

Thirty-year trends of anxiety disorders among adolescents based on the 2019 Global Burden of Disease Study

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ABSTRACT

Background Anxiety disorders are the most common psychiatric problems, affecting approximately 1 in 12 children and 1 in 4 adolescents. Understanding the incidence, burden and correlated risks of anxiety disorders among children and adolescents can help identify areas of success, stagnation and emerging threats, thereby facilitating effective improvement strategies.

Aims To estimate the incidence and burden trends of anxiety disorders in children and adolescents from 1990 to 2019 in 204 countries and compare the incidence and disease burden in different countries. To examine the association between anxiety disorders and social indicators (healthcare access and quality of life).

Methods Data were obtained from the Global Burden of Disease Study 2019. The age-standardised incidence rates (ASIRs) and disability-adjusted life years (DALYs) were reported to assess the burden of anxiety disorders, and the estimated annual percentage change was calculated to quantify the temporal trends. Pearson's correlation was used to investigate country-level risk factors for incidence and DALYs.

Results Globally, there were 932 million incident cases of anxiety disorders in children and adolescents, 739.29 per 100 000 ASIRs and 380.62 million DALYs in 2019. From 1990 to 2019, the estimated annual percentage change of incidence of anxiety disorders decreased by 2.2%. Significant variations were observed in the age-standardised burden rate and the changing trend of anxiety disorders among countries. Portugal reported the highest ASIR of anxiety disorders, while Mexico had the largest increase rate of ASIR. In 2019, Portugal reported the highest number of DALYs (1001.71 million), and India (212.09 million) reported the lowest number of DALYs. The burden of anxiety disorders was positively correlated with the average number of psychiatrists, psychologists and nurses in the mental health sector (per 100 000), and quality of life and the correlation coefficients were 0.58, 0.67, 0.43 and 0.53, respectively.

Conclusions The incidence and global burden of anxiety disorders in adolescents have continued to decrease over the past 30 years. However, the incidence and disease burden in developed countries are still increasing steadily. Policymakers should design and implement mental health strategies for

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Anxiety disorders impact not only individuals and their households but also extend to communities and economies.
- ⇒ Children and adolescents are particularly vulnerable to anxiety disorders.
- ⇒ However, the disease burden details among children and adolescents remain unknown, and the burden of anxiety disorders and relevant mental health resources exhibit geographical disparities.

WHAT THIS STUDY ADDS

- ⇒ We reported age-standardised incidence rates and disability-adjusted life years to assess the burden of anxiety disorders and estimated the annual percentage change to quantify the temporal trends among children and adolescents based on data from the Global Burden of Disease Study.
- ⇒ Geographical disparities were analysed, and country-level risk factors for incidence and disability-adjusted life years were investigated.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ This study tracked the incidence and disease burden of anxiety disorders among adolescents globally, with a focus on dynamic change and provided specific recommendations for the prevention and treatment of adolescent anxiety disorders.
- ⇒ Policymakers should be cognizant of the varying incidence of adolescent anxiety disorders across different countries due to distinct cultural factors, and formulate tailored policies accordingly.
- ⇒ In particular, developing countries should prioritise enhancing their capacity to identify and treat anxiety disorders by improving the accessibility of mental health professionals, including psychiatrists, psychologists and nurses.

adolescents based on their specific developmental status, as well as the cultural and regional characteristics of each country.

INTRODUCTION

Anxiety disorders are chronic and disabling conditions characterised by intense and prolonged feelings of fear and distress.¹ They

stand as the most prevalent mental disorders globally, causing health loss, role impairment² and disadvantages across the life span.³ Anxiety disorders may occur early in life and often recur intermittently,⁴ making them one of the most disabling mental disorders.⁵

The estimated number of newly diagnosed patients with anxiety disorders has increased significantly over the years,^{6,7} causing more than 44.5 million disability-adjusted life years (DALYs).⁸ It is crucial to grasp the latest spatial distribution and temporal trends of anxiety disorders worldwide, as they not only affect individuals and households but also communities and economies. The estimated global cost of anxiety disorders averages 2.08% of health expenditures, equivalent to 0.22% of global gross domestic product (GDP).⁹

Adolescents aged 10–19 years, as defined by the United Nations, are particularly vulnerable to anxiety disorders due to the transitional period they undergo between childhood and adulthood,¹⁰ which involves physical, emotional and psychosocial changes. Developmental theorists have identified adolescence as a phase of increased risk for stress and mental disorders.¹¹ During this phase, adolescents establish behaviour patterns related to physical activity and social activity, which may serve as potential risk or protective factors for their current and future health.¹² In high-income countries, the prevalence of total childhood mental disorders is 12.7%, with anxiety disorders accounting for 5.2%.¹³ Additionally, it is estimated that 6.5% of adolescents aged 13–17 years have been diagnosed with anxiety disorders,¹⁴ suggesting that the incidence of adolescent anxiety disorders may fluctuate with changes in social development. While several reviews have reported varying burdens of anxiety disorders among children and adolescents,^{15,16} few studies have used DALYs to describe the burden in detail. Given that adolescents constitute almost a sixth of the global population,¹⁷ it is crucial to estimate the burden of anxiety disorders in this age group.

