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Global burden of mental disorders in 204 countries and territories, 1990–2021: results from the global burden of disease study 2021

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Abstract

Background Mental disorders, one of the leading causes of the global health-related burden, which has been exacerbated by the emergence of the COVID-19 pandemic (2019–2021). In this study, we aim to provide global, regional, and national estimates of the mental disorders burden from 1990 to 2021, including during the COVID-19.

Methods We collected data from the Global Burden of Disease Study 2021 (GBD 2021) on the incidence, disability-adjusted life years (DALYs), age-standardized incidence rate (ASIR), and age-standardized DALY rate (ASR) of 12 mental disorders from 204 countries and regions. The socio-demographic index (SDI) was used to evaluate the correlation between mental disorders burden and different regions. We utilized joinpoint regression analysis to estimate the average annual percentage change (AAPC).

Results In 2021, there were 444,397,716 incident cases and 155,418,119 DALYs globally from mental disorders. From 1990 to 2021, there was an upward trend in both ASIR [15.23% (12.97–17.60%)] and ASR [17.28% (15.06–19.44%)]. In 2021, the highest ASIR was observed in Central Sub-Saharan Africa (8706.11), while the lowest was in East Asia (3340.99). Australia (2787.87) had the highest ASR. Nationally, Greenland, Greece, the United States, and Australia had the highest ASRs. During the COVID-19 pandemic, aside from East Asia, both the ASIR showed an upward trend in the five SDI and other GBD regions. In 2021, the ASR for females was higher than that for males. Among the 12 subtypes, major depressive disorder (557.87) and anxiety disorders (524.33) had the highest ASR. Major depressive disorder ranked first in ASR in 13 of the 21 regions worldwide. Despite the overall upward trend in DALYs for mental disorders [AAPC: 5.96; 95%CI: (4.99, 6.92)], the ASR exhibited varying trends among different subtypes, with anxiety disorders experiencing the most significant increase.

Conclusions GBD 2021 showed that the burden of mental disorders has increased over the past three decades, with notable regional disparities. High SDI regions and females should be paid more attention. To alleviate future burdens, providing comprehensive mental health support, establishing effective mental health knowledge dissemination and tailored interventions are in great need.

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Clinical trial number Not applicable.

Keywords Mental disorders, Global burden of disease, Incidence, Disability-adjusted life years

Introduction

Mental disorders have been a significant public health issue and the leading causes of the global health-related burden. It was estimated that by 2019, approximately 12% of the global population suffered from mental disorders, accounting for about 5% of the global disability-adjusted life years (DALYs) [1, 2]. According to the 2019 Global Burden of Disease (GBD) study, mental disorders ranked among the top 10 global diseases in terms of prevalence, and the DALYs for mental disorders have risen from the 13th position in 1990 to the 7th in 2019, indicating a rapid increase in the global disease burden [3, 4]. Influenced by the COVID-19 pandemic, the prevalence of mental disorders such as depression and anxiety disorders has begun to rise sharply [5]. Given the high burden of mental disorders, it is imperative to develop healthcare policies and programs to address this issue, in great need of in-depth understanding of the scale of the impact of these disorders [6].

There were significant regional disparities in the incidence and prevalence of mental disorders. In 2019, Australasia, Tropical Latin America, and High-income North America exhibited the highest prevalence rates [7]. According to the “World Mental Health Report” released by the World Health Organization (WHO) in 2022, 970 million people worldwide suffered from mental disorders, with 82% of them living in low- and middle-income countries. The prevalence rate in high-income countries is higher than that in low-income countries [8]. Comprehensive and accurate data on the burden of mental disorders serves as a fundamental prerequisite for policymakers to allocate resources and develop policies effectively. Therefore, it is necessary to grasp the latest spatial distribution and temporal trends of mental disorders across different countries and regions.

Although previous studies have reported estimates of the burden of mental disorders, they have focused more on analyzing subtypes of mental disorders, such as depression and anxiety, rather than comprehensively analyzing the burden of 12 mental disorders. The emergence of the COVID-19 pandemic in 2019 has led to a deterioration in mental health status. Epidemiological studies have indicated that the direct psychological impact of the pandemic, as well as its long-term effects on the economic and social conditions of the population, may increase the prevalence of common mental illnesses [9]. Previous studies have not systematically analyzed the impact of COVID-19 on mental disorders. This study aims to summarize the incidence, DALYs, and long-term trends of mental disorders in different countries and

regions from 1990 to 2021 and from 2019 to 2021, stratified by gender, based on the 2021 GBD study. Understanding the latest burden patterns will help raise global awareness of mental disorders and inform the design of targeted prevention and intervention strategies tailored to the characteristics of different regions.

Methods

Overview

The data analyzed in this study was sourced from the GBD 2021. As a comprehensive database, the GBD 2021 provides data on 371 diseases and injuries, as well as 88 risk factors, across 204 countries and territories from 1990 to 2021 [10, 11]. For most diseases and injuries, standardized tools were employed to model the processed data, enabling estimates of each quantity of interest by age, sex, location, and year. Advanced statistical models, such as Meta-Regression Bayesian, Regularized, Trimmed (MR-BRT), DisMod-MR 2.1, and Spatio-Temporal Gaussian Process Regression (ST-GPR), were utilized for downstream data analysis [4, 12].

Estimation of DALYs

DALYs were estimated by summing the years lived with disability (YLD) and the years of life lost (YLL), serving as an overall measure of the burden of disease [13]. YLDs were estimated by multiplying prevalence estimates of different severity levels with appropriate disability weight. YLLs were calculated by multiplying deaths from a specific cause by the remaining years of life expected at the time of death, based on a standard life expectancy [4]. The DALYs for mental disorders is calculated by adding the YLDs and the YLLs.

Data source

This study analyzed the estimated incidence and DALYs of 12 mental disorders in 204 countries and regions from 1990 to 2021. These data were obtained from the Global HealthData Exchange (GHDx) query tool. In this study, we extracted information on mental disorders by countries and territories, focusing on sex-specific incidence and DALYs from the GBD 2021. This included the number of incidence and DALYs, age-standardized incidence rate (ASIR), and age-standardized DALY rate (ASR) of 12 mental disorders, and the corresponding 95% uncertainty interval (UIs). These methods had been described in previous research [4]. The socio-demographic index (SDI) is a comprehensive indicator introduced by the Institute for Health Metrics and Evaluation (IHME) in 2015 to evaluate the development level of countries or regions,

was used to analyze the interrelationship between social development and population health outcomes [11]. It is the geometric mean of the total fertility rate of people under 25, the average educational attainment of the population aged 15 and over, and the 0 to 1 index of the lagging index of per capita income distribution [14]. SDI varies between 0 and 1, with higher SDI implying better socioeconomic development. Based on the SDI, regions are classified into five levels, including low (<0.46), low-middle ($0.46\text{--}0.60$), middle ($0.61\text{--}0.69$), high-middle ($0.70\text{--}0.81$) and high SDI (>0.81) [15].

Case definition

In this study, we present GBD 2021 results for mental disorders. The GBD 2021 mental disorders included were anxiety disorders, major depressive disorder, schizophrenia, bipolar disorder, dysthymia, anorexia nervosa, bulimia nervosa, autism spectrum disorders, attention-deficit/hyperactivity disorder, conduct disorder, idiopathic developmental intellectual disability, and other mental disorders. To ensure comparability in measurements, we defined mental disorders according to criteria outlined in the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV) and the International Classification of Diseases 10 (ICD-10), as these standards are used by most of the included mental health surveys. The DSM-IV and ICD-10 definitions of the mental disorders described in this study are detailed in the supplementary appendix (Table S1).

