Dynamic changes and future trend predictions of the global burden of anxiety disorders: analysis of 204 countries and regions from 1990 to 2021 and the impact of the COVID-19 pandemic

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Summary

Background Anxiety disorders is a significant contributor to the Global Burden of Diseases (GBD), particularly in the aftermath of the COVID-19 pandemic, which has exacerbated the issue. Previous studies have not examined the impact of the COVID-19 pandemic on anxiety disorders over the entire time series, nor have they offered predictions regarding future trends of global anxiety disorders in the aftermath of the pandemic. This study aims to present the Age-Standardized Prevalence Rates (ASPR), Age-Standardized Incidence Rates (ASIR), and disability-adjusted life years (DALYs) associated with anxiety disorders from 1990 to 2021 across 204 countries and regions, emphasizing the age structure and the disease burden following the pandemic. Additionally, it examines the relationship between the burden of anxiety disorders and the COVID-19 pandemic, as well as trend predictions for the incidence of anxiety disorders from 2022 to 2050.

Methods We analysed data from the GBD 2021 study, employed the GBD method to integrate epidemiological data on ASPR, ASIR, and DALYs to accurately assess the global burden of anxiety disorders across various regions, genders, and age groups. Additionally, joint point regression analysis was applied to rigorously examine the time trends of anxiety disorders from 1990 to 2021, calculating the annual percentage change (APC), annual average percentage change (AAPC), and their corresponding 95% confidence intervals (CIs). Furthermore, path analysis was utilized to investigate the impact pathways between the COVID-19 pandemic and anxiety disorders. Finally, a Bayesian age-period-cohort (BAPC) model was employed to predict the prevalence trends of anxiety disorders from 2022 to 2050.

Findings From 1990 to 2021, the ASPR, ASIR, and DALYs associated with anxiety disorders worldwide exhibited a significant upward trend, particularly evident from 2019 to 2021, during which all three metrics experienced a sharp increase. The most pronounced changes in the burden of anxiety disorders from 2019 to 2021 were observed in high socio-demographic index (SDI) regions, where the ASIR surpassed expected levels in tropical Latin America, high-income North America, and Australia in 2021. Bulgaria recorded the highest increase in anxiety disorders burden during this period, with a change rate of 0.32, while Bhutan experienced the smallest increase, with a total change rate of 0.02. Notably, the global anxiety disorders burden among women is greater than that among men. From 2019 to 2021, women aged 20–24 years were particularly impacted by the COVID-19 pandemic, with a change rate of 0.21. Additionally, the ASIR of COVID-19 pandemic in 2021 had a significant positive correlation with the prevalence of anxiety disorders, standardized path coefficient value of 0.224 ($z = 2.708$, $P < 0.01$). Projections indicate that by 2050, the number of individuals affected by anxiety disorders may reach 87.36 million (95% UI: 59.28–115.44). It is also anticipated that the prevalence of anxiety disorders among the 15–19 age group will exceed that of other age groups by 2050.

Interpretation The COVID-19 pandemic has significantly impacted the future burden of anxiety disorders, necessitating greater attention towards young individuals, particularly women. There is an urgent need for the

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adoption of targeted prevention and treatment strategies on a global scale, especially in high SDI regions, to effectively address the escalating issue of anxiety disorder burden.

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Keywords: Anxiety disorders; Disease burden; COVID-19 pandemic

Research in context

Evidence before this study

Anxiety disorders have been widely recognized as a major global health problem by sources such as the Global Burden of Disease (GBD) study and various epidemiological reports. We conducted a comprehensive analysis from January 1990 to December 2021, with iterative searches in PubMed and Scopus databases using terms such as "anxiety disorders", "global burden of disease" and "anxiety", "COVID-19 Pandemic" and "anxiety". We conducted a review of highly relevant articles from the searched literature to investigate the burden of disease for anxiety disorders during the COVID-19 Pandemic. We found an increased prevalence of anxiety during the COVID-19 Pandemic. However, we did not find that explored the impact of the COVID-19 Pandemic on the burden of disease for anxiety disorders over the entire timeline and that analysed and projected its long-term impact.

Added value of this study

This study provides an up-to-date and comprehensive analysis of global incidence, prevalence, and disability-adjusted life years (DALYs) due to anxiety disorders from 1990 to 2021 using the most recent data from GBD 2021. Because of the impact of the COVID-19 Pandemic on global mental health, this study focuses on the impact of the COVID-19 Pandemic on the burden of disease for anxiety disorders over the time series. The results reveal that the incidence of the COVID-19 Pandemic positively influences the prevalence of anxiety disorders. The burden of anxiety disorders in high SDI regions and among young women was most significantly affected by the pandemic, and it was predicted that the burden of anxiety disorders would tend to be younger in the future.

Implications of all the available evidence

The GBD 2021 study highlights the global burden of anxiety disorders and significant regional, country, gender, and age differences. This demonstrates the urgent need for targeted interventions, rational allocation of limited healthcare resources and development of adaptive preventive treatments and strategies to alleviate the disease burden of anxiety disorders in the aftermath of the COVID-19 epidemic pandemic at different regional, national, gender, and age levels.

Introduction

Anxiety disorders are among the most prevalent mental disorders and represent a significant global health burden.[1,2] Anxiety disorders significantly affect both personal mental and physical health, contributing to social impairments, diminished quality of life, and increased economic costs; they may also elevate the risk of suicide. Furthermore, these disorders not only impact individual mental health but are also linked to a range of physical health issues.[3] Factors contributing to the disease burden of anxiety disorders include gender, age, region, and other variables. The prevalence of anxiety disorders varies significantly among countries with different socio-demographic index (SDI) scores, with areas exhibiting high SDI showing a higher prevalence of these disorders.[4,5] Anxiety disorders are marked by a high incidence rate, a tendency for long-term relapse, and a disabling nature.[3] The global prevalence of anxiety disorders is increasing, posing a significant threat to the well-being and quality of life of the population. Particularly since 2019, the global COVID-19 pandemic has profoundly impacted mental health worldwide, especially concerning anxiety disorders. Health fears, social isolation, disruptions to daily life, and economic uncertainty resulting from the pandemic have led many individuals to experience unprecedented levels of anxiety disorders and stress.[6] Research indicates that a notable increase in anxiety disorders symptoms has been reported by many during the pandemic, particularly among those facing unemployment, lacking social support, and confronting health risks. Notably, the incidence of anxiety disorders has risen significantly since the onset of the COVID-19 pandemic in 2019. Studies indicate that the prevalence of anxiety disorders during the pandemic reached 46%.[7] Furthermore, major depressive disorder and anxiety disorders saw increases

of 28% and 26%, respectively, globally in 2020, with prevalence rising markedly in countries severely affected by **COVID-19 pandemic**, particularly among women and young people.[8]

The rise in the global burden of anxiety disorders following the COVID-19 pandemic is concerning. However, in comparison to cancer, cardiovascular diseases, and other health conditions, anxiety disorders have not been prioritized as a critical global health issue. The significant burden of anxiety disorders and the widespread occurrence of various disorders necessitate immediate attention from all nations. It is essential to develop targeted healthcare strategies informed by the current epidemiological landscape, complemented by suitable policies and public health measures. Previous studies have primarily focused on the burden of anxiety disorders at specific points in time or have conducted time series analyses on data collected prior to 2019. Previous researchers have conducted studies on the impact of the covid-19 pandemic on anxiety burden, but there is a lack of research that predicts the future trends of the global anxiety disorder burden by integrating burden data collected during the pandemic and exploring the pandemic's influence on the development of future anxiety disorder burden. The focus of this study is to understand the global burden of anxiety disorders, examining trends from 1990 to 2021, analyzing the impact of the COVID-19 pandemic on the burden of anxiety while exploring differences by gender and age group, and projecting future prevalence trends up to 2050. Our goal was to provide a crucial basis for the future prevention, treatment, and intervention strategies for anxiety disorders, as well as to establish a foundation for the rational allocation of mental health resources and the formulation of public health policies.

Methods

Data collection and download

We obtained the data in this study from Global Burden of Diseases (GBD) 2021 public datasets available from https://vizhub.healthdata.org/gbd-results/. The 2021 GBD Study employs the most recent epidemiological data and improved standardized methodologies to deliver a comprehensive assessment of 369 diseases, injuries, and injury-related health effects, as well as 88 risk factors, across 204 countries and territories.[9] Our analyses were limited to precise values of prevalence, incidence, and disability-adjusted life years and COVID-19 prevalence, incidence data associated with anxiety disorders and their 95% uncertainty intervals (UIs). Furthermore, the study SDI, a metric that quantifies the sociodemographic development level of a region based on income, education, and fertility. Due to patient information desensitization in the GBD study, the Institutional Review Board of the University of Washington approved the waiver of informed consent.