Significant geographical disparities exist in the burden of anxiety disorders and accessibility to mental health resources. Limited incidence data hinder the understanding of anxiety disorders burden among adolescents globally, particularly in low-income and middle-income countries.¹⁸ These countries account for 90% of the global adolescent population,¹⁹ and often provide severely limited healthcare services for children and adolescents.^{17,20} Only 44.2% of children with mental disorders received any form of healthcare service even in high-income countries.¹³ *The Lancet* has urged the global community to expand mental health services, especially in low-income and middle-income countries.²¹ However, services for anxiety disorders are not given global health priority due to insufficient information on global or regional time trends, and few countries have collected and reported data using the same instrument over the years.

Regional variations in adolescent anxiety disorders might stem from national disparities, including healthcare resources and the overall national environment.

Research indicates that limited access to psychiatrists contributes to delayed treatment for adolescents with anxiety disorders.^{22,23} Moreover, the Environmental, Social and Governance (ESG) Index reveals the societal contexts, environmental stressors and governance structures that may exacerbate or alleviate anxiety levels among adolescents. The quality of life (QoL) Index serves as a comprehensive measure of the overall well-being and life satisfaction of adolescents. Previous research has found that adverse living environments characterised by insecurity and conflict may decrease the QoL and elevate anxiety levels among adolescents.²⁴ To substantiate the divergence in adolescent anxiety across nations, we investigated the interplay between healthcare accessibility, the ESG Index, the QoL Index and anxiety disorders.

This study presents the prevalence of anxiety disorders among adolescents and the associated DALYs in 1990 and 2019, along with global and national trends. DALY is the age loss caused by certain diseases; one DALY can be regarded as the loss of one year in full health. DALYs are used to assess health status and understand the impact of diseases or social environments on patient health. DALYs also provide important reference for health resource allocation and disease prevention policies.

We aimed to (1) Estimate the incidence trends of anxiety disorders in 204 countries from 1990 to 2019 among children and adolescents aged 10–19 years, (2) Compare the incidence and disease burden of anxiety disorders across different countries or different historical periods in the same region, and (3) Examine the association between healthcare access, the ESG Index and the QoL Index and the incidence of anxiety disorders. This research aims to facilitate the assessment and interpretation of Global Burden of Disease (GBD) 2019 estimates for stakeholders, including governments and international agencies, researchers and clinicians engaged in the identification, management and prevention of adolescent mental health, and highlight priority areas for improvement in the mental disorder burden estimation methodology.

METHODS

Data source

Data on adolescents' anxiety disorder estimates were obtained from the GBD, which adheres to the Guidelines for Accurate and Transparent Health Estimates Reporting.²⁵ The GBD database provides a tool to quantify health loss attributable to various diseases, injuries and risk factors so that health systems can be improved and disparities can be eliminated. Decision makers can use the tools provided by GBD to compare the impacts of different diseases and make informed decisions accordingly. The database captures premature death and disability from 370 diseases and injuries in 204 countries and territories, by age and sex, from 1990 to the present. Some of the GBD data sources are publicly available, published in studies or shared on the web by organisations

like WHO and countries like Brazil. Other sources are shared by partners or through our network of over 3000 collaborators, and the context of data collection across different countries and organisations. Comprehensive descriptions of each analytical component of GBD are available on the Global Health website (<http://ghdx.healthdata.org>).²⁶

The GBD Study estimates incidence, prevalence, years of life lost (YLLs), years of life lived with disability (YLDs), DALYs for anxiety disorders and groups of risk factors at the global level, regionally and nationally. YLLs were estimated using standardised approaches of data identification and extraction. Cause-specific YLDs were calculated by multiplying sequela-level prevalence with corresponding disability weights that were derived from population and internet surveys of more than 60 000 persons and adjusted for comorbidity through microsimulation.^{27–28} DALYs are the sum of YLDs and YLLs and are used to measure the comprehensive health status of a population for a given location, sex, year and age combination.²⁹ Because anxiety disorders were not recognised as causes of death, YLLs were not estimated, and YLDs approximated DALYs. To distinguish the differences in DALYs across regions, we selected the DALY rate (per 100 000) from the GBD data.

