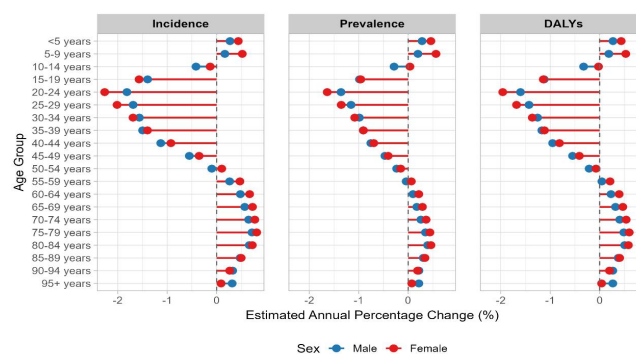


Figure 6. EAPC of Depressive Disorders Burden by Age and Sex in China from 1990 to 2021

20–54 and ≥ 85. Prevalence followed similar age-group trends. DALYs increased in < 19 and 60–84, decreased in 20–54 and ≥ 85.

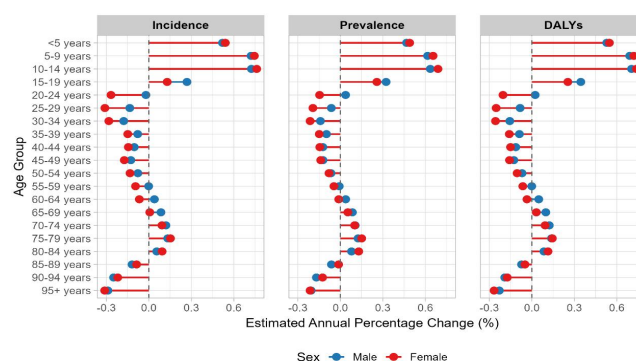


Figure 7. EAPC of Depressive Disorders Burden by Age and Sex in Global from 1990 to 2021

These findings highlight shifting age risks—younger and older populations face growing burden (especially globally), emphasizing the need for age-targeted interventions.

Projected analysis of depressive disorders disease burden in China and globally, 2022–2050

Incidence projections

Model-based projections indicate a continued decline in the age-standardized incidence rate (ASIR) of depressive disorders in China from 2022 to 2050 (Figure 8). Among males, the ASIR is projected to decrease from 1,741.0 per 100,000 in 2022 to 1,493.0 in 2035, and further to 1,411.5 by 2050. A similar downward trend is expected for females, with the ASIR declining from 2,882.7 to 2,361.2 by 2035, and to 1,991.3 by 2050.

In contrast, global projections suggest a substantial rise in incidence rates over the same period. For males, the

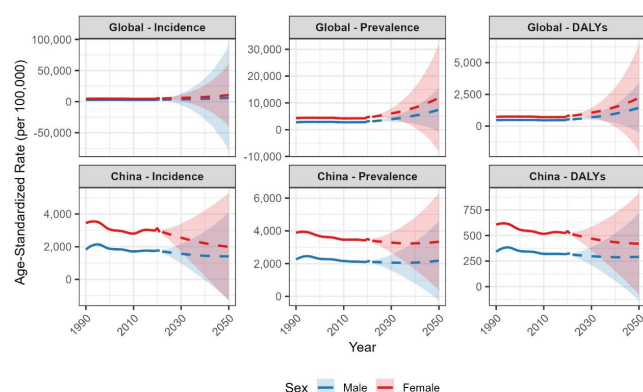


Figure 8. The Projection of Depressive Disorders Burden in China and Global. DALYs, Disability-adjusted life years. (The shaded area represents the range of projected changes)

ASIR is projected to increase from 3,342.8 per 100,000 in 2022 to 4,112.3 in 2035 and to 6,116.9 in 2050. For females, an even steeper increase is anticipated, from 5,250.0 per 100,000 in 2022 to 6,592.4 in 2035, and reaching to 10,642.2 by 2050.

Prevalence projections

The ASPR in China is expected to follow a U-shaped trajectory: declining initially, then rising slightly. Among males, the ASPR is projected to drop from 2,175.5 per 100,000 in 2022 to 2,053.5 by 2035, before rebounding to 2,182.9 by 2050. Among females, the rate is expected to decline from 3,443.3 to 3,242.7 in 2035, then increase modestly to 3,341.1 by 2050.

In contrast, global prevalence is projected to steadily increase throughout the period. For males, the ASPR is estimated to grow from 3,152.8 in 2022 to 4,517.6 by 2035 and to 7,481.6 by 2050. For females, it is expected to rise from 4,765.4 to 7,034.6 in 2035 and further to 11,897.0 by 2050.