Definition of anxiety and description of burden

Patients with anxiety disorders included in this study, they are characterized by excessive and persistent fear, anxiety disorders, or avoidance of perceived threats, and may also be accompanied by panic attacks.[10] This classification is based on the diagnostic criteria outlined in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), and the International Classification of Diseases, Eleventh Edition (ICD-11),[11] which encompass three levels: cognitive, emotional, and somatic. The key symptoms that classify anxiety disorders include separation anxiety disorders, selective mutism, specific phobia, social anxiety disorder, panic disorder, agoraphobia, and generalized anxiety disorder. In 2021, a comprehensive assessment was conducted to quantify the burden of anxiety disorders at the national level, focusing on prevalence, incidence, and disability-adjusted life years. The survey also examines the demographic variables that influence the prevalence of anxiety disorders and investigates the distribution of the disorder's burden across different age groups and genders.

Statistical analysis

This study first used joint point regression analysis, which is a statistical method commonly used in epidemiological research to evaluate the temporal trend of disease prevalence or mortality. This model effectively identifies and quantifies significant changes in the prevalence of anxiety disorders in time series data at the global, different SDI regions, and national levels. Helps to calculate annual percentage change (APC) and its corresponding 95% confidence interval (CI), allowing for trends throughout the entire study time frame. In addition, to comprehensively evaluate the observed trends, we calculated the annual average percentage change (AAPC) and summarized the trend data from 1990 to 2021. In statistics, when the APC or AAPC estimate and its 95% confidence interval lower limit exceed zero, it indicates an upward trend; On the contrary, when the estimated 95% CI upper limit is below zero, it indicates a decrease If the 95% confidence interval of APC or AAPC is zero, it indicates that the trend remains stable.

$$\text{Total rate of change} = \frac{(a_{2019} - a_{1990})}{a_{1990}} \times 100\%$$

$$\text{Annual average rate of change} = \sqrt[n]{\frac{a_n}{a_0}} - 1$$

Age standardized incidence rate (ASIR), age standardized prevalence rate (ASPR) and age standardized **disability-adjusted life years (DALYs)** per 100,000 people are used to quantify differences in anxiety disorders burden in different historical periods, genders and

regions to avoid differences in age composition of the population. Joinpoint regression analysis was conducted using Joinpoint 4.9.0.0 software. Secondly, this study applied path analysis to analyze the path relationship between the COVID-19 pandemic and anxiety disorders, we firstly did the analysis of co-variance between the two data-sets, and secondly, we analyzed the COVID-19 pandemic in 2020 and 2021 with the ASPRs, ASIRs, and DALYs of anxiety disorders, to explore the paths of the influence of the two in the horizontal timeline and the vertical timeline. Finally, we applied Bayesian age-period-cohort (BAPC) to predict the trend of prevalence of anxiety disorders from 2022 to 2050 by dividing the age in 5-year intervals into 19 age groups of 5–9 years old, 10–14 years old .....90–94 years old, and ≥95 years old, and calculating a Bayesian formula based on 3 factors: age, period, and cohort, and by applying the Bayesian formula to calculate the hypothesized probability distribution based on 3 factors: age, period, and cohort, and by combining the prior and sample information to derive the posterior information. The statistical computing application software R (version 4.3.2) (https://www.R-project.org/) was used. All analyzed results with $P < 0.05$ were considered statistically significant.

Role of the funding source

The funder of this study played no role in the design of the study, the collection of data, the analysis of data, the interpretation of data, or the writing of the report. The first author had complete access to the data, while the corresponding author held final responsibility for the decision to submit the manuscript for publication.

Results

Regional and national anxiety disorders burden

This study analyzed GBD data from various regions and countries, revealing that from 1990 to 2021, the overall ASPR, ASIR, and DALYs associated with anxiety disorders worldwide have consistently increased, with a notable surge occurring from 2005 to 2021. The ASPR for anxiety disorders exhibited an average annual change of 0.84 from 1990 to 2005; however, this figure escalated to 4.92 from 2005 to 2021, resulting in an AAPC of 0.61 (Table 1). In contrast, the ASIR for anxiety disorders demonstrated a change rate of –0.30 from 1990 to 2005, followed by a significant increase to 7.52 from 2005 to 2021, with an AAPC value of 0.69. The DALYs associated with anxiety disorders also increased, from 0.12 during the period from 1990 to 2005 to 4.92 from 2005 to 2021, with an AAPC of 0.60 (Table 2). To investigate the variations in the burden of anxiety disorders across different regions from 1990 to 2021, this study first classified and analyzed global regions based on SDI. The findings indicated that from 2019 to 2021, the total change rates of ASPR, ASIR, and DALYs in high SDI regions were the highest, recorded at 0.19, 0.22, and 0.19, respectively. The corresponding AAPCs were 0.75 (95% UI: 0.30–1.20), 0.93 (95% UI: 0.57–1.29), and 0.77% (95% UI: 0.54%–1.01%) (Table 2). The highest annual average change rates of ASPR, ASIR, and DALYs in high SDI areas from 2005 to 2021 were 56.46, 9.42, and 6.61, respectively (Fig. 1A–C). In high SDI regions, the highest incidence rate was 668.9 cases per 100,000 people (95% UI: 917.3–463.4) (Table 1 and Fig. 1C).

This study analyzed the burden of anxiety disorders across different regions classified by the GBD grouping and identified a positive correlation between GBD regions and ASIR at the regional level. To investigate the specific years during which the burden of anxiety disorders experienced a sudden increase, a joint point regression analysis was conducted. The results indicated that from 1990 to 2021, and specifically from 2019 to 2021, the ASPR, ASIR, and DALYs all exhibited a sudden upward trend, with AAPC of 0.61% (95% UI: 0.44%–0.77%; $P < 0.01$), 0.69% (95% UI: 0.49%–0.89%; $P < 0.01$), and 0.60% (95% UI: 0.41%–0.79%; $P < 0.01$), respectively (Supplementary Figures S1–S3 and Table 2). In the joint point regression analysis, we observed differences in the burden of anxiety disorders across various SDI regions worldwide. High SDI regions exhibited the most significant growth trends in ASPR, ASIR, and DALYs from 2019 to 2021, with AAPC values of 0.75% (95% UI: 0.30%–1.20%; $P < 0.01$), 0.93% (95% UI: 0.57%–1.29%; $P < 0.01$), and 0.77% (95% UI: 0.54%–1.01%; $P < 0.01$), respectively (Fig. 1 and Table 2). An analysis of 21 GBD regions revealed that the ASIR ratios for anxiety disorders in tropical Latin America, high-income North America, and Australia were higher than anticipated (Fig. 2A). To identify specific countries with a severe burden of anxiety disorders, this study analyzed the differences among 204 countries. Our analysis of the anxiety disorders burden in 2021 revealed that Portugal had the highest ASPR, ASIR, and DALYs, with values of 9712.44 cases per 100,000 people (95% UI: 6864.89–13062.44), 1290.64 cases per 100,000 people (95% UI: 929.74–1775.32), and 1156.75 cases per 100,000 people (95% UI: 692.93–1723.82), respectively (Figs. 2B and 3A–C). In contrast, Inner Mongolia recorded the lowest ASPR, ASIR, and DALYs, with figures of 2256.89 cases per 100,000 people (95% UI: 3146.73–1636.92), 377.89 cases per 100,000 people (95% UI: 271.89–517.95), and 268.06 cases per 100,000 people (95% UI: 167.42–389.76), respectively (Fig. 3A–C). Additionally, we found that Bulgaria experienced the highest increase in anxiety disorders burden from 2019 to 2021, with a total change rate of 0.32 (95% UI: 0.22–0.40), while Bhutan had the lowest increase, with a total change rate of 0.02 (95% UI: –0.11 to 0.09) (Supplementary Table S1).