Country-level variables

We obtained country-level data on the ESG Index,³⁰ healthcare access within the mental sector (psychiatrists, psychologists and social workers),³¹ healthcare index and QoL.³²

The ESG Index covers 183 countries and territories and encompasses three subindexes (environment, human rights, and health and safety) based on 65 variables to measure ESG risk exposure. Country scores are presented on a 0–100 scale, where 0 corresponds to the lowest risk and 100 to the highest risk. Adolescent mental health varies across nations due to differences in national policies regarding environment, human rights and security.³³ Adolescents in countries without conflicts face lower risks of anxiety, while those in countries with strong human rights policies receive greater attention and protection.³⁴ Therefore, our study selected the ESG Index, which reflects a nation's environment, human rights, and health and safety. As a comprehensive indicator, the ESG Index can capture the multiple impacts of various factors on adolescent anxiety at a national level, assisting professionals in developing and implementing effective corporate social responsibility policies to reduce anxiety risks.

Healthcare access includes the number of psychiatrists, psychologists, nurses and social workers working in the mental health sector per 100 000 population. The QoL Index is an estimation of overall QoL by using an empirical formula that takes into account the Purchasing Power Index (higher index signifies better economic level), Pollution Index (lower index indicates less pollution), house price to income ratio (lower ratio suggests lower house price burden), Cost of Living Index (lower index

implies lower living cost), Safety Index (higher index signifies safer environment), Healthcare Index (higher index indicates better health resources and medicine), Traffic Commute Time Index (lower index indicates shorter transport time) and Climate Index (higher index suggests better weather conducive to comfortable living). More QoL Index details can be found in https://www.numbeo.com/quality-of-life/rankings_by_country.jsp. The flowchart for data inclusion is shown in [figure 1](#).

Analysis

We extracted incidence and DALYs, calculated the age-standardised incidence rates (ASIRs), and estimated the annual percentage change (APC) in anxiety disorders among children and adolescents aged 10–19 years in 204 countries from 1990 to 2019. The ASIR and estimated APC were used to quantify the incidence trends of anxiety disorders. The ASIR of anxiety disorders was used to compare the incidence of anxiety disorders in different countries or different historical periods in the same region. The method used to calculate ASIR has been reported previously.³⁵ The estimated APC, a widely used measure of the ASIR trend over a specific time interval, describes the overall rates of changes in anxiety disorders per year in the selected time period. In the current study, it was designed to indicate the overall trend (increasing/decreasing) among different regions worldwide, which could provide an overall figure of anxiety disorders globally and identify the regions with relatively high increasing/decreasing rates. It was estimated by the loglinear regression model: $y = b_0 + b_1x + e$, where $y = \ln(\text{rate})$, $x = \text{calendar year}$, $b_0 = \text{intercept}$ and $e = \text{error}$. The estimated APC was calculated as $100 \times (\exp(\beta) - 1)$, and its 95% confidence interval (CI) was obtained from a linear regression model.³⁵ When the estimated APC 95% CIs are both ≤ 0 , the ASIR is considered to be decreasing.³⁶ Associations between the incidence rate and the abovementioned country-level variables were tested by Pearson's correlation.

All statistical analyses were conducted using Microsoft Excel (V.16.63.1) and R (V.3.6.3). The significant level was set as $\alpha < 0.05$.

RESULTS

Incidence of anxiety disorders

Globally, there were an estimated 787 million cases of anxiety disorders in 1990 and 932 million cases in 2019, representing a 18.42% increase. The highest increase occurred in Equatorial Guinea (290.72%), followed by Qatar (274.64%) and Afghanistan (250.14%). The number of incident cases of anxiety disorders decreased from 1990 to 2019 in 70 countries, mostly in Bosnia and Herzegovina (–53.46%), followed by Georgia (–52.57%) and Lithuania (–50.34%) (online supplemental table S1). Incident case refers to the number of newly diagnosed cases of a particular disease that occur within a specified period of time. Incident cases can be used to identify