DALYs projections

In China, the ASDR for depressive disorders is projected to follow distinct gender-specific trends. Among males, the ASDR is expected to decline slightly from 323.9 per 100,000 in 2022 to 291.3 in 2035, followed by a modest rebound to 292.0 by 2050. In contrast, females are projected to experience a steady and continuous decline, from 518.8 in 2022 to 420.5 by 2050. Globally, however, epidemiological projections indicate a substantial escalation in DALYs linked to depressive disorders across all genders. For males, the ASDR is expected to rise from 534.9 in 2022 to 814.6 by 2035 and to 1,452.0 by 2050. For females, a more dramatic escalation is projected—from 811.7 in 2022 to 1,248.2 in 2035, and to 2,228.0 by 2050.

Overall, the contrasting patterns between China and the global average—particularly the decline in China versus the sharp rise globally—underscore shifting epidemiological dynamics.

DISCUSSION

Lower overall burden in China but persistent gender gaps and age-specific risks

In 2021, China exhibited lower ASIR, ASPR, and ASDR for depressive disorders compared to global averages. In both China and worldwide, females exhibited significantly higher age-standardized rates across all indicators than males, consistent with existing literature (Liu *et al.*, 2024; Ren *et al.*, 2020; Wang *et al.*, 2025). Key contributors may include: (1) women's dual roles in domestic caregiving and professional responsibilities, which heighten their exposure to chronic stress (Jin *et al.*, 2022); (2) cultural under-recognition of female emotional distress, which may delay diagnosis and intervention (Sun *et al.*, 2023); and (3) females exhibit higher utilization of medical services for depressive symptoms due to greater willingness to report emotional distress, while men suppress emotions and avoid treatment, leading to underdiagnosis.

The burden of depressive disorders also demonstrated a strong age gradient. In both China and globally, age-standardized rates increased with advancing age, peaking in older adult populations. This pattern reflects age-related declines in physical health, the growing burden of chronic diseases (Jin *et al.*, 2022), and psychosocial challenges such as retirement, bereavement, and social isolation (Avasthi & Grover, 2018).

Given these findings, older adults and females should be prioritized in mental health policy planning. Implementing routine psychological screening, enhancing access to geriatric mental health services, and providing targeted psychoeducation for high risk populations may improve quality of life while mitigating future disease burden.

Trends in depressive disorders burden, 1990–2021: overall decline in China vs. stability globally

Between 1990 and 2021, the burden of depressive disorders in China demonstrated a modest but consistent downward trend, particularly among individuals aged 10–54. Males experienced a slightly steeper decline than females. Conversely, the global burden remained relatively stable, with minimal changes across most age groups and indicators.

China's downward trajectory likely reflects its rapid socioeconomic transformation. Improvements in living

standards and employment opportunities have reduced key psychosocial stressors such as poverty and insecurity. Moreover, the expansion of public health infrastructure, increased societal awareness of mental health, and stronger family and community-based support systems may have enhanced early detection and treatment accessibility (Avasthi & Grover, 2018; Chandra *et al.*, 2019). However, the rising burden among the youngest (< 9) and oldest (55+) groups suggests a need to recalibrate public health responses to better serve these vulnerable populations.

Gaps in depression burden between China and global averages stem from infrastructure and diagnostic differences. China's three-tier primary care system and mandatory screening for elderly and adolescents improve detection. In contrast, most low income regions lack standardized tools, psychiatric staff, and funding; mild cases are mislabeled as fatigue, and stigma worsens underreporting.

Notably, despite a slightly greater global decline in burden among females during this period, women still consistently face a higher burden than men. This underscores the need for gender-sensitive mental health interventions, including training healthcare providers in gender-specific symptom expression and providing greater psychosocial support for caregiving populations (Chandra *et al.*, 2019).

In addition, age-specific patterns revealed by our study point to a shifting distribution of burden. Notably, both in China and worldwide, younger (< 10 or < 19 years) and older (≥ 55 or ≥ 65 years) populations experienced increasing burdens of depressive disorders from 1990 to 2021. These findings underscore an emerging U-shaped age pattern in the depressive disorder burden: children/adolescents and older adults are becoming the key affected groups. This may reflect rising psychosocial pressures on youth (e.g., academic competition, online exposure) and cumulative vulnerability in the elderly (e.g., multimorbidity, bereavement).