Statistical analysis

Differences in age structure may contribute to heterogeneity in the burden of mental disorders, especially in incidence and DALYs [16]. To adjust for the effect of age structure differences, we used ASIR and ASR to quantify the disease burden and trends of mental disorders in different regions based on the GBD standard population distribution [17]. Age-standardized rates were calculated based on the world standard population reported in the GBD 2021 [18]. Furthermore, we have calculated the 95% uncertainty interval (UI). All estimates for the 95% UI are derived from the 25th and 975th ordinals of the posterior distribution drawn 1000 times during each step of the burden estimation process [7].

Joinpoint regression, a statistical method widely used in epidemiological studies, was employed to analyze trend changes in time series data. This method identifies “joinpoints” that split the data into multiple segments, with each segment exhibiting its own annual percentage change. In this study, we calculated the annual percentage change (APC) and average annual percent change (AAPC) of DALYs for mental disorders from 1990 to 2021 using joinpoint regression analysis, aiming to determine the temporal trends in the global burden of mental

disorders. We employed a log-linear model to analyze the APC and AAPC in ASR for mental disorders, along with their corresponding 95% confidence intervals (CI). A grid search method was used to fit the regression function and determine the number and position of joinpoints, with a maximum of 5 joinpoints allowed [19]. This model professionally identifies and quantitatively describes significant turning points in the time series data related to mental disorder estimates. An APC or AAPC estimate and its 95% CI lower bound were both greater than zero, it indicated an upward trend within the specified interval. Conversely, an APC or AAPC estimate and the upper bound of its 95% CI both less than zero suggest a downward trend [20, 21]. For instance, a positive AAPC indicates an upward trend in the ASR for mental disorders during the study period, while a negative AAPC reflects a downward trend. Joinpoint regression program (version 4.9.1.0) was used to perform joinpoint trend analysis to analyze trend changes in time series data [22]. Spearman correlation analysis was applied to evaluate the association between the SDI and the burden of mental disorders by location and year [23]. In this study, the main statistical analysis and drawing of the figures were performed using R software (version 4.2.3), and a two-sided $p < 0.05$ was considered statistically significant.

Results

Global burden of mental disorders

The global incidence and DALYs of mental disorders between 1990 and 2021 are presented in Tables 1 and 2. Globally, there has been a significant increase in the incidence of mental disorders, reaching 444,397,716 cases in 2021. The ASIR of mental disorders has risen from 4737.97 in 1990 to 5459.77 in 2021, representing a 15.23% increase. From 2019 to 2021, the ASIR of mental disorders increased by 16.08% (Table 1). Across all five SDI regions, the ASIR for mental disorders is on the rise. The highest ASIR was observed in the low SDI region, with 6514.44 per 100,000 person-years, followed by the high SDI region with 6423.82 per 100,000 person-years. The lowest ASIR was found in the high-middle SDI regions, with 4917.24 per 100,000 person-years. Regionally, the incidences increased in all 21 GBD regions between 1990 and 2021. In 2021, the highest ASIR was found in Central Sub-Saharan Africa (8706.11), while the lowest was in East Asia (3340.99). Over the past three decades, the ASIR of mental disorders has increased in all 21 GBD regions except for East Asia (-5.55%), with High-income North America experiencing the most rapid growth (56.49%). Notably, from 2019 to 2021, the fastest growing region was Andean Latin America (31.37%). The 2021 global map of the ASIR of mental disorders is presented in Fig. 1a. The countries with the highest ASIR for mental disorders were Greenland, Palestine, Uganda, Greece,

Table 1 Incidence of mental disorders, and percentage change of age-standardized rates by GBD region

World region	1990			2019			2021			Percentage change of ASIR	
	Number of cases	ASIR per 100,000	Number of cases	ASIR per 100,000	Number of cases	ASIR per 100,000	Number of cases	ASIR per 100,000	Number of cases	1990–2021	2019–2021
Global	241,360,894	4737.97(4278.42,5368.46)	374,348,205	4703.23(4247.84,5334.32)	444,397,716	5459.77(4873.72,6241.42)				15.23(12.97,17.60)	16.08(14.22,18.00)
Low SDI	23,709,009	6143.20(5397.31,7113.59)	50,605,025	5861.74(5164.94,6762.84)	60,311,401	6514.44(5697.32,7557.96)				6.04(1.97,9.92)	11.13(6.80,15.31)
Low-middle SDI	55,310,181	5665.99(5054.42,6486.09)	95,238,869	5330.20(4759.97,6080.08)	116,086,947	6216.11(5495.21,7144.06)				9.71(5.38,14.25)	16.62(12.05,20.87)
Middle SDI	68,734,614	4227.59(3825.97,4770.91)	107,423,074	4260.84(3870.13,4789.73)	126,831,832	4920.13(4442.47,5540.26)				16.38(14.01,18.91)	15.47(12.91,18.23)
High-middle SDI	48,995,902	4539.15(4134.81,5057.42)	61,968,787	4326.48(3937.12,4843.04)	70,163,005	4917.24(4414.74,5538.76)				8.32(4.11,12.48)	13.65(10.03,17.57)
High SDI	44,390,980	4835.38(4415.93,5367.04)	58,825,036	5270.11(4760.83,5950.82)	70,659,768	6423.82(5760.36,7244.81)				32.85(28.39,37.98)	21.89(18.63,25.34)
Andean Latin America	1,464,494	4243.82(3782.93,4830.68)	2,604,677	4070.36(3639.89,4687.07)	3,583,280	5347.37(4595.75,6241.11)				26.00(13.96,40.20)	31.37(18.58,45.39)
Australasia	1,418,295	6766.65(6089.73,7556.67)	2,019,342	6827.27(6066.05,7815.30)	2,231,887	7325.01(6147.35,8863.53)				8.25(-7.22,26.30)	7.29(-7.81,24.20)
Caribbean	1,948,481	5803.64(5154.29,6668.33)	2,584,766	5297.02(4665.54,6132.14)	3,122,929	6307.79(5409.94,7386.54)				8.68(0.29,18.08)	19.08(10.54,29.18)
Central Asia	2,741,842	4448.91(3934.43,5055.71)	3,873,032	4278.75(3794.93,4893.24)	4,684,861	4994.54(4299.53,5811.01)				12.26(3.84,22.01)	16.72(7.27,26.71)
Central Europe	5,045,588	3802.67(3437.13,4277.96)	4,728,494	3478.35(3142.74,3913.23)	5,712,470	4364.02(3862.89,4955.29)				14.76(8.98,20.94)	25.46(19.97,32.21)
Central Latin America	6,437,675	4458.02(4017.97,5047.77)	12,460,247	4854.37(4375.38,5478.64)	15,343,630	5849.19(5223.78,6692.60)				31.21(25.97,36.95)	20.49(15.88,25.13)
Central Sub-Saharan Africa	3,527,046	8271.15(7096.42,9844.93)	8,374,614	8023.19(6936.78,9482.64)	9,791,079	8706.11(7166.05,10620.38)				5.25(-6.92,20.21)	8.51(-4.18,22.48)
East Asia	42,832,652	3537.32(3214.57,3939.56)	55,224,836	3342.22(3058.38,3686.25)	56,340,545	3340.99(3025.52,3712.33)				-5.55(-9.83,-0.99)	-0.04(-3.38,3.83)
Eastern Europe	12,459,215	5103.58(4537.33,5713.92)	11,408,784	4720.44(4200.09,5309.38)	14,023,794	6014.06(5286.17,6838.01)				17.84(12.25,24.82)	27.40(21.45,34.99)
Eastern Sub-Saharan Africa	9,655,721	7014.94(6190.74,8082.61)	20,759,153	6673.86(5917.56,7655.79)	25,372,933	7528.26(6567.61,8690.75)				7.31(1.96,13.44)	12.80(6.73,18.94)
High-income Asia Pacific	5,924,027	3276.75(2999.91,3622.88)	6,465,420	3377.09(3095.76,3745.76)	7,350,005	3950.35(3551.76,4462.44)				20.55(14.32,27.21)	16.97(11.27,23.02)
High-income North America	15,096,975	5205.05(4701.26,5826.75)	23,451,454	6417.86(5818.29,7228.01)	29,528,973	8145.60(7295.06,9182.34)				56.49(50.04,63.07)	26.92(22.34,32.28)
North Africa and Middle East	19,331,360	6334.31(5557.62,7364.13)	38,717,768	6400.93(5545.95,7463.87)	46,242,810	7336.22(6303.06,8574.72)				15.81(10.24,21.48)	14.61(9.56,20.12)
Oceania	228,322	3774.89(3318.00,4378.00)	464,450	3692.82(3252.82,4283.07)	527,864	3981.68(3330.94,4801.24)				5.47(-7.42,20.21)	7.82(-5.91,23.24)
South Asia	52,393,027	5730.80(5137.66,6540.88)	91,516,789	5207.73(4654.64,5906.19)	112,893,184	6134.14(5462.68,7015.18)				7.03(3.11,11.72)	17.78(13.41,22.41)
Southeast Asia	14,009,335	3167.44(2844.43,3579.11)	21,721,272	3104.21(2785.32,3485.37)	26,764,622	3720.30(3311.08,4216.65)				17.45(13.45,22.26)	19.84(15.48,24.81)
Southern Latin America	2,463,407	4980.19(4497.42,5639.55)	3,207,726	4662.74(4229.63,5239.88)	4,018,237	5775.16(4900.07,6788.32)				15.96(2.41,29.82)	23.85(10.52,37.83)
Southern Sub-Saharan Africa	2,524,563	5700.30(5128.44,6492.29)	4,273,341	5686.72(5105.84,6454.32)	5,531,245	7052.85(6182.21,8128.01)				23.72(16.52,32.01)	24.02(16.69,32.11)
Tropical Latin America	8,655,965	6083.62(5503.83,6856.24)	13,484,023	5692.05(5193.08,6297.35)	17,191,337	7097.75(6342.27,8053.77)				16.67(10.49,23.24)	24.69(17.64,32.02)
Western Europe	24,941,474	6120.52(5603.73,6762.26)	27,848,760	5984.89(5352.55,6812.56)	32,649,490	7218.40(6356.58,8319.83)				17.94(11.02,25.75)	20.61(14.83,26.97)
Western Sub-Saharan Africa	8,261,430	5614.08(4983.27,6430.13)	19,159,258	5405.37(4793.92,6170.41)	21,492,542	5657.36(4960.75,6496.80)				0.77(-3.21,4.65)	4.66(0.46,8.60)