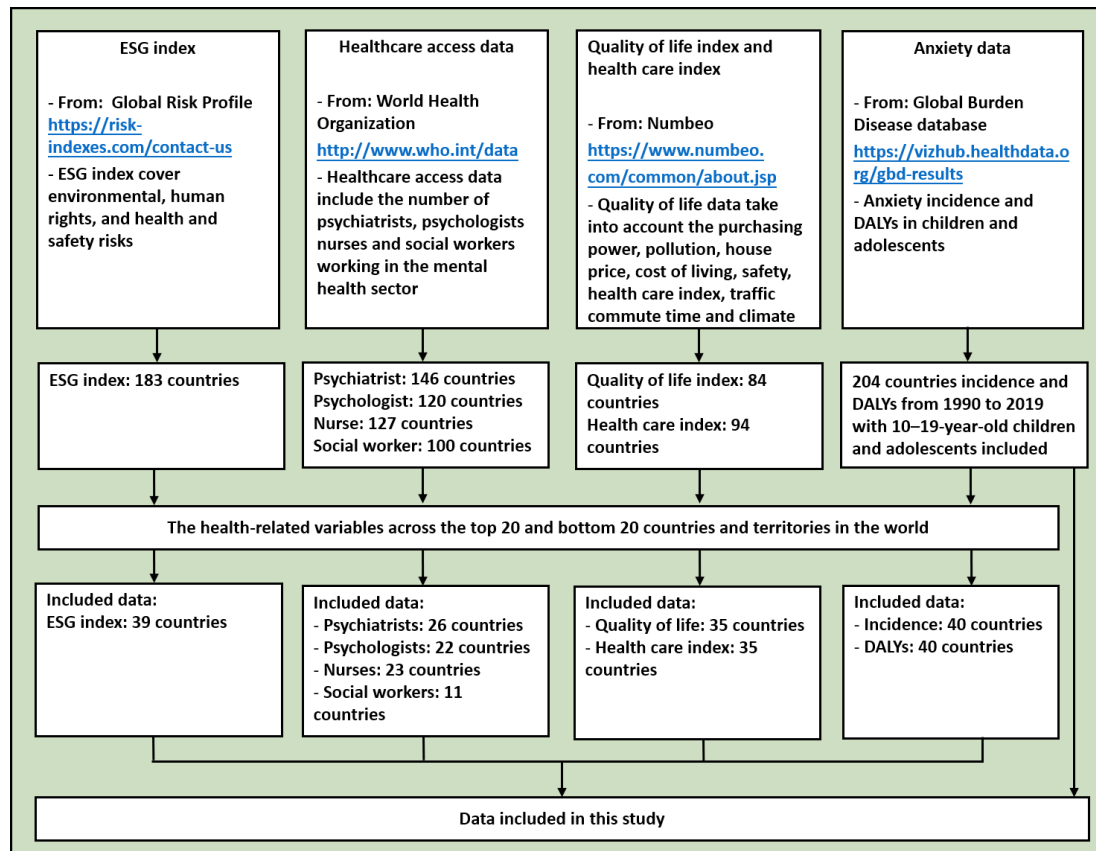


Figure 1 Flowchart of data inclusion from Global Burden of Disease, Global Risk Profile, WHO, Numbeo database. ESG Index is from Global Risk Profile, which is a comprehensive data covering environmental, human rights, and health and safety risks. Healthcare access data (the number of psychiatrists, psychologists and social workers) is from WHO open public data. Quality of life and healthcare indexes are from the Numbeo database, which is the world's largest crowd-sourced global database of quality-of-life data. Data from several micro countries were excluded from the analysis due to missing information. DALYs, disability-adjusted life years; ESG Index, Environmental, Social and Governance Index.

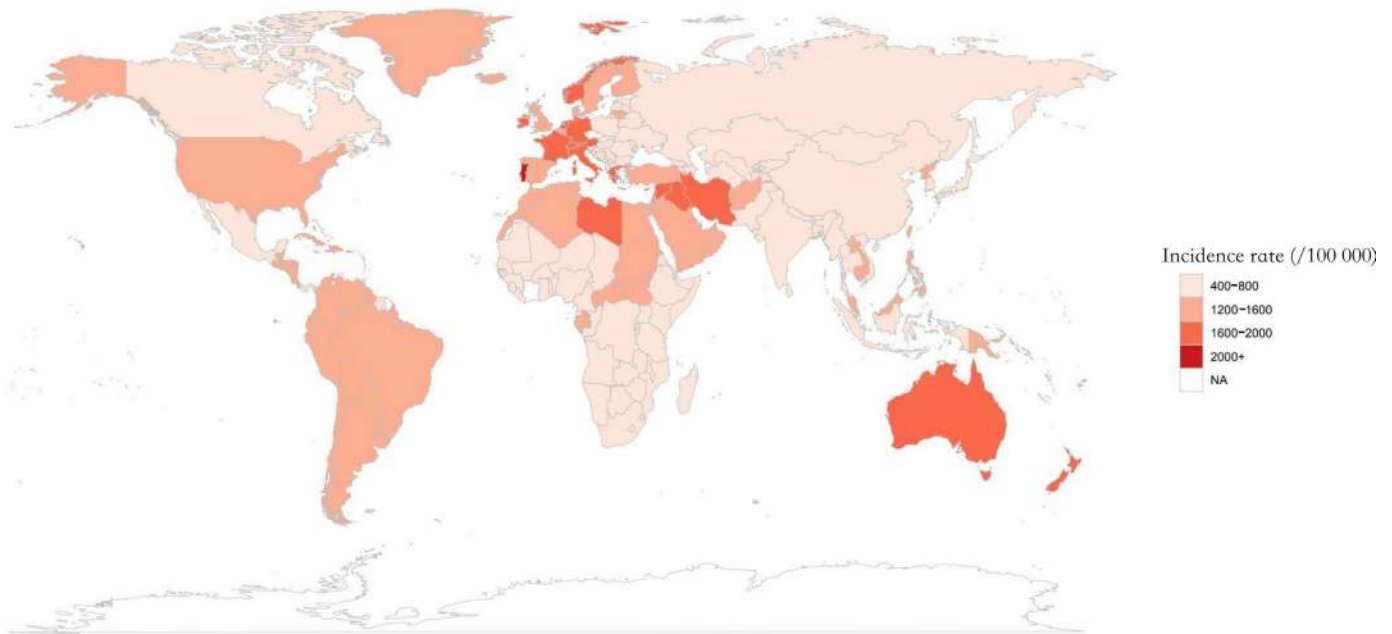
trends, assess the burden of a disease and evaluate the effectiveness of prevention and control measures. Incidence refers to the probability of developing a disease or condition within a specific population and time frame. Incidence rates are typically expressed as a percentage or ratio (eg, per 100 000 people). Incident cases and incidence are closely related concepts but focus on different aspects of disease occurrence. Incident cases refer to the number of new cases within a specified period, while incidence refers to the overall probability of developing a disease within a specific population and time frame.