Projections indicate a rising global depressive disorders burden from 2022 to 2050

Model-based forecasts reveal diverging trajectories in the depressive disorder burden between China and the rest of the world over the next three decades. In China, the ASIR and DALYs rate are projected to decline or remain relatively stable through 2050. Specifically, male DALYs are expected to follow a "decline-then-rise" pattern, possibly reflecting the aging population and increasing unmet needs in elderly male cohorts. In contrast, the global burden is expected to rise dramatically, particularly among females. By 2050, the global

ASIR for women may exceed 10,000 per 100,000 population, while ASPR and DALYs are likewise projected to nearly double or triple, highlighting a looming public health challenge.

The projected increase in global burden—despite medical advances—can be attributed to several factors. First, population aging, especially in middle- and low-SDI regions, is accelerating the accumulation of chronic comorbidities and mental health vulnerability (R. Li *et al.*, 2025). Second, mental health resources remain severely limited in low-resource settings, where underdiagnosis, stigma, and delayed treatment remain widespread (He *et al.*, 2025; Mathias *et al.*, 2021; Zhang *et al.*, 2025). Additionally, global trends in urbanization, social fragmentation, and digital overload may contribute to rising psychological distress in young populations.

Policy implications and recommendations: age- and gender-sensitive strategies needed

Therefore, integrating the empirical evidence from this study with the existing policy frameworks in China, we propose a set of targeted policy recommendations. These recommendations are designed to address the identified implementation gaps—particularly in workforce distribution, gender-specific outreach, and screening coverage—while leveraging the institutional foundation already established by the 2013 Mental Health Law and the National Mental Health Work Plan (2021–2030). The specific strategies are detailed below. Four priorities are recommended: The first is Policy Integration Across the Life Course. Governments should adopt age-sensitive mental health policies that strengthen early identification and support for children and adolescents, while also expanding geriatric mental health services. Integration with primary care, schools, and eldercare institutions is essential. The second is Gender-Responsive Service Planning. Mental health programs must address structural and social determinants affecting women disproportionately. Gender-sensitive training, community outreach, and treatment access should be prioritized (Baiden *et al.*, 2025; Feng *et al.*, 2023). The third is Healthcare System Capacity Building. Standardized clinical pathways, strengthened mental health workforce development (Baiden *et al.*, 2025; Jang *et al.*, 2026), and improved community-based services are crucial for both early intervention and long-term management of depressive disorders (Fan *et al.*, 2025; Y. Li *et al.*, 2025; Viana *et al.*, 2025). The fourth is Research and Innovation. Longitudinal and intervention research focusing on high-risk age groups should be expanded. Digital health solutions (Barbati *et al.*, 2025; H. Y. Li *et al.*, 2025), such as telepsychiatry and AI-based screening tools, may offer scalable approaches in resource-constrained settings.

Limitations

The GBD database offers comprehensive estimates of depressive disorder burden globally and in China; however, several limitations warrant consideration, consistent with critiques in existing literature. First, granular subnational data (e.g., provincial disparities in China, regional variations in multiple countries) remain inaccessible from GBD, precluding analysis of intra-country socioeconomic or cultural influences on depression burden. Second, projections for future burden rely on historical trends and may not fully account for unforeseen societal shifts, including policy changes, economic crises, or advancements in mental health interventions. These limitations highlight the need for context-specific, multi-source data collection to refine global and regional estimates of depressive disorders.

CONCLUSIONS

This study provides updated and forward-looking evidence on the burden of depressive disorders in China and globally over a 60-year window. While China has achieved notable reductions since 1990, new challenges are emerging—particularly among children and the elderly. In contrast, the global burden is projected to rise sharply, especially among females and vulnerable age groups. To mitigate the growing mental health crisis, targeted, age- and gender-sensitive policies must be implemented. Comprehensive strategies spanning prevention, early detection, service delivery, and public engagement will be essential in addressing the evolving landscape of depressive disorders.

DECLARATIONS

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Author contributions

Wei Su and Zan Li contributed equally to the conception and design of the study and to drafting the initial manuscript. Xinqi Yao was responsible for grammatical correction and language polishing of the full text. Shuang Ma contributed to data collection, analysis, interpretation and critical revision of the manuscript. All authors have read and approved the final version of the manuscript.

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Ethical approval

Not applicable.

Informed consent

Not applicable.

Conflict of interest

The authors declare no competing interests.

Use of large language models, AI and machine learning tools

No AI tools were used.

Data availability statement

All data are openly available in the Global Health Data Exchange GBD Results Tool, <http://ghdx.healthdata.org>

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