ASIR, the age-standardized incidence rate

Angola, Lebanon, and Central African Republic. The lowest were Myanmar, Democratic People's Republic of Korea, and China (Fig. 1a).

Mental disorders contributed to 155,418,119 DALYs worldwide in 2021. The ASR was 1909.14, representing an increase of 17.28% compared to 1990. The ASR for mental disorders increased from 1738.12 (95%UI: 1308.29, 2210.63) in 2019 to 1909.14 (95%UI: 1440.15, 2437.87) in 2021, marking an increase of 10.18% (Table 2). The highest ASR was observed in the high SDI region (2276.02), while the lowest was found in the high-middle SDI (1806.88). Regionally, Australasia had the largest ASR in 2021 (2787.87), followed by High-income North America (2662.06). At the national level, China, Democratic People's Republic of Korea, and Viet Nam had the lowest ASR. Conversely, Greenland, Greece, The United States, and Australia were among the countries with the highest ASR (Fig. 1b). Of note, both the ASIR and ASR were higher for females than for males in 2021 (Fig. 1c-d).

Global burden of 12 subtypes of mental disorders

We further analyzed the variations in the global burden of 12 subtypes of mental disorders during the period. Among these subtypes, major depressive disorder and anxiety disorders had the highest DALYs in 2021. The ASR for major depressive disorder, anxiety disorders, and bulimia nervosa showed significant increases between 1990 and 2021, whereas schizophrenia and bipolar disorder showed a downward trend from 2019 to 2021. Major depressive disorder, anxiety disorders, bipolar disorder and dysthymia were more common among females than males in 2021 (Table 3).

Table 3 also presents the trends of global mental disorders in terms of AAPC DALYs, categorized by gender and subtypes, from 1990 to 2021. Joinpoint regression analysis revealed shifts in the DALYs trends for global mental disorders over this period. Despite fluctuations in specific timeframes, more than half of the subtypes among the 12 mental disorders exhibited an overall upward trend in ASR for DALYs. We observed a continuous increase in the ASR of DALYs for anxiety disorders, major depressive disorder, dysthymia, and bulimia nervosa, with AAPCs of 2.85 (95% CI: 2.53, 3.16), 2.60 (95% CI: 2.11, 3.10), 0.11 (95% CI: 0.09, 0.12), and 0.18 (95% CI: 0.17, 0.19), respectively. Significant increases were noted between 2019 and 2021, with APCs of 9.30, 11.50, 0.90, and 0.64, respectively. It is worth noting that the DALYs for schizophrenia, bipolar disorder, anorexia nervosa, and autism spectrum disorders demonstrated an upward trend from 1990 to 2021, but experienced a slight decline during the period from 2019 to 2021, with APCs of -0.03, -0.06, -0.43, and -0.01, respectively.

Next, we figured out the proportions of ASIR and ASR for the 12 subtypes at the global and regional levels in

2021. As shown, the major depressive disorder (75.72%) accounted for the highest ASIR proportion globally, followed by anxiety disorders (12.46%). Central Sub-Saharan Africa had the highest proportion of major depressive disorder, reaching 86.00% (Fig. 2a). The ASR of major depressive disorder was the highest globally, accounting for 30.01%. The highest ASR of major depressive disorder was in Central Sub-Saharan Africa, followed by Eastern Sub-Saharan Africa, South Asia, Southern Sub-Saharan Africa, and Western Sub-Saharan Africa, accounting for 45.47%, 39.62%, 36.85%, 36.33% and 34.61% respectively. The ASR for anxiety disorders was highest in Tropical Latin America (40.83%) (Fig. 2a). Figure 2b shows the ranking of ASIR and ASR for the 12 subtypes of mental disorders across 21 GBD regions. In 13 of 21 world regions, major depressive disorder ranked first in ASR (Fig. 2b). In High-income Asia Pacific, autism spectrum disorders ranked first. The ASR for anorexia nervosa ranked last in 19 of 21 regions.