year	Prevalence (1/100,000)			Incidence (1/100,000)			Disability-adjusted life years (1/100,000)		
	Male	Female	Both	Male	Female	Both	Male	Female	Both
Global									
1990	2807.4 (2410.0, 3284.8)	4674.2 (4018.0, 5451.7)	3746.4 (3234.7, 4368.5)	479.3 (402.2, 579.8)	649.3 (537.7, 795.8)	562.5 (468.3, 686.1)	335.9 (231.2, 461.1)	550.7 (383.1, 745.5)	443.7 (306.2, 603.3)
2005	2747.4 (2382.9, 3182.6)	4761.7 (4127.4, 5483.4)	3759.1 (3264.4, 4328.2)	470.3 (397.8, 563.5)	649.1 (539.9, 787.7)	557.9 (465.9, 674.8)	329.1 (226.8, 453.3)	561.3 (389.7, 764.1)	445.5 (307.8, 608.5)
2021	3308.5 (2830.4, 3887.8)	5535.6 (4730.4, 6495.3)	4421.9 (3768.3, 5182.1)	576.5 (486.3, 701.8)	784.5 (649.3, 966.0)	678.3 (565.2, 832.4)	396.9 (272.3, 547.7)	652.2 (453.4, 887.2)	524.3 (363.1, 716.3)
Total rate of change (%)	0.15 (0.15, 0.16)	0.16 (0.15, 0.16)	0.15 (0.14, 0.16)	0.17 (0.17, 0.17)	0.17 (0.17, 0.18)	0.17 (0.17, 0.18)	0.15 (0.15, 0.16)	0.16 (0.16, 0.16)	0.15 (0.16, 0.16)
Average annual rate of change (%)									
1990–2005	−4.00 (−6.81, −1.81)	5.83 (2.12, 7.29)	0.84 (−2.68, 1.98)	−0.60 (−1.08, −0.29)	−0.01 (−0.54, 0.15)	−0.30 (−0.75, −0.16)	−0.45 (−0.51, −0.29)	0.71 (0.45, 1.24)	0.12 (0.10, 0.35)
2005–2019	35.07 (27.97, 44.08)	48.37 (37.69, 63.24)	41.43 (31.49, 53.36)	6.64 (5.53, 8.64)	8.46 (6.83, 11.14)	7.52 (6.20, 9.85)	4.24 (2.84, 5.90)	5.68 (3.98, 7.69)	4.92 (3.46, 6.74)
High SDI									
1990	3235.1 (2774.5, 3786.0)	5828.0 (5010.2, 6814.0)	4544.4 (3905.8, 5298.2)	552.2 (462.6, 672.6)	771.2 (634.4, 953.3)	658.9 (548.6, 807.9)	388.1 (265.0, 532.2)	689.5 (477.5, 941.5)	539.9 (370.9, 737.4)
2005	3370.6 (2919.6, 3890.5)	6105.7 (5364.4, 6961.1)	4736.2 (4119.2, 5404.3)	573.9 (478.9, 695.6)	814.2 (673.9, 1000.36)	690.8 (576.3, 835.9)	404.8 (280.2, 555.4)	722.5 (503.2, 981.3)	563.1 (389.2, 771.4)
2021	4035.2 (3405.3, 4780.6)	7297.3 (6223.9, 8669.8)	5639.5 (4807.4, 6672.6)	698.2 (587.1, 844.3)	994.4 (819.7, 1218.2)	841.6 (702.1, 1030.9)	484.1 (331.2, 668.9)	860.5 (593.2, 1173.5)	668.9 (463.4, 917.3)
Total rate of change (%)	0.20 (0.19, 0.21)	0.20 (0.20, 0.21)	0.19 (0.19, 0.21)	0.21 (0.20, 0.21)	0.22 (0.22, 0.23)	0.22 (0.22, 0.22)	0.20 (0.20, 0.20)	0.20 (0.19, 0.20)	0.19 (0.20, 0.20)
Average annual rate of change (%)									
1990–2005	9.04 (6.96, 9.68)	18.51 (9.80, 23.61)	12.79 (7.07, 14.23)	1.45 (1.09, 1.53)	2.86 (2.64, 3.14)	2.13 (1.85, 1.87)	1.11 (1.01, 1.54)	2.20 (1.71, 2.65)	1.55 (1.22, 2.27)
2005–2019	41.54 (30.36, 55.63)	74.48 (53.72, 106.79)	56.46 (43.01, 79.27)	7.77 (6.76, 9.29)	11.26 (9.11, 13.61)	9.42 (7.86, 12.19)	4.96 (3.18, 7.10)	8.62 (5.62, 12.01)	6.61 (4.63, 9.12)
High-middle SDI									
1990	2628.1 (2242.1, 3068.4)	4752.9 (4104.2, 5503.1)	3708.6 (3214.5, 4297.1)	453.7 (382.2, 542.8)	669.8 (562.8, 819.8)	559.4 (469.0, 679.8)	316.0 (218.3, 437.9)	564.3 (391.4, 767.2)	441.9 (306.7, 605.2)
2005	2501.6 (2157.4, 2878.1)	4681.1 (4085.0, 5385.7)	3602.6 (3141.4, 4141.1)	437.4 (373.4, 519.1)	663.1 (558.5, 802.4)	547.5 (464.5, 655.1)	301.9 (208.5, 413.9)	557.2 (391.5, 759.1)	430.5 (302.4, 589.3)
2021	3072.6 (2571.4, 3661.3)	5609.8 (4757.2, 6606.8)	4325.3 (3667.4, 5079.8)	540.6 (447.0, 664.8)	810.1 (666.4, 1014.9)	669.8 (553.8, 827.7)	371.2 (248.1, 515.4)	667.8 (454.5, 909.1)	517.3 (350.4, 711.2)
Total rate of change (%)	0.14 (0.13, 0.16)	0.15 (0.14, 0.17)	0.14 (0.12, 0.15)	0.16 (0.14, 0.18)	0.17 (0.16, 0.19)	0.16 (0.15, 0.18)	0.15 (0.12, 0.15)	0.15 (0.14, 0.16)	0.15 (0.12, 0.15)
Average annual rate of change (%)									
1990–2005	−8.43 (−12.70, −5.64)	−4.79 (−7.82, −1.28)	−7.07 (−10.40, −4.87)	−1.08 (−1.58, −0.59)	−0.45 (−1.16, −0.29)	−0.79 (−1.65, −0.30)	−0.95 (−1.60, −0.65)	−0.47 (−0.54, 0.01)	−0.76 (−1.06, −0.29)
2005–2019	35.69 (25.88, 48.96)	58.04 (42.01, 76.32)	45.17 (32.88, 58.67)	6.45 (4.60, 9.11)	9.19 (6.75, 13.28)	7.65 (5.58, 10.79)	4.34 (2.48, 6.34)	6.91 (3.94, 9.38)	5.42 (3.00, 7.62)
Middle SDI									
1990	2855.1 (2472.3, 3302.1)	4581.5 (3964.4, 5303.2)	3710.5 (3222.2, 4290.1)	484.2 (408.6, 579.7)	657.2 (545.4, 797.0)	568.6 (474.4, 686.6)	432.6 (237.2, 467.4)	541.4 (374.4, 737.0)	441.1 (304.7, 599.6)
2005	2797.3 (2430.5, 3202.9)	4889.6 (4239.9, 5610.1)	3839.4 (3350.4, 4406.0)	477.9 (406.7, 564.6)	671.4 (559.3, 812.5)	572.6 (480.7, 686.2)	336.1 (232.6, 460.5)	578.1 (398.8, 786.4)	456.5 (315.2, 623.5)
2021	3400.9 (2919.6, 3957.5)	5724.5 (4909.6, 6648.7)	4556.6 (3889.4, 5294.1)	589.1 (495.8, 714.8)	818.8 (673.6, 1003.9)	700.9 (582.4, 859.4)	408.8 (282.7, 565.3)	676.9 (467.2, 921.5)	541.9 (374.7, 741.6)
Total rate of change (%)	0.16 (0.15, 0.17)	0.20 (0.19, 0.20)	0.19 (0.17, 0.19)	0.18 (0.18, 0.19)	0.20 (0.19, 0.21)	0.19 (0.19, 0.20)	0.16 (0.16, 0.17)	0.20 (0.20, 0.20)	0.19 (0.19, 0.19)
Average annual rate of change (%)									
1990–2005	−3.86 (−6.61, −2.79)	20.54 (18.37, 20.46)	8.59 (7.73, 8.55)	−0.42 (−1.00, −0.12)	0.94 (0.92, 1.03)	0.27 (−0.03, 0.42)	−0.43 (−0.46, −0.30)	2.45 (1.63, 3.29)	1.03 (0.71, 1.59)
2005–2019	37.72 (30.57, 47.16)	52.18 (41.86, 64.91)	44.83 (33.69, 55.51)	6.94 (5.57, 9.38)	9.21 (7.14, 11.96)	8.02 (6.36, 10.83)	4.55 (3.13, 6.55)	6.17 (4.27, 8.44)	5.34 (3.72, 7.38)
Low-middle SDI									
1990	2694.6 (2269.2, 3171.6)	4076.8 (3467.1, 4813.3)	3376.2 (2864.6, 3983.7)	468.7 (392.5, 567.4)	594.5 (489.0, 733.9)	530.7 (437.5, 651.4)	319.8 (218.0, 436.0)	474.9 (330.3, 640.5)	396.3 (274.5, 536.2)
2005	2663.4 (2284.9, 3099.2)	4285.6 (3706.7, 4953.0)	3471.1 (2999.5, 4011.5)	460.6 (387.8, 549.3)	596.4 (495.6, 724.9)	527.5 (438.6, 641.4)	316.7 (217.7, 432.4)	499.6 (346.5, 672.9)	407.7 (280.6, 550.5)
2021	3201.8 (2712.3, 3782.6)	5013.5 (4275.6, 5894.6)	4110.3 (3502.9, 4813.7)	565.3 (468.9, 686.8)	736.1 (603.5, 913.6)	649.4 (534.8, 801.3)	382.5 (266.6, 523.6)	586.7 (406.8, 790.4)	484.8 (338.1, 655.6)
Total rate of change (%)	0.16 (0.16, 0.16)	0.19 (0.18, 0.19)	0.18 (0.17, 0.18)	0.17 (0.16, 0.17)	0.19 (0.19, 0.20)	0.18 (0.18, 0.19)	0.16 (0.17, 0.18)	0.19 (0.19, 0.19)	0.18 (0.18, 0.19)
Average annual rate of change (%)									
1990–2005	−2.08 (−4.82, 1.05)	13.92 (9.31, 15.97)	6.32 (1.85, 9.00)	−0.54 (−1.21, −0.31)	0.13 (−0.60, 0.44)	−0.21 (−0.67, 0.08)	−0.21 (−0.24, −0.02)	1.64 (1.08, 2.16)	0.76 (0.41, 0.95)
2005–2019	33.65 (26.71, 42.71)	45.50 (35.56, 58.85)	39.96 (31.47, 50.14)	6.54 (5.06, 8.59)	8.72 (6.75, 11.79)	7.62 (6.01, 10.00)	4.11 (3.06, 5.70)	5.44 (3.77, 7.35)	4.82 (3.58, 6.57)
Low SDI									
1990	2726.9 (2274.1, 3278.2)	3874.0 (3248.4, 4641.0)	3300.6 (2770.4, 3963.4)	470.8 (387.7, 581.1)	570.2 (465.8, 715.3)	520.6 (425.2, 649.8)	323.2 (219.6, 444.1)	449.8 (307.7, 608.6)	386.5 (264.1, 525.8)
2005	2675.7 (2228.9, 3227.7)	3845.4 (3207.9, 4576.4)	3260.9 (2725.2, 3894.1)	463.1 (385.9, 570.9)	562.9 (462.1, 704.9)	512.7 (423.4, 638.4)	317.6 (214.3, 435.8)	448.1 (307.1, 612.2)	382.9 (262.2, 521.9)
2021	3113.6 (2544.8, 3800.1)	4437.4 (3634.9, 5364.5)	3782.3 (3110.3, 4584.1)	543.8 (449.6, 671.7)	663.7 (542.8, 831.4)	603.9 (496.2, 752.2)	372.2 (245.3, 509.4)	519.1 (348.2, 708.7)	446.4 (296.1, 609.8)
Total rate of change (%)	0.12 (0.11, 0.14)	0.13 (0.11, 0.13)	0.13 (0.11, 0.14)	0.13 (0.13, 0.14)	0.14 (0.14, 0.14)	0.14 (0.14, 0.14)	0.13 (0.10, 0.13)	0.13 (0.12, 0.14)	0.13 (0.11, 0.14)
Average annual rate of change (%)									
1990–2005	−3.41 (−3.37, −3.02)	−1.91 (−4.31, −2.70)	−2.64 (−4.63, −3.01)	−0.53 (−0.68, −0.12)	−0.48 (−0.69, −0.24)	−0.52 (−0.76, −0.12)	−0.37 (−0.56, −0.35)	−0.11 (−0.04, 0.24)	−0.24 (−0.26, −0.12)
2005–2021	27.37 (19.74, 35.78)	37.00 (26.69, 49.25)	32.59 (24.07, 43.13)	5.05 (3.98, 6.30)	6.30 (5.04, 7.91)	5.70 (4.55, 7.11)	3.41 (1.94, 4.60)	4.44 (2.57, 6.03)	3.97 (2.12, 5.49)