The supplemental tables show the ASIR, DALY rate and estimated APC (incidence and DALYs) of anxiety disorders worldwide in adolescents in 1990 and 2019 across various countries and territories. **Figure 2A** and **figure 2B** show the ASIR of anxiety disorders worldwide in adolescents in 1990 and 2019. The global ASIR of anxiety disorders fell from 744.91 (95% uncertainty interval (UI): 744.39 to 745.43) per 100 000 in 1990 to 739.29 (95% UI: 738.82 to 739.76) per 100 000 in 2019. The ASIR of anxiety disorders in the 204 analysed countries and regions varied considerably in both 1990 (**figure 2A**) and 2019 (**figure 2B**). In 1990, Portugal had the highest ASIR of anxiety disorders (1582.24 per 100 000), followed by

Norway (1508.62 per 100 000) and Iran (1497.29 per 100 000), while Uzbekistan (435.27 per 100 000), Kyrgyzstan (439.39 per 100 000) and Kazakhstan (447.72 per 100 000) had the lowest ASIR. In 2019, Portugal maintained the highest ASIR of anxiety disorders (1602.32 per 100 000), followed by Iran (1560.69 per 100 000) and Ireland (1503.45 per 100 000), while Uzbekistan (435.94 per 100 000), Kyrgyzstan (440.51 per 100 000) and Kazakhstan (451.30 per 100 000) reported the lowest ASIR (online supplemental table S2).

Figure 3A visualises the estimated APC (incidence) of anxiety disorders worldwide among adolescents. The global estimated APC was -0.02 (95% CI: -0.01 to -0.04) from 1990 to 2019. The increase in ASIR across the 204 countries and regions was most pronounced in Mexico (estimated APC: 1.00, 95% CI: 0.65 to 1.35), followed by Ireland (estimated APC: 0.65, 95% CI: 0.40 to 0.90) and Lebanon (estimated APC: 0.57, 95% CI: 0.38 to 0.76). Conversely, the decrease in ASIR was most pronounced in Colombia (estimated APC: -0.39 , 95% CI: -0.08 to -0.70), followed by Taiwan, China (estimated APC: -0.36 , 95% CI: -0.28 to -0.43) and Japan (estimated APC: -0.34 , 95% CI: -0.31 to -0.38) (online supplemental table S3).