The trends of mental disorders disease burden in regions with different SDI levels from 1990 to 2021

As mentioned above, the number of cases of mental disorder in 2021 was twice that of 30 years ago. From 1990 to 2021, the trends of both the ASIR and ASR of mental disorders were upward, increasing by 15.23% and 17.28%, respectively (Tables 1 and 2; Fig. 3a-b). Both sexes experienced an obvious rise in ASIR and ASR, with females consistently having a higher. Among all SDI regions, the ASIR and ASR have been exhibiting a particularly rapid escalation since 2019. Nevertheless, the variations in ASIR and ASR differed significantly across different SDI regions. The incidence of mental disorders in high and middle SDI regions increased slowly before 2019, followed by a sharp rise after 2019. For the low-middle and low SDI regions, the incidence of mental disorders kept fluctuating first and hit a peak in 2005. Since then, the incidence has continued to decline, with a slow increase again observed in 2019. Compared with the global level, the low-middle and low SDI regions had the higher ASIR. For the ASR, the high, low-middle and low SDI regions were higher than the global level, while the middle and high-middle SDI regions were lower.

Mental disorders incidence and DALYs in relation to SDI

The observed regional ASIR and ASR in relation to SDI, versus the expected level for each location based on SDI, are shown in Fig. 3c. Both the ASIR and ASR had a non-linear relationship with the SDI of GBD regions. Globally, the burden of mental disorders almost closely followed expected trends over the study period. While among the 21 regions, the observed patterns varied widely. Some regions stayed well below expected levels throughout the study period with little change in age-standardized

Table 2 DALYs of mental disorders in 2021, and percentage change of age-standardized rates by GBD region

World region	2019			2021			Percentage change of ASR	
	Number of DALYs	ASR per 100,000	Number of DALYs	ASR per 100,000	Number of DALYs	ASR per 100,000	1990–2021	2019–2021
Global	89,567,099	1745.15(1314.32,2214.47)	138,453,211	1738.12(1308.29,2210.63)	155,418,119	1909.14(1440.15,2437.87)	17.28(15.06,19.44)	10.18(8.83,11.46)
Low SDI	7,645,112	186.188(1395.11,2401.28)	16,805,739	1836.88(1373.03,2359.95)	19,117,472	1964.32(1463.82,2530.28)	12.19(9.67,14.70)	8.61(6.22,10.99)
Low-middle SDI	18,719,851	1838.15(1375.03,2356.10)	32,748,795	1791.40(1342.03,2288.04)	37,352,846	1968.25(1480.56,2533.15)	20.63(16.69,24.38)	11.45(9.02,13.92)
Middle SDI	26,700,052	1627.38(1225.92,2063.50)	41,930,138	1650.13(1242.47,2095.44)	47,067,857	1816.49(1369.70,2310.33)	24.04(20.51,27.14)	10.52(8.82,12.12)
High-middle SDI	18,211,389	1671.33(1260.67,2122.96)	23,521,926	1648.84(1243.62,2094.28)	25,764,095	1806.88(1364.02,2290.90)	15.38(12.41,18.88)	8.95(6.72,11.22)
High SDI	18,207,905	1956.55(1480.64,2473.36)	23,336,865	2027.55(1534.76,2566.03)	18,207,905	2276.02(1710.69,2886.64)	14.76(12.12,17.47)	10.68(8.72,12.74)
Andean Latin America	630,276	1828.65(1375.57,2339.06)	1,181,926	1825.23(1364.44,2329.47)	1,470,468	2175.32(1597.74,2830.02)	34.03(24.56,44.99)	20.22(12.18,29.89)
Australasia	554,994	2609.71(1950.75,3349.12)	821,429	2681.89(2016.93,3442.45)	880,846	2787.87(2088.14,3552.40)	3.94(-3.77,12.67)	3.66(-4.17,12.36)
Caribbean	656,306	1934.62(1436.83,2484.77)	910,312	1866.16(1394.07,2396.41)	1,029,437	2082.12(1548.02,2715.62)	16.64(11.02,22.65)	11.73(6.77,17.25)
Central Asia	944,337	1484.65(1119.71,1902.71)	1,364,944	1466.30(1104.34,1871.73)	1,535,702	1603.18(1206.41,2060.86)	17.65(12.36,23.52)	9.53(4.69,14.12)
Central Europe	2,017,814	1528.92(1169.19,1927.43)	1,960,653	1498.25(1142.11,1886.92)	2,182,318	1712.83(1297.62,2176.20)	17.37(13.86,21.27)	12.38(9.10,15.68)
Central Latin America	2,480,054	1673.34(1263.96,2140.13)	4,586,288	1774.05(1330.82,2273.49)	5,247,771	1993.08(1480.80,2558.59)	37.50(32.10,43.36)	13.47(10.31,16.99)
Central Sub-Saharan Africa	942,596	2118.47(1564.97,2752.91)	2,308,899	2110.82(1586.14,2739.58)	2,616,801	2233.63(1647.69,2950.03)	11.43(4.03,20.17)	7.74(0.84,15.78)
East Asia	17,695,222	1450.67(1095.61,1834.85)	22,909,873	1398.13(1058.68,1770.21)	24,029,128	1447.28(1103.83,1825.01)	12.25(7.75,17.14)	4.28(2.17,6.68)
Eastern Europe	4,019,811	1668.96(1248.15,2119.26)	3,814,348	1635.43(1221.57,2074.01)	4,340,593	1910.06(1423.91,2436.16)	18.28(14.90,22.57)	14.99(11.59,18.97)
Eastern Sub-Saharan Africa	2,962,957	1990.29(1482.98,2575.21)	6,612,096	1960.51(1459.54,2525.98)	7,679,754	2126.41(1586.72,2744.99)	16.08(12.69,19.63)	10.92(7.74,14.03)
High-income Asia Pacific	2,863,619	1554.80(1179.04,1932.41)	3,068,966	1577.35(1195.17,1960.64)	3,286,395	1721.55(1305.43,2154.41)	7.30(4.40,10.75)	7.62(5.07,10.94)
High-income North America	6,387,812	2152.02(1621.42,2726.69)	8,831,876	2319.04(1737.27,2926.87)	10,106,541	2662.06(1977.68,3399.24)	20.28(16.69,24.24)	13.41(10.90,16.29)
North Africa and Middle East	6,564,776	2131.18(1595.27,2757.58)	13,138,710	2151.24(1610.31,2784.08)	14,960,229	2359.65(1745.61,3049.99)	24.07(19.56,28.72)	10.78(7.56,14.15)
Oceania	89,588	1522.16(1149.14,1956.12)	188,766	1517.06(1141.30,1932.53)	208,648	1591.91(1175.71,2085.55)	9.53(0.85,18.28)	5.44(-2.78,13.80)
South Asia	17,712,064	1834.57(1375.65,2335.07)	31,453,177	1749.41(1311.92,2219.26)	35,948,514	1925.51(1447.69,2471.47)	20.18(15.72,24.74)	11.87(9.28,14.47)
Southeast Asia	6,243,886	1438.95(1090.28,1812.42)	10,204,059	1434.00(1091.84,1816.59)	6,243,886	1588.29(1206.94,2022.22)	23.82(19.67,28.23)	11.44(8.91,14.39)
Southern Latin America	993,418	2018.97(1526.97,2568.90)	1,372,829	1968.57(1490.93,2510.91)	1,591,301	2249.71(1653.51,2928.35)	17.22(8.34,26.84)	14.46(5.75,25.10)
Southern Sub-Saharan Africa	833,002	1805.43(1353.31,2309.14)	1,394,613	1800.76(1349.52,2297.27)	1,659,944	2073.72(1548.89,2686.33)	30.07(25.12,35.51)	16.92(12.66,21.36)
Tropical Latin America	3,088,704	2145.85(1602.80,2762.53)	5,399,428	2256.85(1665.95,2895.97)	6,336,303	2601.75(1916.60,3349.09)	37.55(31.34,43.92)	15.41(11.45,19.58)
Western Europe	9,197,289	2243.61(1676.13,2871.42)	10,401,819	2240.86(1676.53,2874.71)	11,520,860	2522.52(1872.21,3250.66)	10.09(6.27,13.95)	10.46(7.02,13.94)
Western Sub-Saharan Africa	2,688,574	1709.71(1277.72,2177.53)	6,528,200	1703.06(1275.72,2175.80)	7,189,409	1755.29(1304.72,2236.64)	5.45(3.34,7.40)	4.16(2.12,6.14)