PREVALENCE-The proportion of people in a population who are a case of a disease, injury or sequela, INCIDENCE–The number of new cases of a given cause during. A given period in a specified population, DALYs, Disability-adjusted life years; SDI, sociodemographic index.

Table 1: **Burden of anxiety disorder related to different SDI regions in the world from 1990 to 2021.**

	Global			High SDI			High-middle SDI			LOW SDI			Low middle SDI			Middle SDI		
	Male	Female	Both	Male	Female	Both	Male	Female	Both	Male	Female	Both	Male	Female	Both	Male	Female	Both
Prevalence																		
AAPC	0.59	0.61	0.61	0.76	0.87	0.75	0.53	0.56	0.52	0.48	0.50	0.50	0.62	0.76	0.72	0.62	0.78	0.73
Lower CI	0.44	0.48	0.44	0.31	0.57	0.30	0.41	0.42	0.33	0.43	0.43	0.45	0.57	0.69	0.69	0.50	0.61	0.57
Upper CI	0.75	0.75	0.77	1.21	1.17	1.20	0.65	0.70	0.72	0.52	0.56	0.54	0.67	0.82	0.76	0.73	0.96	0.89
P-value	<0.001	<0.001	<0.001	<0.001	<0.001	0.00106	<0.001	<0.001	<0.001	<0.001	0.0006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Incidence																		
AAPC	0.66	0.70	0.69	0.80	0.93	0.93	0.61	0.65	0.64	0.52	0.56	0.55	0.68	0.80	0.75	0.70	0.78	0.76
Lower CI	0.53	0.47	0.49	0.48	0.70	0.57	0.46	0.48	0.43	0.48	0.49	0.51	0.63	0.74	0.72	0.59	0.64	0.56
Upper CI	0.79	0.94	0.89	1.12	1.16	1.29	0.75	0.81	0.86	0.56	0.62	0.60	0.72	0.86	0.79	0.80	0.93	0.96
P-value	<0.001	<0.001	<0.001	<0.001	<0.001	0.00106	<0.001	<0.001	<0.001	<0.001	0.0006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Disability-adjusted life years																		
AAPC	0.60	0.60	0.60	0.79	0.80	0.77	0.56	0.57	0.53	0.50	0.53	0.52	0.64	0.77	0.73	0.60	0.77	0.75
Lower CI	0.50	0.40	0.41	0.49	0.58	0.54	0.50	0.38	0.39	0.44	0.47	0.48	0.54	0.67	0.67	0.44	0.50	0.55
Upper CI	0.70	0.81	0.79	1.09	1.02	1.01	0.62	0.75	0.68	0.57	0.58	0.57	0.73	0.86	0.79	0.77	1.05	0.95
P-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

CI, Confidence interval.

Table 2: **Trend analysis of the anxiety disorder burden in different income regions of the world from 1990 to 2021, AAPC–Average annual percent change.**

Age and sex anxiety disorders burden

This study analyzes the differences in the burden of anxiety disorders across various genders and age groups. Firstly, we examined the disparities in anxiety disorders burden between genders, revealing that from 1990 to 2021, the analysis of ASPR, ASIR, and DALYs for global male and female anxiety disorders consistently indicated a higher proportion among women compared to men (Fig. 4 and Supplementary Figures S1–S3). Additionally, we compared the growth rates of anxiety disorder burdens for men and women from 2019 to 2021, finding that the growth rate for women exceeded that of men (Supplementary Figures S1–S3). Secondly, we further investigated the differences in anxiety disorders burden across various age groups in 2021. The results indicated that the age group with the highest prevalence of anxiety disorders worldwide was 25–29 years, while the age group with the highest incidence rate was 10–14 years (Fig. 4A, B). Furthermore, the age group with the highest DALYs was also 25–29 years (Fig. 4C). We analyzed the overall change in anxiety disorders incidence rates by gender and age structure from 2019 to 2021, discovering that the highest total change rate was observed in women aged 20–24, with a total change rate of 0.214, followed closely by women aged 15–19 and both sex aged 20–24, with a total change rate of 0.209 and 0.208 (Supplementary Table S2).