A



B

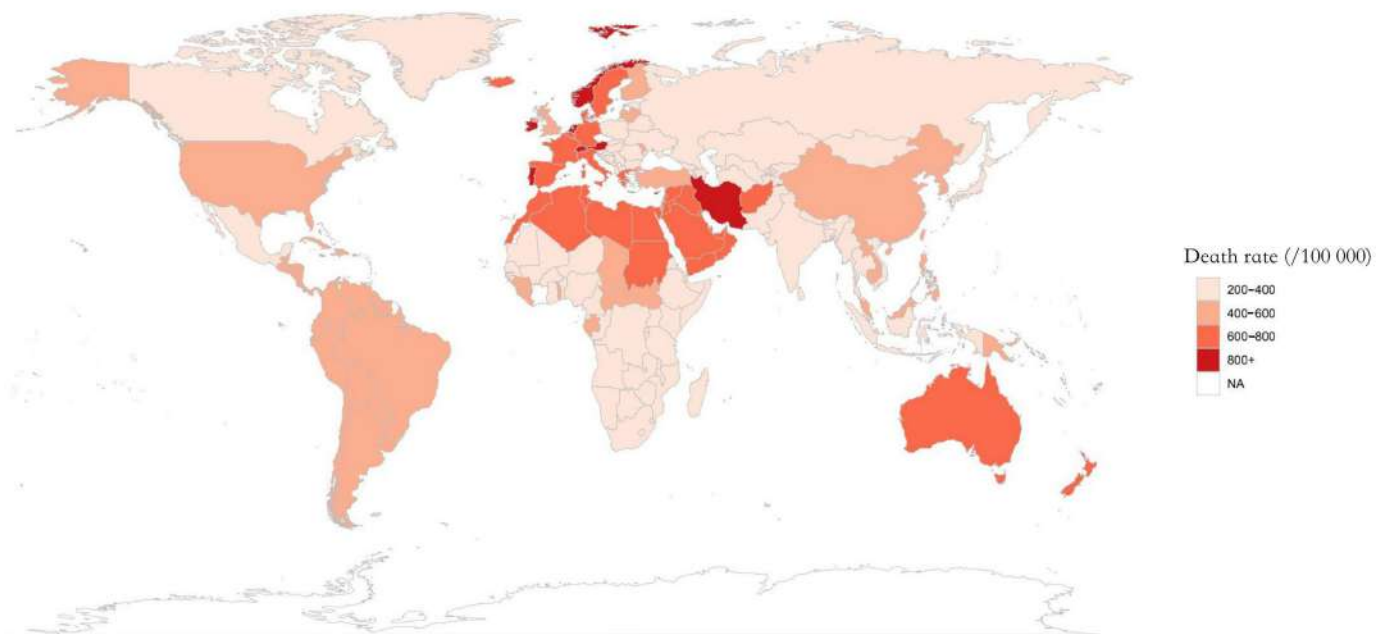


Figure 2 Incidence rates of anxiety disorders in adolescents worldwide in 1990 and 2019. (A) ASIRs of anxiety disorders in adolescents worldwide in 1990. (B) ASIRs of anxiety disorders in adolescents worldwide in 2019. ASIRs, age-standardised incidence rates; NA, not available.

Global burden of anxiety disorders

Globally, anxiety disorders accounted for a DALY rate of 391.39 (95% UI: 391.01 to 391.76) in 1990 and 380.62 (95% UI: 380.28 to 380.96) in 2019.

In 1990, among 204 countries and regions, Portugal had the highest age-standardised DALY rate (976.29, 95% UI: 961.52 to 991.24), followed by Norway (875.49) and Iran (843.13), while India (211.83), Uzbekistan (215.69) and