ASR, the age-standardized DALYs rate

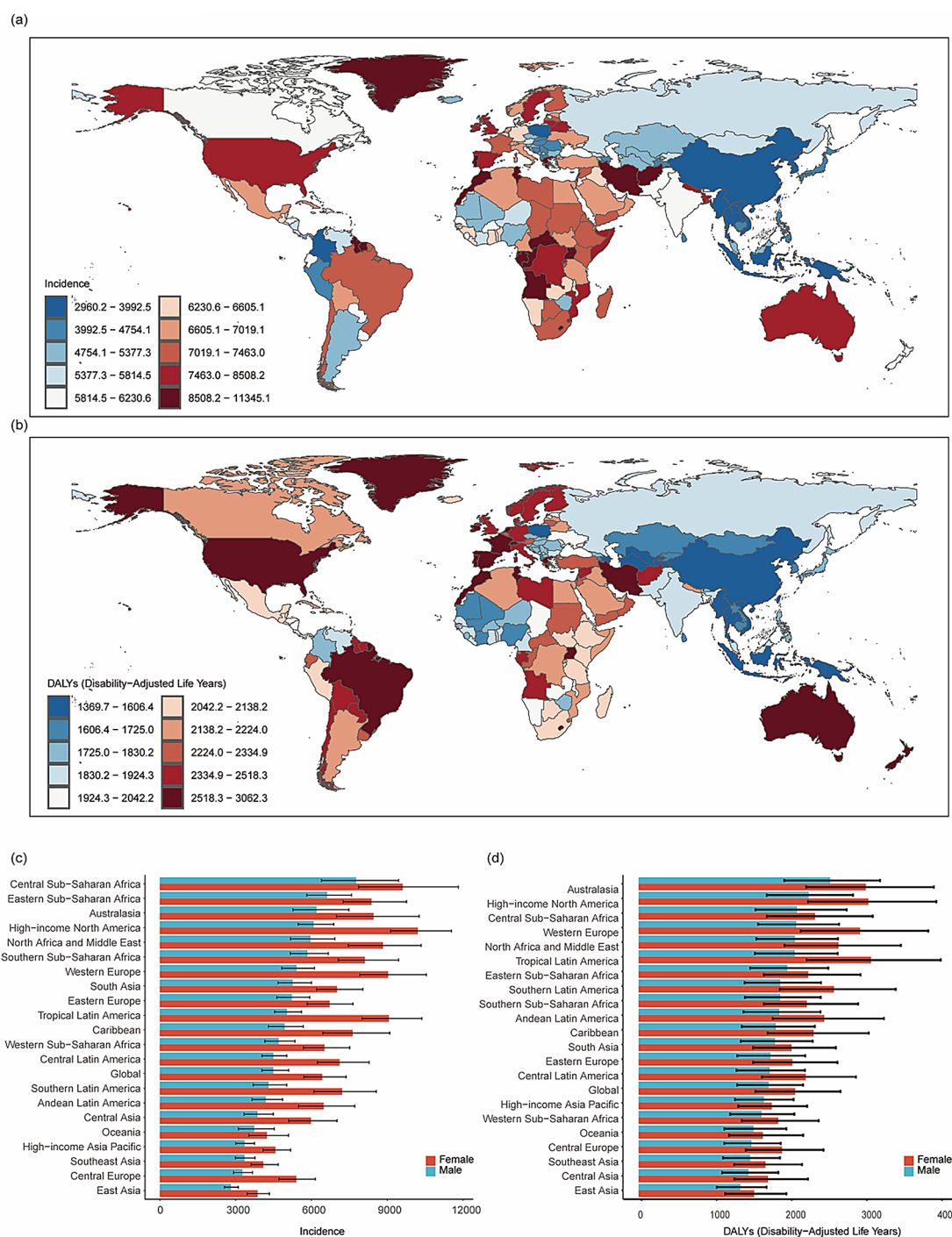


Fig. 1 The burden of mental disorders across 204 countries and territories in 2021. **(a)** The age-standardized incidence rate in 204 countries and territories; **(b)** The age-standardized disability-adjusted life years (DALYs) rate in 204 countries and territories; **(c)** The age-standardized incidence rate in 21 GBD regions by sexes; **(d)** The age-standardized DALYs rate in 21 GBD regions by sexes

Table 3 The global age-standardized dalys for 12 mental disorders in 2021, and the corresponding percentage change and average annual percentage changes (AAPC) from 1990 to 2021