The relationship between COVID-19 pandemic and the burden of anxiety disorders and future predictions

By analyzing the anxiety disorders burden across various regions, countries, age groups, and genders worldwide, it was observed that between 2019 and 2021, there was a significant increase in anxiety disorders burden. This rise may be attributed to the global COVID-19 pandemic during the same period. To investigate this relationship, we conducted an association analysis to examine the connection between anxiety disorder burden and COVID-19 pandemic. First, covariance analysis indicated no significant co-variance between anxiety disorder burden and COVID-19 data-sets (VIF = 1.616, P = 0.02). Second, correlation analysis conducted in 2020 and 2021 revealed a significant correlation between the ASIR of COVID-19 pandemic and the ASPR of anxiety disorders ($P < 0.05$). Lastly, further analysis of both data-sets aimed to uncover specific pathways of influence. The results indicated that the ASIR of COVID-19 pandemic in 2021 had a significant effect on the ASPR of anxiety disorders in 2021, with a standardized path coefficient value of 0.224, which is greater than zero. This pathway was significantly expressed at the 0.01 level ($z = 2.708$, $P < 0.01$) (Fig. 5).

The sudden increase in the burden of anxiety disorders may have significant implications for the future. In this context, we further predicted the future prevalence of anxiety disorders following the impact of the COVID-19 pandemic. We employed BAPC analysis to initially estimate the prevalence of gender dysphoria within the globally standardized age group. The results indicated a slight initial decrease in prevalence, followed by a continuous increase in subsequent years (Fig. 6A). By 2030, the prevalence of anxiety disorders is projected to rise to 4565.65 per 100,000 people (95% UI: 3956.19–5175.12). By 2050, this prevalence is expected to reach 5752.68 per 100,000 people (95% UI: 3984.78–7520.58) (Supplementary Table S3). Furthermore, our analysis of anxiety disorder prevalence across

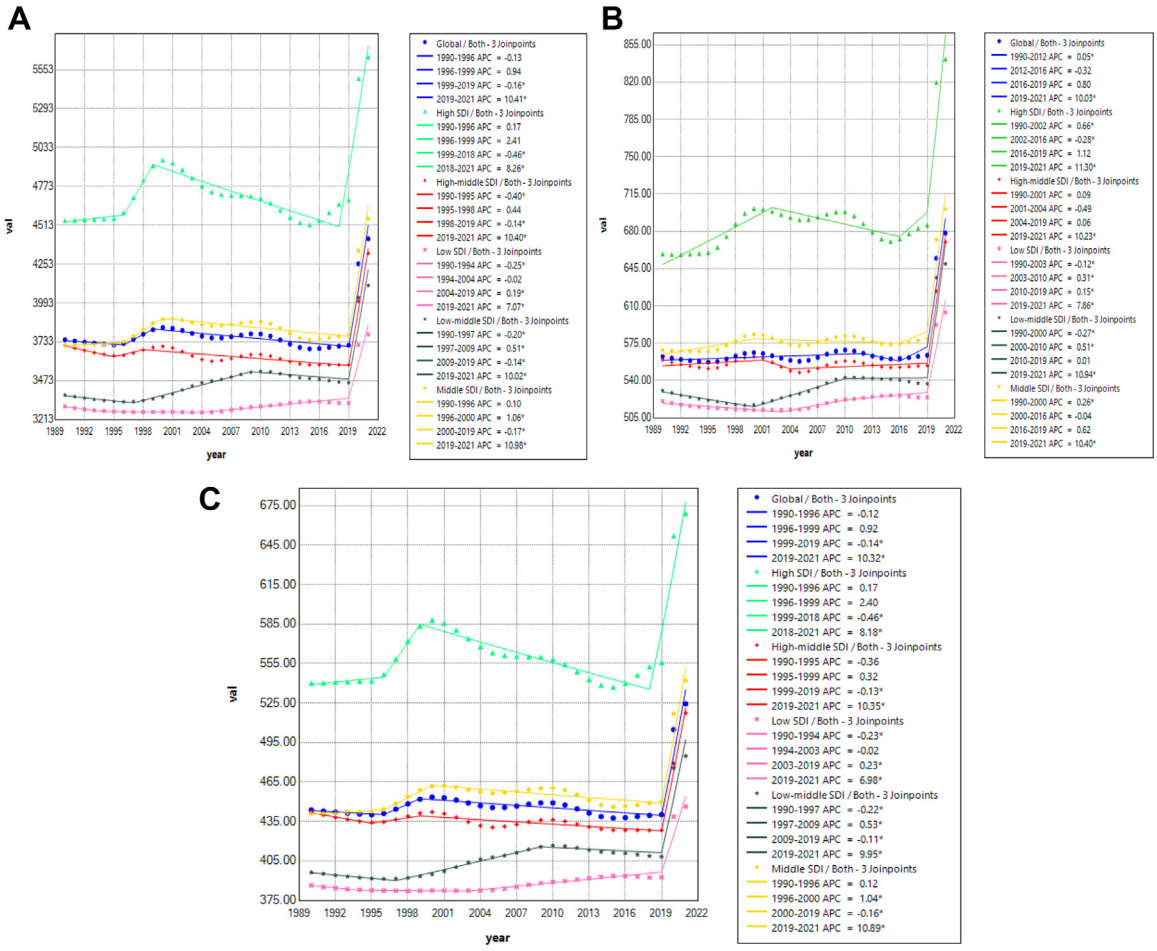

Fig. 1: **Trends in jointpoint regression analyses of age-standardized rates (per 100,000 population) of anxiety disorders across SDI regions from 1990 to 2021 (A) age-standardized prevalence rates of anxiety disorders; (B) age-standardized incidence rates of anxiety disorders; (C) age-standardized DALYs rates for anxiety. SDI, socio-demographic index; DALYs, disability-adjusted life years.**

different age groups revealed that by 2050, the 15–19 age group will exhibit the highest prevalence, estimated at 8307.99 per 100,000 people (95% UI: 5285.01–11330.98). An analysis of the changes in age and gender prevalence rates from 2022 to 2050 reveals that historically, the age group with the highest prevalence of anxiety disorders was between 35 and 55 years old. However, predictions indicate that from 2036 to 2050, the prevalence of anxiety disorders among women in the 15–19 age group will surpass that of all other age groups, with the 20–24 age group, encompassing all genders, occupying the second highest prevalence position (Supplementary Table S4, Fig. 6B).

Discussion

The results indicate that the global burden of anxiety disorders has exhibited a consistent upward trend from 1990 to 2021. Notably, between 2005 and 2021, the increases in anxiety disorder ASPR, ASIR, and DALYs were particularly pronounced, with their change rates rising from 0.84, –0.30, and 0.12 from 1990 to 2005, to 4.92, 7.52, and 4.92 from 2005 to 2021, respectively. This substantial increase in the burden of anxiety disorders during this period not only reflects the epidemiological trends of these disorders but is also closely associated with significant global events, socio-economic conditions, heightened awareness of mental health issues, and modifications in data collection and reporting methodologies.[12,13]

Subsequently, this study applied joint point regression analysis to explore the specific years of the sudden increase in anxiety disorders burden from 2005 to 2021. The results indicated that there was a notable surge in global anxiety disorders burden between 2019 and 2021, suggesting that the COVID-19 pandemic may have created an environment that suddenly exacerbated the global anxiety disorders burden.[14–17] Next, we analyzed