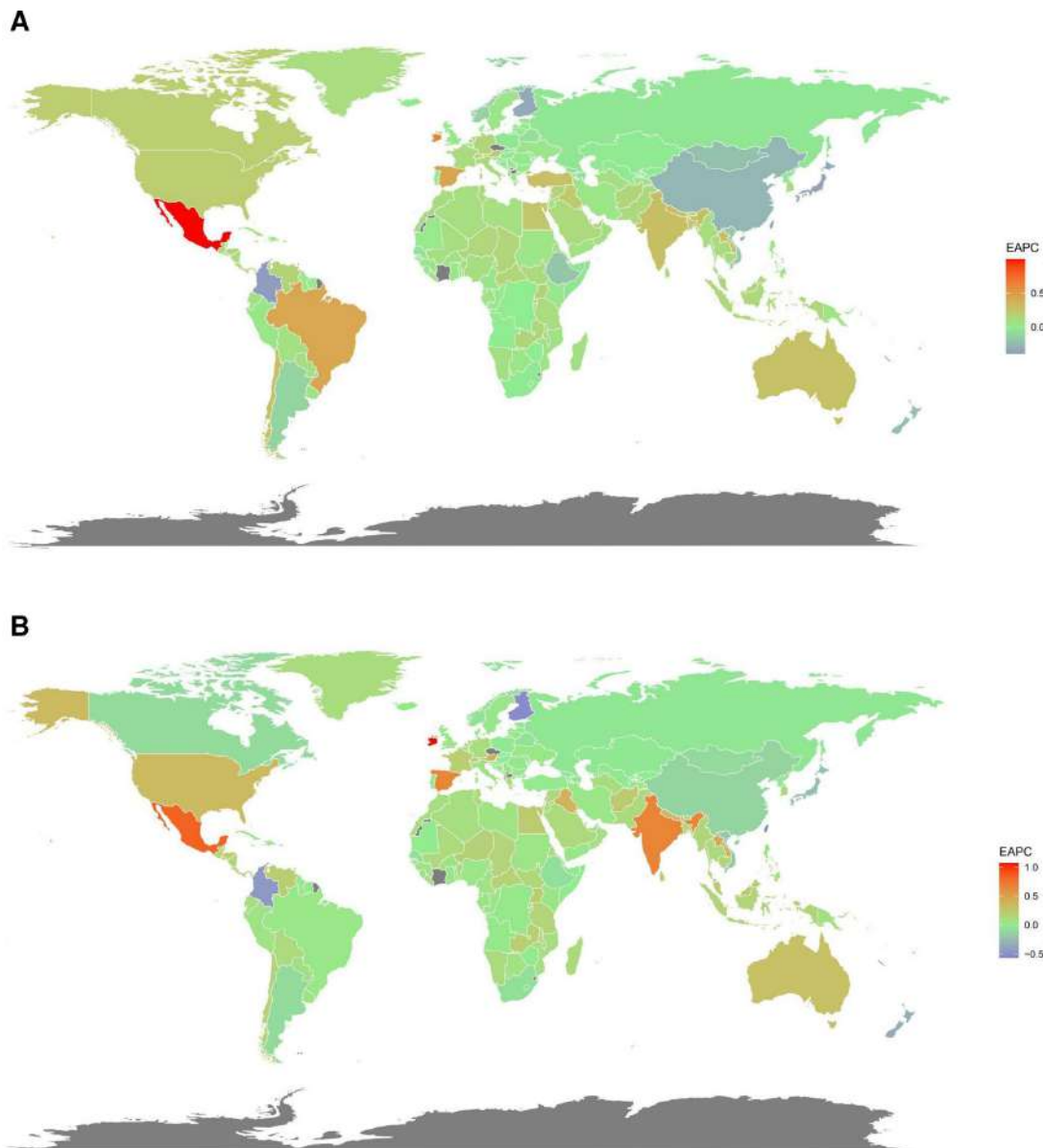


Figure 3 Estimated annual percentage change (incidence and DALYs) in anxiety disorders in adolescents worldwide. (A) Estimated APC (incidence). (B) Estimated APC (DALYs). APC, annual percentage change; DALYs, disability-adjusted life years; EAPC, estimated annual percentage change.

Nepal (217.43) had relatively low DALY rates. In 2019, Portugal maintained the highest DALY rate (1001.71), followed by Ireland (897.80) and Iran (873.64). India (212.09), Uzbekistan (216.87) and Kyrgyzstan (218.99) had the lowest DALY rates (online supplemental table S4). The largest increase in DALYs was reported in Equatorial Guinea (300.31%), followed by Qatar (272.22%) and Afghanistan (250.03%). The DALYs of anxiety disorders decreased from 1990 to 2019 in 74 countries, with the most significant declines seen in Georgia (−52.97%), followed by Bosnia and Herzegovina (−52.92%) and Taiwan, China (−51.76%) (online supplemental table S5).

Figure 3B presents the estimated APC (DALYs) of anxiety disorders in adolescents worldwide. The increase in DALYs across the 204 countries and regions was most

pronounced in Ireland (estimated APC: 1.07, 95% CI: 0.62 to 1.52), followed by Lebanon (estimated APC: 0.89, 95% CI: 0.61 to 1.17) and Mexico (estimated APC: 0.83, 95% CI: 0.38 to 1.29). The decrease in DALYs was most pronounced in Taiwan, China (estimated APC: −0.56, 95% CI: −0.45 to −0.68), followed by Finland (estimated APC: −0.51, 95% CI: −0.31 to −0.72) and Colombia (estimated APC: −0.44, 95% CI: −0.09 to −0.79) (online supplemental table S6).

Associations among incidence rates, DALYs and country-level variables

Table 1 shows the sociodemographic and health-related variables across countries and territories. Norway, Netherlands, France and Monaco have the most psychiatrists, (48.04 per 100 000), psychologists (123.50 per 100 000),



Table 1 The sociodemographic and health-related variables across the top 20 and bottom 20 countries and territories in the world (sort by 2019 DALY rate)

Healthcare resource in the mental health sector (per 100 000 population)							ESG Index	Healthcare Index	Quality of Life Index
Psychiatrists	Psychologists	Nurses	Social workers						
Top 20 countries and territories									
Portugal	NA	NA	NA	NA	23.46	80.30	163.80		
Ireland	NA	NA	NA	NA	50.23	63.20	154.00		
Iran	2.02	5.17	9.45	1.51	22.99	45.40	73.80		
Switzerland	43.96	84.14	92.66	NA	44.81	59.30	193.60		
Netherlands	20.87	123.50	NA	NA	40.55	59.70	196.70		
Norway	48.04	73.52	NA	NA	62.00	76.70	182.70		
Cyprus	NA	NA	34.97	0.00	18.68	71.50	148.50		
Austria	NA	NA	NA	NA	20.19	77.20	185.80		
Malta	NA	NA	NA	NA	22.16	66.30	112.70		
France	20.91	48.70	98.02	NA	16.21	51.80	153.80		
Germany	13.20	49.55	NA	NA	17.59	74.50	179.00		
Lebanon	1.21	3.30	3.14	1.33	60.43	63.20	88.90		
Greece	5.80	8.78	12.75	3.46	18.58	71.00	128.60		
Syria	0.37	1.07	1.07	0.80	41.74	NA	NA		
San Marino	NA	NA	NA	NA	54.04	NA	NA		
Palestine	NA	NA	NA	NA	34.85	NA	NA		
Monaco	31.33	53.52	2.45	102.60	52.16	NA	NA		
New Zealand	28.54	NA	75.13	NA	59.26	71.00	176.70		
Libya	NA	NA	NA	NA	47.75	NA	NA		
Bottom 20 countries and territories									
Ethiopia	0.08	0.05	1.00	0.04	62.28	NA	NA		
Japan	11.87	3.04	83.81	8.33	30.45	57.50	176.30		
Kenya	0.18	NA	NA	NA	55.79	61.80	101.40		
Poland	24.18	16.35	30.92	NA	25.88	57.60	139.90		
Djibouti	NA	NA	NA	NA	58.73	NA	NA		
Somalia	NA	NA	NA	NA	74.20	NA	NA		
Georgia	6.71	2.33	5.92	NA	16.21	76.70	118.60		
Azerbaijan	3.45	1.16	6.72	0.11	41.12	46.80	109.60		
Tajikistan	1.39	NA	1.50	NA	56.01	NA	NA		