	2021		1990–2021		2019–2021	
	Number of DALYs	ASR per 100,000	Percentage change of ASR	AAPC in ASR	Percentage change of ASR	APC in ASR
Mental disorders						
Total	155,418,119	1909.14(1440.15,2437.87)	17.28(15.06,19.44)	5.96(4.99,6.92)	10.18(8.83,11.46)	4.80(3.94,5.68)
Male	70,381,365	1732.39(1312.80,2189.59)	15.55(13.18,17.78)	4.72(4.15,5.29)	8.37(7.11,9.58)	3.89(3.17,4.62)
Female	85,036,754	2084.12(1556.67,2687.29)	18.68(16.47,20.81)	7.07(6.18,7.97)	11.71(10.31,13.17)	5.61(4.60,6.62)
Anxiety disorders						
Total	42,509,645	524.33(363.05,716.25)	18.16(15.57,20.95)	2.85(2.53,3.16)	19.11(16.59,21.48)	9.30(6.07,12.63)
Male	16,113,657	396.91(272.28,547.66)	18.17(15.38,20.95)	2.17(1.96,2.37)	17.82(15.18,20.39)	8.55(7.20,9.90)
Female	26,395,988	652.16(453.44,887.15)	18.42(15.76,21.32)	3.58(3.19,3.97)	19.98(17.45,22.47)	9.54(8.10,11.00)
Major depressive disorder						
Total	46,018,844	557.87(381.19,760.70)	16.07(13.19,18.96)	2.60(2.11,3.10)	18.08(15.86,20.45)	11.50(5.50,17.85)
Male	17,895,583	436.59(297.51,595.74)	19.16(16.46,22.27)	2.28(1.91,2.66)	17.82(15.39,20.42)	6.78(4.89,8.70)
Female	28,123,261	678.54(464.94,923.36)	14.32(11.21,17.39)	3.29(2.34,4.23)	18.36(15.98,20.75)	8.80(6.515,11.13)
Schizophrenia						
Total	14,816,611	177.75(131.51,228.79)	0.64(-0.48,1.71)	0.04(0.03,0.05)	-0.14(-0.86,0.60)	-0.03(-0.04,-0.01)
Male	7,870,786	188.96(139.92,243.73)	0.89(-0.43,2.20)	0.06(0.05,0.07)	-0.10(-1.12,0.89)	-0.03(-0.05,-0.02)
Female	6,945,825	166.40(122.80,213.92)	0.46(-0.89,1.81)	0.03(0.02,0.03)	-0.19(-1.25,0.84)	-0.04(-0.06,-0.03)
Bipolar disorder						
Total	8,007,783	166.40(122.80,213.92)	0.29(-1.14,1.65)	0.00(0.00,0.01)	-0.16(-0.73,0.39)	-0.06(-0.10,-0.02)
Male	3,869,179	94.16(60.91,135.74)	2.07(0.43,3.66)	0.06(0.05,0.07)	-0.02(-0.79,0.77)	0.02(-0.08,0.11)
Female	4,138,604	100.48(65.15,143.98)	-1.29(-2.74,0.10)	-0.04(-0.04,-0.03)	-0.29(-1.12,0.45)	-0.13(-0.20,-0.05)
Dysthymia						
Total	10,311,517	123.27(79.24,174.71)	2.82(1.16,4.58)	0.11(0.09,0.12)	1.81(0.56,2.98)	0.90(0.64,1.17)
Male	4,315,356	103.91(66.67,147.42)	2.18(-0.10,4.21)	0.07(0.06,0.08)	1.77(0.19,3.36)	0.88(0.59,1.18)
Female	5,996,161	142.62(91.89,202.72)	3.22(1.05,5.45)	0.14(0.11,0.16)	1.84(0.10,3.71)	0.92(0.61,1.23)
Anorexia nervosa						
Total	798,443	10.31(6.42,16.25)	5.18(3.05,7.45)	0.02(0.02,0.02)	-0.85(-2.28,0.80)	-0.43(-0.55,-0.30)
Male	219,973	5.59(3.35,9.02)	9.03(5.73,12.45)	0.02(0.02,0.02)	-0.24(-3.02,2.76)	-0.12(-0.25,0.01)
Female	578,470	15.18(9.53,23.90)	4.10(1.47,6.85)	0.02(0.01,0.02)	-1.02(-2.63,0.71)	-0.51(-0.67,-0.35)
Bulimia nervosa						
Total	2,604,702	33.05(18.64,55.29)	20.06(18.37,21.94)	0.18(0.17,0.19)	0.18(-0.85,1.22)	0.64(0.60,0.69)
Male	1,040,190	26.01(14.68,43.25)	24.62(21.930,27.48)	0.17(0.17,0.17)	0.917(-0.504,2.41)	0.68(0.63,0.72)
Female	1,564,512	40.297(22.67,66.23)	17.32(15.07,19.47)	0.19(0.18,0.20)	-0.26(-1.53,1.04)	-0.30(-0.82,0.23)
Autism spectrum disorders						
Total	11,544,038	147.55(100.21,208.15)	2.11(0.55,3.41)	0.10(0.09,0.11)	-0.02(-0.75,0.69)	-0.01(-0.06,0.04)
Male	7,896,838	199.80(136.29,281.96)	1.97(0.08,3.54)	0.13(0.12,0.14)	-0.09(-1.02,0.81)	-0.03(-0.07,0.00)
Female	3,647,200	94.45(64.55,133.017)	2.23(0.96,3.69)	0.07(0.06,0.07)	0.13(-0.73,1.09)	0.07(0.04,0.11)
Attention-deficit/hyperactivity disorder						
Total	1,030,941	13.49(7.41,21.89)	-9.68(-11.90,-7.29)	-0.04(-0.05,-0.04)	-0.07(-1.96,1.99)	-0.24(-0.35,-0.13)
Male	742,264	19.04(10.44,30.75)	-9.81(-12.51,-6.80)	-0.07(-0.07,-0.06)	0.06(-2.55,2.68)	-0.19(-0.28,-0.09)
Female	288,678	7.69(4.18,12.69)	-9.93(-12.83,-6.63)	-0.03(-0.03,-0.02)	-0.44(-2.87,2.11)	-0.48(-0.51,-0.46)
Conduct disorder						
Total	5,002,614	67.68(36.75,105.51)	3.03(1.42,4.86)	0.06(0.06,0.07)	-0.11(-0.75,0.54)	0.00(-0.03,0.03)
Male	3,257,831	85.60(47.16,132.77)	1.79(0.13,3.94)	0.05(0.04,0.06)	-0.08(-0.92,0.73)	0.01(-0.01,0.03)
Female	1,744,783	48.67(26.08,76.31)	4.74(2.21,6.96)	0.07(0.07,0.08)	-0.14(-1.19,1.03)	-0.01(-0.04,0.03)
Idiopathic developmental intellectual disability						
Total	3,810,635	49.92(23.17,85.33)	-13.67(-17.95,-8.41)	-0.24(-0.25,-0.23)	0.12(-0.79,1.14)	0.06(-0.27,0.39)

Table 3 (continued)

	2021		1990–2021		2019–2021	
	Number of DALYs	ASR per 100,000	Percentage change of ASR	AAPC in ASR	Percentage change of ASR	APC in ASR
Male	1,872,569	48.32(20.77,84.58)	-16.91(-21.73,-12.51)	-0.31(-0.32,-0.30)	-0.05(-1.27,1.29)	-0.03(-0.45,0.41)
Female	1,938,066	51.52(25.49,85.54)	-10.35(-14.58,-4.28)	-0.19(-0.20,-0.18)	0.28(-0.97,1.37)	-0.78(-0.82,-0.72)
Other mental disorders						
Total	8,962,344	106.59(68.18,160.68)	-0.34(-1.06,0.33)	-0.01(-0.01,-0.01)	-0.22(-0.72,0.24)	-0.11(-0.13,-0.10)
Male	5,287,137	127.47(81.99,191.81)	-0.52(-1.37,0.23)	-0.02(-0.03,-0.02)	-0.19(-0.81,0.39)	-0.10(-0.11,-0.09)
Female	3,675,207	86.08(55.86,127.90)	-0.16(-0.99,0.72)	-0.01(-0.01,-0.01)	-0.28(-1.04,0.38)	-0.14(-0.17,-0.11)

ASR, the age-standardized DALYs rate. AAPC, Average Annual Percentage Change. APC, Annual Percentage Change

rates, while others were well above expected levels but with fluctuating or decreasing age-standardized rates. Although Eastern Europe, High-income North America, and Australasia showed a downward trend in ASR, they still remain higher than expected. Notably, both the ASIR and ASR showed a sharp increase in all regions from 2019 to 2021 (Fig. 3c).

Discussion

Mental disorders impose a significant global burden of disease. Based on the GBD 2021 study, this study comprehensively reported the latest temporal and geographical trends in the burden of mental disorders at the global, regional, and national levels over the past 30 years. From a global perspective, the burden of mental disorders generally showed an increasing trend between 1990 and 2021. This upward trajectory is expected to persist, reflecting the escalating mental health challenges worldwide and the rising demand for psychological well-being. Consequently, numerous countries and regions urgently need to augment their investment in mental health services, implement effective measures to enhance service accessibility, reduce social stigma associated with mental health issues, bolster public awareness of psychological problems, and offer a broader range of support and treatment options [24]. However, the ASIR of mental disorders in East Asia continued to decline during this period. Consistent with previous research findings [7, 25], we observed that the incidence and DALYs rates among females were consistently higher than those among males across different countries and regions. This may be attributed to the fact that females, who often bear the responsibility of maintaining normal household functions, tend to experience greater family and societal pressures compared to males. Furthermore, female's lower income and savings levels place them at a more disadvantageous position in terms of economic and social security [24].

The disease burden was considerably heavy in most regions. Our research findings indicated that the ASR for mental disorders was highest in high SDI and lowest in parts of Sub-Saharan Africa and Asia, consistent with

previous studies [26]. The escalating burden of mental health is primarily attributed to population growth and aging, rather than an increase in disease prevalence [27]. In addition, Sub-Saharan Africa and parts of Asia had the lowest coverage of epidemiological data, and therefore there is more uncertainty surrounding estimates [7]. Although the ASIR for mental disorders was on the rise in most regions, the incidence of mental disorders in East Asia continued to decline.