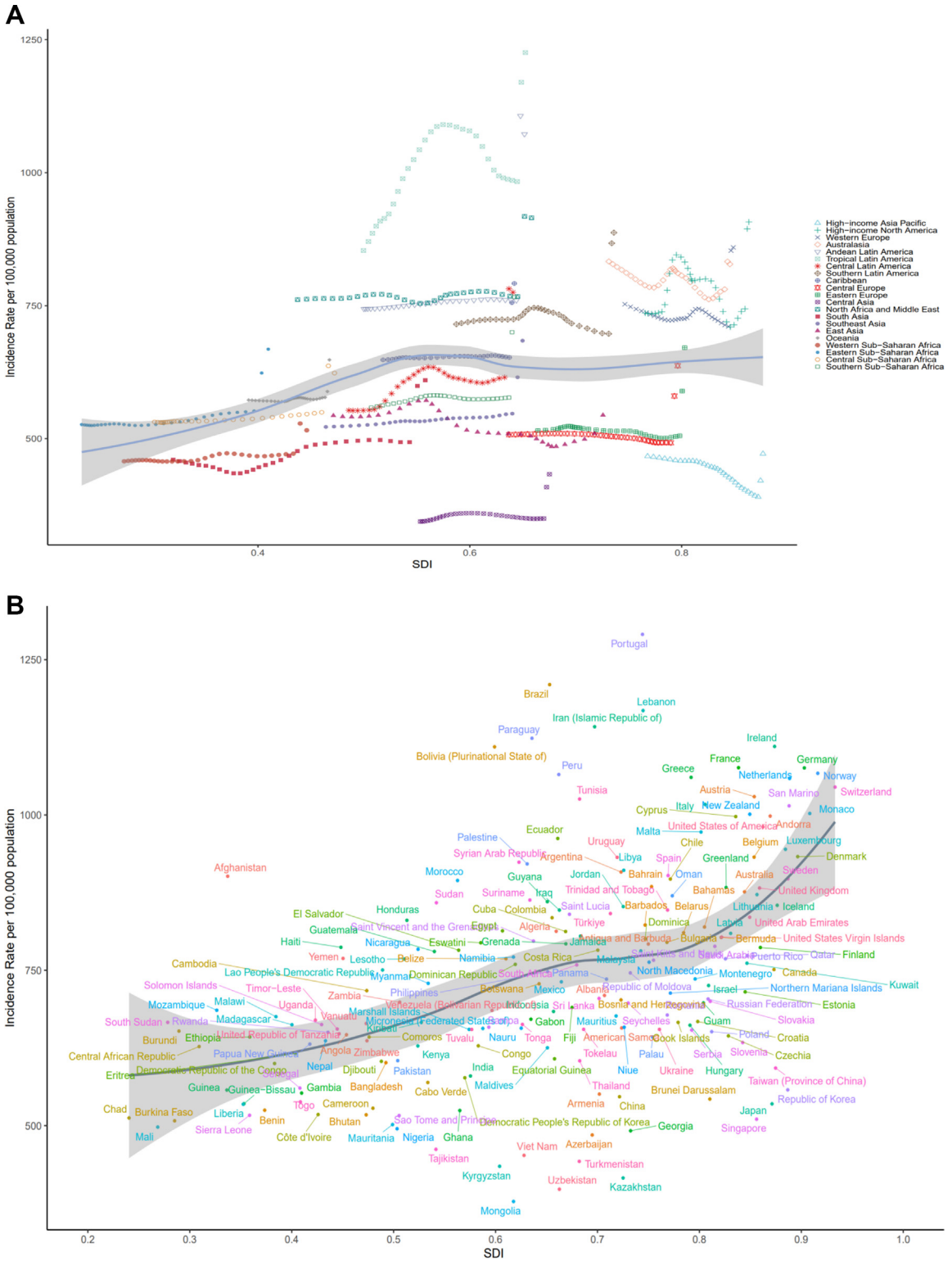

Fig. 2: (A) Trends for age-standardized incidence rates (per 100,000 population) of Anxiety disorders among 21 regions by socio-demographic index for both sexes combined, 1990–2021; (B) The association between the Anxiety disorders ASIR and SDI at the 204 national levels. ASIR, Age-Standardized Incidence Rates.

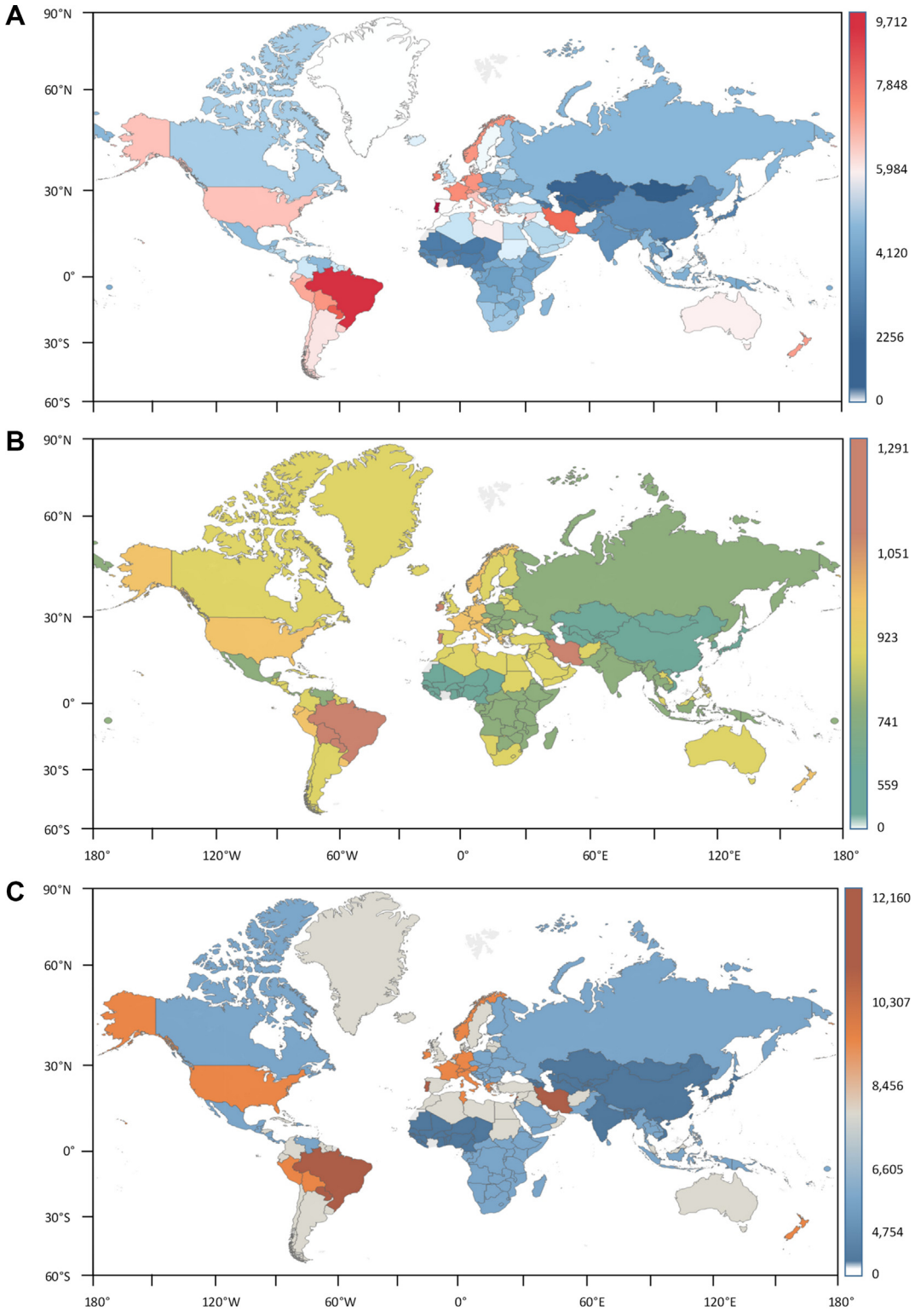

Fig. 3: Age-standardized rates (per 100,000 population) of anxiety disorders in 204 countries in 2021. (A) age-standardized prevalence rates of anxiety disorders; (B) age-standardized incidence rates of anxiety disorders; (C) age-standardized DALYs rates for anxiety.

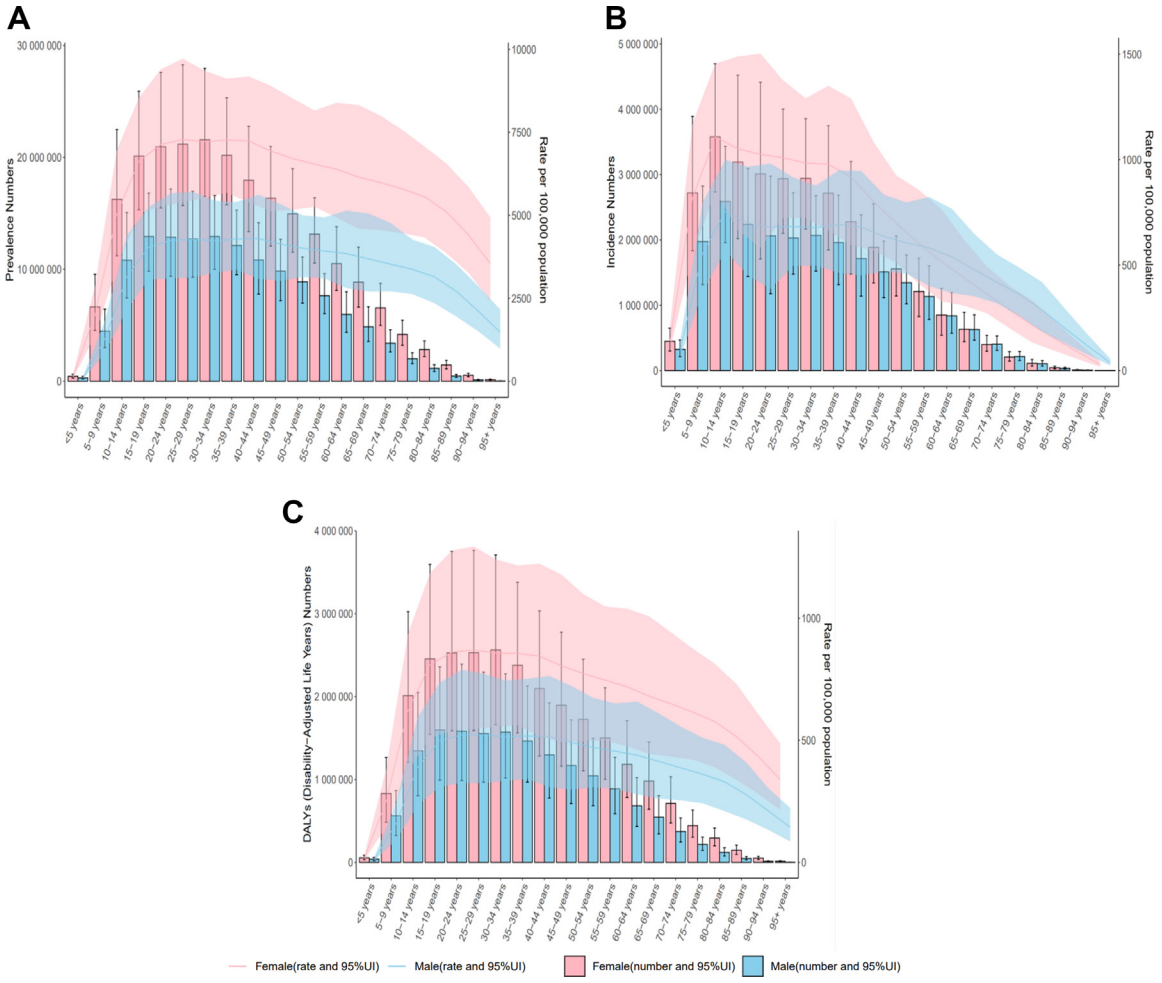

Fig. 4: **Sex and 20 Age Group Analyses of the Global Burden of Anxiety Disorders in 2021 (A) prevalence rates (per 100,000 population) of nxiety disorders (B) Incidence rates (per 100,000 population) of anxiety disorders (C) DALYs rates (per 100,000 population) of anxiety disorders.**

the differences in the surge of anxiety disorders burden across various SDI regions post-2019. The results demonstrated that, compared to other SDI regions, high SDI areas experienced the most substantial increase in the burden of anxiety disorders from 2019 to 2021, indicating that high SDI regions were the most

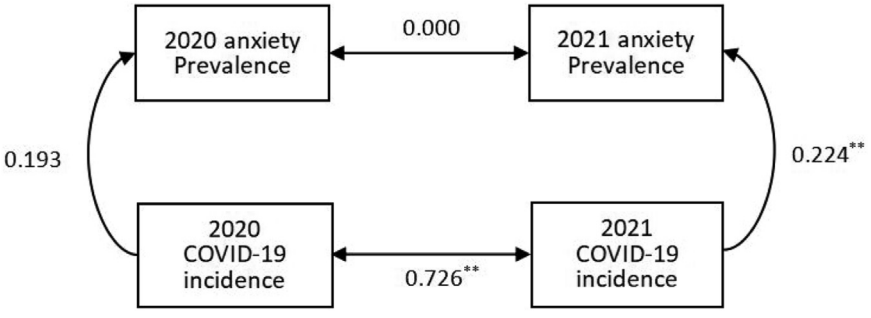

Fig. 5: **Path analysis of the age-standardized prevalence of anxiety disorders (per 100,000 people) versus the age-standardized incidence of covid-19 (per 100,000 people) in both sexes between 2020 and 2021.**

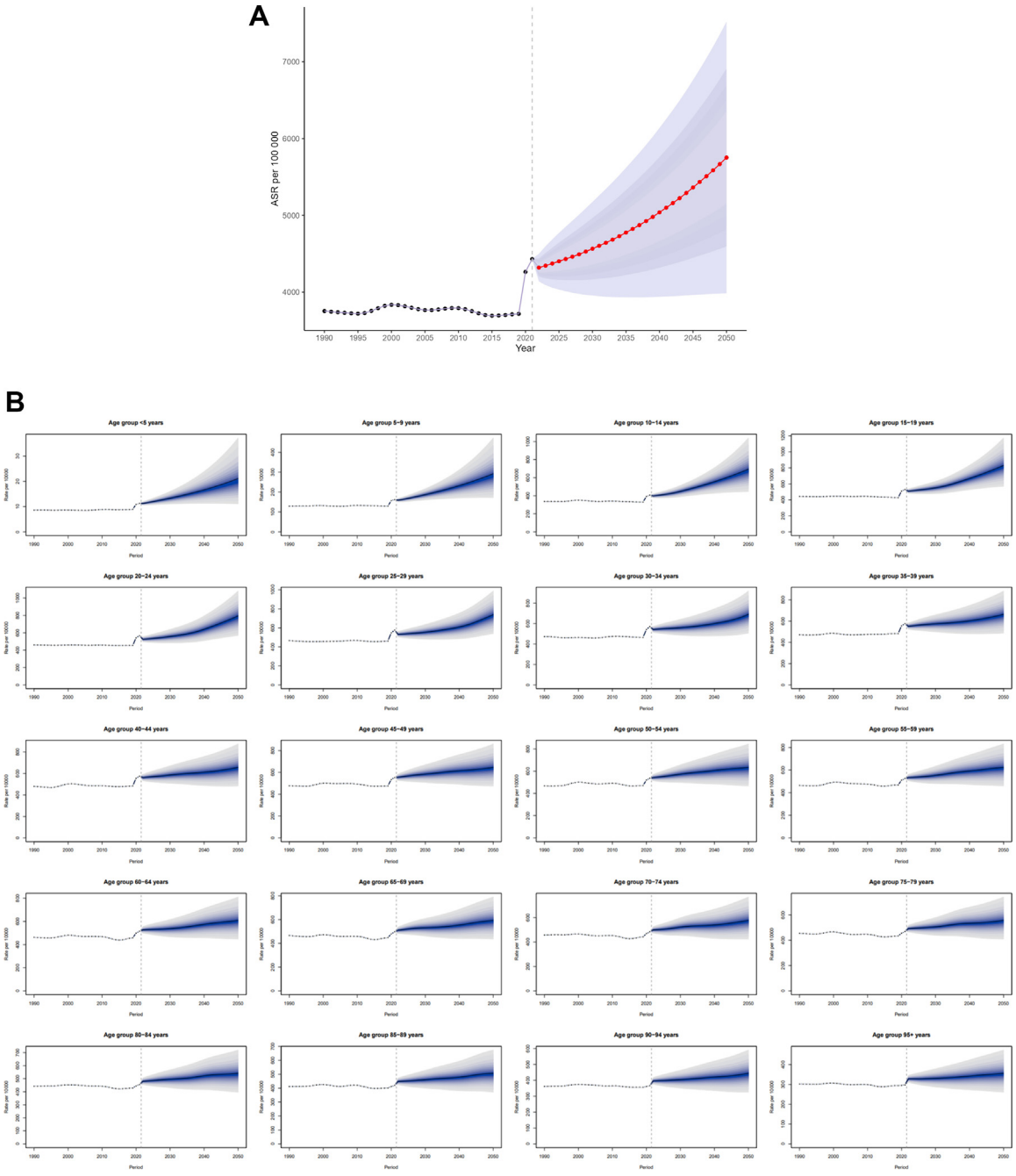

Fig. 6: **(A) Predictions age-standardized prevalence rates (per 100,000 population) in both sexes combined for Anxiety disorders in globally from 2022 to 2050; (B) Predictions prevalence rates (per 100,000 population) in both sexes combined for Anxiety disorders in 20 age groups from 2022 to 2050.**