Nationally, our study found that the countries with the highest DALYs for mental disorders were Greenland, Greece, the United States, and Australia; which is consistent with previous research results [7]. One of the countries with the lowest incidence rate was China. The possible reasons may lie in the following aspects: (1) Data on the incidence of mental disorders in China primarily originate from national health service surveys, disease monitoring, and published literature. However, there may exist systematic errors in data collection methods. For instance, while the multi-stage stratified cluster sampling approach used in large-scale epidemiological surveys in China, such as the 2019 China Mental Health Survey, is representative, its household survey mode may lead to inadequate coverage of highly mobile migrant worker populations and remote rural residents [28, 29]. (2) Despite the increased awareness of mental health issues among the Chinese public in recent years, acceptance remains insufficient compared to other countries. Existing research suggests that this discrepancy may stem from deep-seated cultural factors [30, 31]. As the core of traditional Chinese culture, Confucianism places greater emphasis on social harmony rather than individual psychological states. Its strong focus on self-restraint through adherence to social norms has led many Chinese people to internalize their psychological issues rather than seek professional help [32]. Furthermore, mental illnesses are often perceived as “character flaws” rather than medical problems, and in many cases, they are even considered morally unacceptable. This perception complicates the accurate diagnosis and timely treatment of mental illnesses [33].

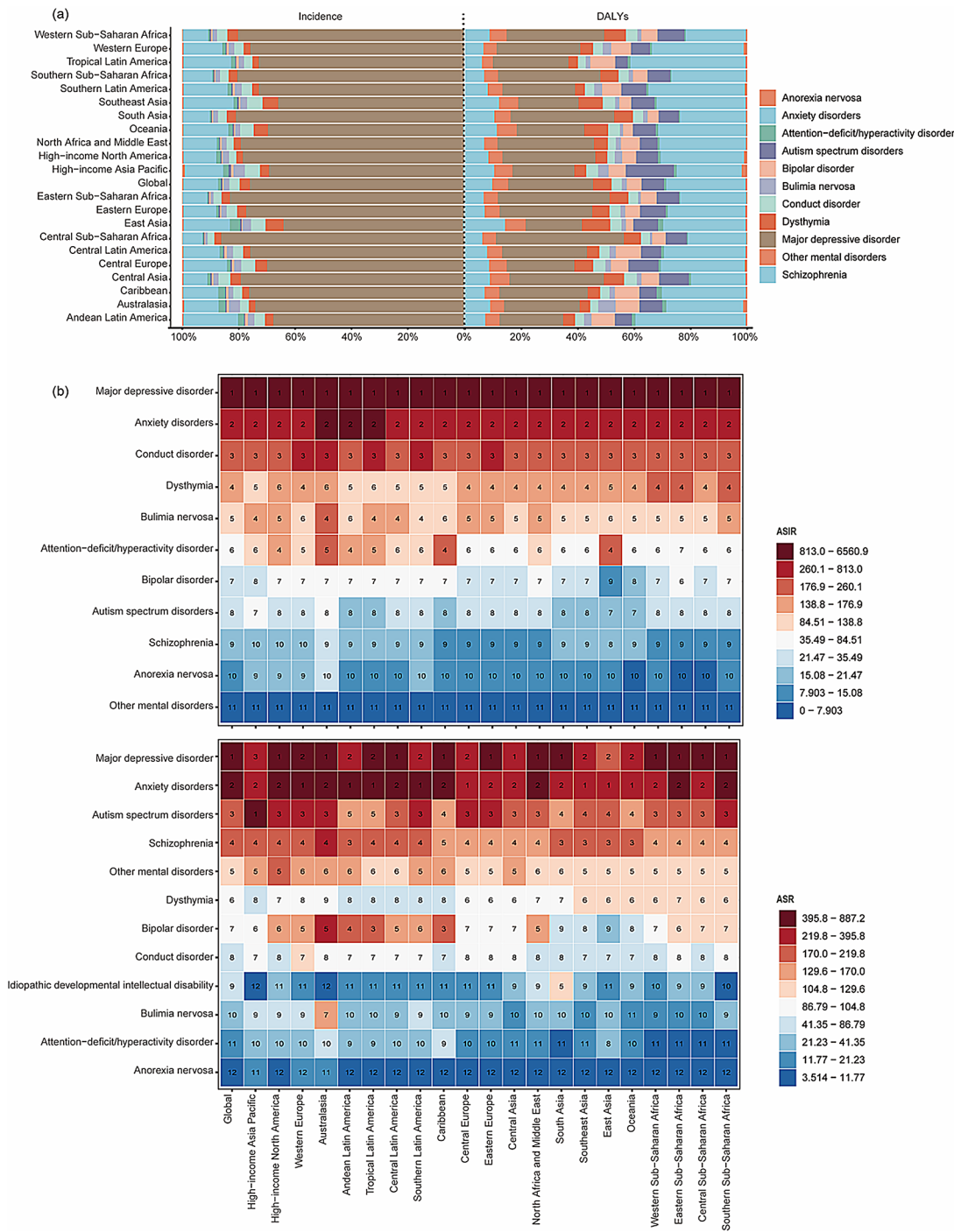


Fig. 2 The age-standardized burden for the 12 subtypes of mental disorders across regions in 2021. **(a)** Percentage of the age-standardized rates for the 12 subtypes of mental disorders; **(b)** Ranking of the age-standardized rates for mental disorders. Ranks range from 1 (dark red) with the highest rate to 12 (dark blue) with the lowest rate

Among these 12 subtypes, major depressive disorder and anxiety disorders constitute the major prevalent mental illnesses worldwide, estimated to have caused approximately 46.02 million and 42.51 million DALYs in 2021, respectively. The high burden pattern of major depressive disorder and anxiety disorders is consistent

with other studies [6, 34]. Females had a higher DALYs for anxiety disorders, major depressive disorder, bipolar disorder, dysthymia, anorexia nervosa, bulimia nervosa and idiopathic developmental intellectual disability compared to males. Despite the higher burden of mental disorders among females, the rate of DALYs for multiple