adversely affected by the pandemic. This outcome may be associated with higher rates of recognition and diagnosis of anxiety disorders in high SDI regions, as well as the rapid dissemination of information that led to increased anxiety disorders due to the uncertainty surrounding the pandemic.[18] Additionally, we conducted an analysis based on GBD regional groupings to examine the differences in anxiety disorders burden among regions. The results indicated that tropical Latin America, high-income North America, and Australia had ASIR that were higher than expected. The finding that tropical Latin America had the highest ASIR aligns with previous research; however, the

rankings shifted for Central Latin America and South Asia, which previously held the second and third positions in anxiety disorders ASIR. In this study, high-income North America and Australia were ranked second and third, respectively. This shift suggests that the COVID-19 pandemic significantly impacted the anxiety disorders ASIR in high-income North America and Australia, likely due to business closures, layoffs, rising unemployment rates, increased economic uncertainty, and strict lockdown and social distancing measures.[19–22] Finally, the analysis of the anxiety disorder burden in 204 countries in 2021 revealed that Portugal had the highest burden of anxiety disorders, while Inner Mongolia had the lowest. This finding is consistent with previous research and remained unchanged despite the impacts of the pandemic.[23,24] Additionally, our study examined the countries that experienced the most significant increase in anxiety disorders burden from 2019 to 2021, identifying Bulgaria as having the largest increase, whereas Bhutan recorded the smallest rise. This outcome may be attributed to the challenges Bulgaria encountered during this period, including sluggish economic growth and escalating social inequality, which likely contributed to increased anxiety disorders levels among its residents.[25] In response to the increasingly severe mental health issues arising from the COVID-19 pandemic, Bhutan implemented several measures. The Royal Command established a National COVID-19 Mental Health and Psychosocial Response Team to offer psychological support to those impacted by the pandemic. This team adapted the World Health Organization's Psychological First Aid + (PFA+) guidelines and trained over 20,000 front-line workers to deliver psychosocial support. Furthermore, Bhutan prioritized basic healthcare services for patients with mental health concerns, and a series of measures were effectively implemented to alleviate the mental health challenges resulting from the pandemic.[26]

The analysis of global ASPR, ASIR, and DALYs for anxiety disorders across both genders from 1990 to 2021 reveals that the proportion of anxiety disorders burden in females consistently exceeds that of males. The results of the study show that women bear a greater anxiety disorders burden compared to men. The reasons for the increased risk of anxiety in women remain unclear. In general, innate factors determine that women are more prone to anxiety than men, such as greater sensitivity, insecurity, and emotional expression, and physiological factors, among others, may affect women's response to stress, thereby increasing their likelihood of developing anxiety disorders.[27] Furthermore, the increase in anxiety disorders burden among women from 2019 to 2021 was more pronounced than that among men, suggesting that the pandemic environment had a more significant impact on women's anxiety disorders levels. This may be attributed to home isolation during the pandemic, during which women often assumed familial responsibilities alongside work-related burdens.[28] Additionally, women are more likely to experience anxiety disorders in response to significant stress events. The uncertainty and ongoing stress induced by the pandemic may have exacerbated negative effects on women's mental health.[29–32] Subsequently, this study examined the overall changes in the incidence rates of anxiety disorders by gender and age structure from 2019 to 2021. The results indicated that the total change rate in incidence for females aged 20–24 was the highest, significantly impacting this demographic. The ages of 20–24 represent a critical transition period for many young individuals moving from university life to the workforce.[33,34] The pandemic has severely affected numerous industries, leading to increased unemployment rates, particularly among young people. During this time, restrictions on social activities contributed to a heightened sense of isolation in interpersonal relationships, which may have left young women feeling more lonely and unsupported.[35,36] The analysis of the association between COVID-19 pandemic and anxiety disorders burden during 2020 and 2021 revealed that the ASIR of COVID-19 pandemic in 2021 positively influenced the ASPR of anxiety disorders in the same year. This finding indicates that the pandemic not only impacted physical health but also precipitated a mental health crisis. The results of this study are similar to those of previous studies, and reviewing the COVID-19 Mental Disorders Collaborators' study of the impact of the 2020 COVID-19 pandemic and anxiety burden, we found that the 2021 COVID-19 pandemic continues to have a facilitating impact on anxiety burden. The increase in the ASPR of anxiety disorders may reflect a decline in individuals' psychological adaptability under the pressures of the pandemic.[37] Additionally, physiological responses that may arise post-infection, such as inflammation, could be linked to the exacerbation of anxiety disorders symptoms.[38] Furthermore, this study examined the trend predictions for the future burden of anxiety disorders as influenced by the COVID-19 pandemic. The results suggested that by 2050, the highest prevalence of anxiety disorders would be observed in the age group of 15–19, rendering it the most affected demographic among all age groups. This prediction contrasts with previous studies, which, based on data from 1990 to 2019, indicated that the highest prevalence occurred in the age group of 35–55 years.[39,40] However, the inclusion of pandemic-era data in this study suggests a trend toward younger individuals experiencing anxiety disorders following the pandemic.

This study provides a comprehensive overview of the global burden of anxiety disorders; however, the GBD 2021 database primarily aggregates reports from countries and regions rather than relying on direct national reports. This limitation may affect the completeness and timeliness of the data, potentially resulting in

deficiencies. Firstly, the GBD estimates of anxiety disorders were reconstructed using mathematical models based on a wide array of sources with varying quality, which may lead to deviations from actual data, particularly in less developed regions where prior information is extremely limited, such as Africa and South Asia.[17] Secondly, BAPC models have limitations such as high data requirements, sensitivity to covariance, complex assumptions, computational requirements, and difficulty in causally interpreting and predicting rapidly changing trends. Further, the estimates of the anxiety disorders burden are inevitably biased due to the higher rates of under diagnosis of anxiety disorders in developing countries. Due to a lack of relevant data, we currently lack burden estimates for various subtypes of anxiety disorders, including panic disorder, as well as estimates regarding the severity of social phobia and other anxiety disorders. There are certain considerations that need to be taken into account with regard to the impact of the COVID-19 pandemic on the disease burden of anxiety disorders in different regions and countries, such as differences in embargo policies in various countries, and the situation of domestic politics also affects the development trend of the disease burden of anxiety disorders, and it will be necessary to incorporate these factors into the analysis in future studies.

This study employs GBD2021 data to examine the global, regional, and national burden of anxiety disorders. It analyzes trends from 1990 to 2021, assesses the impact of COVID-19 pandemic on the burden of anxiety disorders, and concludes with projections for the global prevalence of anxiety disorders through 2050. This study utilizes GBD2021 data to delineate the global, regional, and national burden of anxiety disorders, while also analyzing trends from 1990 to 2021. The findings indicate a significant increase in the disease burden of anxiety disorders following the COVID-19 pandemic, particularly pronounced in regions with high SDI. Notably, there is a tendency for anxiety disorders to become more prevalent among younger individuals. These results underscore the necessity for effective allocation of medical resources and the establishment of robust mental health knowledge dissemination initiatives, which can enhance early diagnosis and facilitate diverse intervention strategies. Furthermore, the epidemiological insights provided by this study are instrumental in shaping major public health prevention and control strategies.

Contributors

The study was designed by SC and WH. SC conducted the data analysis and drafted the manuscript. HWS, YS, MZ, YLS, JHW, YYW and CSZ provided technical support. YZ, CC, HYW, ZYX, YRB and LZ collected the data. SC and WH accessed and verified the data. All authors contributed to data interpretation, reviewed, and approved the final version of the manuscript. SC and WH hold ultimate responsibility for the decision to submit for publication.

Data sharing statement

Prevalence, incidence, and DALYs of anxiety disorders from GBD 2021 are available for download via the GBD Results Tool (https://vizhub.healthdata.org/gbd-results/).

Editor note

The *Lancet* Group takes a neutral position with respect to territorial claims in published maps and institutional affiliations.

Declaration of interests

We declare no competing interests.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.eclinm.2024.103014.

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