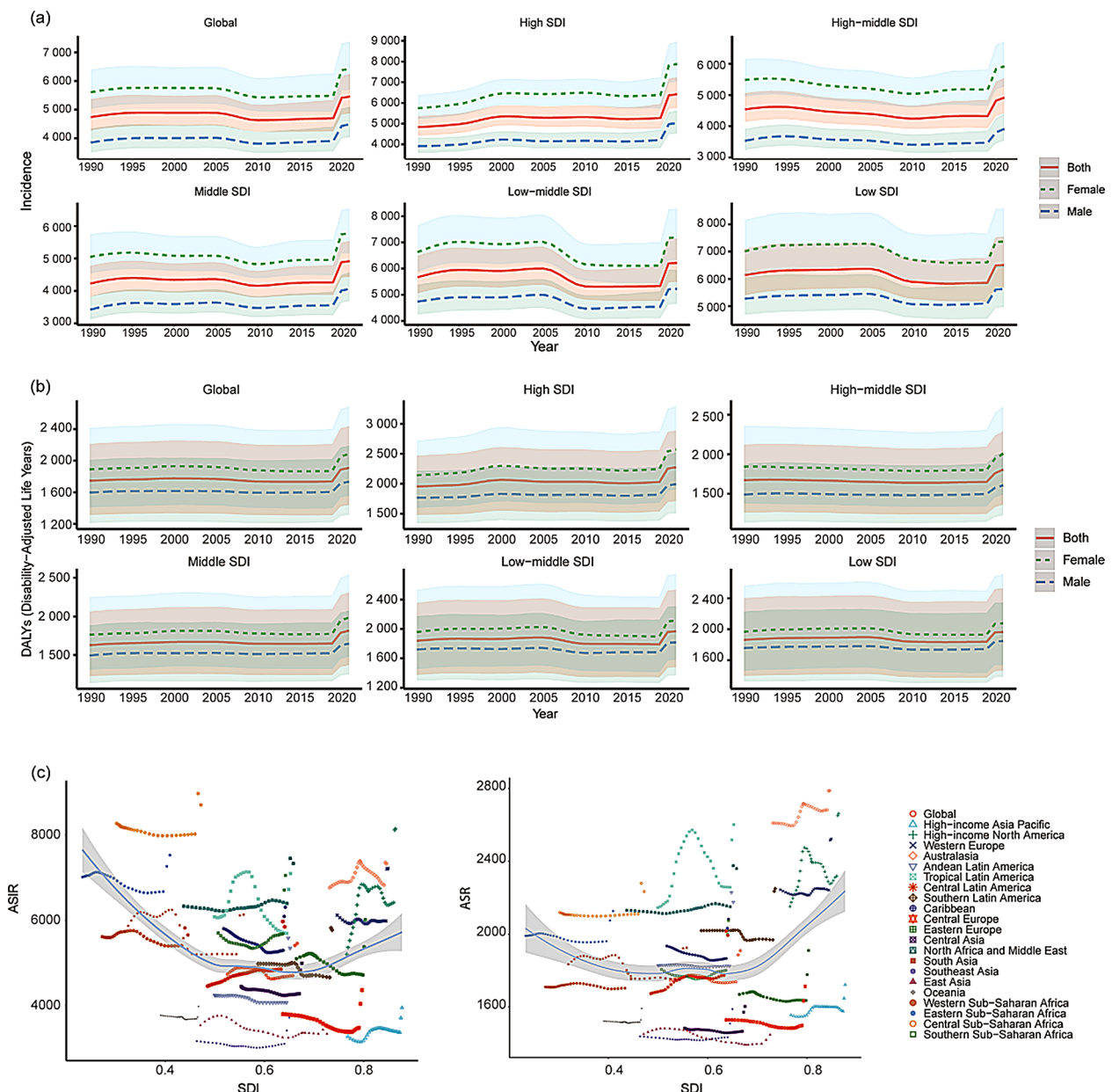


Fig. 3 Trend of the age-standardized rates of mental disorders in 1990–2021. **(a)** Temporal trends in the sex-specific age-standardized incidence rate in global and all the SDI regions; **(b)** Temporal trends in the sex-specific age-standardized DALYs rate in global and all the SDI regions; **(c)** The age-standardized rates of mental disorders in 21 GBD regions by SDI. For each region, points from left to right depict estimates from each year from 1990 to 2021. The blue line represents the average expected relationship between socio-demographic index (SDI) and burden estimates rates for mental disorders based on values from each geographical region over the 1990–2021 estimation period

mental disorders among males has increased significantly from 1990 to 2021. These results indicated that males may be more willing than in the past to seek help or be diagnosed with a mental health condition due to reduced stigma [24, 35]. The disease burden of major depressive disorder was higher in Sub-Saharan Africa and High-income North America. On the one hand, Sub-Saharan Africa has been particularly affected by the HIV infection. People diagnosed with HIV/AIDS often face social stigma and restrictions in employment and marriage,

which in some cases leads to divorce and family exclusion [36]. People living with HIV can be depressed for many reasons, such as physical discomfort, disease progression, and the fear of mortality. On the other hand, High-income North America experiences higher levels of social stress. Studies have found that social stress is a recognized risk factor for depression [37].

In this study, we estimated a continuous significant increase in the burden of major depressive disorder and anxiety disorders following the COVID-19 pandemic,

which may be associated with increasing SARS-CoV-2 infection rates and decreasing human mobility [5]. Research demonstrated that the SARS-CoV-2 infection could lead to the development of mental disorder and suicide behaviors [38, 39]. During the pandemic, people may be exposed to a wide sort of stressful or traumatic events, such as social isolation, being quarantined or infected, which can increase perceived anxiety, depression, disturbing sleep, and quality of life [40]. Our study also found that while the DALYs of schizophrenia was high, the ASR of schizophrenia globally had not changed significantly, with the ASR even slightly decreasing between 2019 and 2021.

The heavy burden of mental disorders has become a widespread public health challenge faced by countries worldwide. Although there is no significant correlation between the burden of mental disorders and the level of social development, the shortage of mental health resources in low- and middle-income countries inexorably leads to disparities in service accessibility [41]. According to the WHO 2020 Mental Health Atlas, high-income regions such as Europe have an average of 9.7 psychiatrists per 100,000 people, whereas low- and middle-income countries generally have less than 1 psychiatrist per 100,000 people. Specifically, in Africa, there is only 0.1 psychiatrist per 100,000 people. Therefore, policymakers need to integrate mental health into primary health care, prioritizing the training and recruitment of mental health professionals to bridge the resource gap. The COVID-19 pandemic has exacerbated the upward trend in mental health disorders, necessitating a swift response from public health systems. This response should entail strengthening mental health support and integrating psychological assistance into the disaster relief and early warning mechanism for major public health emergencies. Professionals should proactively intervene with affected individuals, providing access to services such as psychological crisis intervention hotlines. This will increase their opportunities to obtain mental health services, helping them cope with COVID-19-related psychological distress and thereby reducing the potential psychological harm caused by the pandemic [24].

Limitation

There are some limitations to our study. First, the death rate in mental disorders remains unclear, this rate was not specifically analyzed in our research. Second, mental disorders are burdened by multiple risk factors [16]. Intimate partner violence (IPV), childhood sexual abuse (CSA) and bullying victimization (BV) were widespread stressors that have been reported to have significant relationships with mental disorders [42]. This study did not explore risk factors of mental disorders. Future research

could further analyze attributable risk factors. Third, the COVID-19 pandemic has severely disrupted the global healthcare system, and the diagnosis, treatment, and care of patients with mental disorders have been greatly affected. This situation is likely to result in a notable increase in the burden of mental disorders post-pandemic. However, GBD 2021 categorizes COVID-19 as a separate disease with limited impact on mental disorders. The short time interval since the outbreak of the pandemic may not fully reflect this trend.

Conclusions

The overall burden of mental disorders is still increasing, and there are significant disparities among different gender, regions and subtypes. Adequate attention should be given to the disease burden in high SDI regions and among females. Among the 12 subtypes, major depressive disorder and anxiety disorders carry the heaviest disease burden. To reduce the disease burden, governments and the global health community should develop targeted prevention and intervention strategies, providing comprehensive support for mental health.

Abbreviations

GBD	Global Burden of Disease
DALYs	Disability-adjusted life-years
ASIR	Age-standardized incidence rate
ASR	Age-standardized DALY rate
SDI	Socio-demographic index
APC	Annual percent change
AAPC	Average annual percentage change
WHO	World Health Organization

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

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Author contributions

Y.F. analyzed the data and contributed to writing the manuscript. A.F. collected the data and revised the manuscript for important academic content. Z.Y. and D.F. designed the study. All authors have read and approved the final version of the manuscript.

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Data availability

GBD study 2021 data resources were available online from the Global Health Data Exchange (GHDx) query tool (<http://ghdx.healthdata.org/gbd>).

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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