Continued

Table 1 Continued

Healthcare resource in the mental health sector (per 100 000 population)							ESG Index	Healthcare Index	Quality of Life Index
Psychiatrists	Psychologists	Nurses	Social workers						
Turkmenistan	NA	NA	NA	NA	37.94	NA	NA		
Bhutan	0.51	NA	0.13	NA	51.57	NA	NA		
Pakistan	NA	NA	NA	NA	23.53	75.50	102.10		
Nepal	0.36	0.52	0.56	NA	35.10	NA	NA		
Bangladesh	0.13	0.12	0.87	NA	57.09	42.30	70.10		
Vietnam	NA	NA	NA	NA	40.23	59.30	89.30		
Mongolia	4.03	0.10	4.20	0.10	37.54	NA	NA		
Kazakhstan	1.69	NA	NA	NA	21.04	59.90	97.60		
Kyrgyzstan	NA	0.41	7.37	NA	NA	NA	NA		
Uzbekistan	2.61	0.09	9.21	NA	40.23	NA	NA		
India	0.29	0.07	0.80	0.07	25.54	54.70	117.90		

DALY, disability-adjusted life year; ESG, Environmental, Social and Governance; NA, not available.

nurses (98.02 per 100 000) and social workers (102.60 per 100 000) in the mental health sector, respectively. Ethiopia has the highest ESG Index (62.28). Portugal has the highest Healthcare Index (80.30) and Netherlands has the highest QoL Index (196.70).

Table 2 shows the association between incidence rates and DALYs among different countries. Apart from the correlations among covariables, the incidence rate showed statistical significance with the number of psychiatrists and psychologists. The disease burden of adolescents was positively correlated with the number of psychiatrists, psychologists and nurses in mental health departments and QoL, and the correlation coefficients were 0.58, 0.67, 0.43 and 0.53, respectively. However, there was no significant association between adolescents' anxiety disorders and the number of social workers, the ESG Index and the Healthcare Index.

DISCUSSION
Main findings

Using the available data and analytical framework of GBD 2019, we estimated a significant increase in the number of cases and a decrease in ASIR, estimated APC and burden of anxiety disorders among adolescents over the past three decades. Specifically, the DALY rate of adolescent anxiety disorders fell from 391.39 to 380.62. This finding is in line with previous research, which indicated a decrease in the global DALY rate of depression in the general population, from 588.6 in 1990 to 577.7 in 2017.³⁷ Several factors may contribute to these changes, including sociodemographic and economic environments. For example, effective intervention packages for mental disorders exist in most regions with a high Socio-demographic Index. These interventions have the potential to reduce the burden due to mental disorders by alleviating symptoms, promoting remission or mitigating mortality risk.³⁸ In some regions, unstable environments such as conflict and war may impede the diagnosis and treatment of anxiety disorders in adolescents. Furthermore, increasing acceptance and awareness of mental health issues may encourage adolescents to seek mental health services more readily, contributing to the observed decline in burden.³⁹ Therefore, implementing effective intervention strategies, maintaining a stable social environment and promoting mental health awareness play a significant role in reducing the burden of anxiety disorders.

Our findings indicated that the ASIR of anxiety disorders among adolescents was 7.39 per 1000, a higher figure compared with the 5.8 per 1000⁶ reported for the general population in a previous study. Additionally, our study revealed a global estimated APC for anxiety disorders in adolescents of -0.02, which is lower than the 0.02 estimated APC reported in previous research.⁶ Compared with prior research, we focus on the special group of adolescents and anxiety disorders, while previous studies paid more attention to the most common mental health

Table 2 Correlation between incidence of adolescents' anxiety disorders, disability-adjusted life years and country-level variables

	Incidence (per 100 000 population)			DALY rate (per 100 000 population)		
	Pearson correlation	P value	N	Pearson correlation	P value	N
Psychiatrists	0.50	0.006	29	0.58	0.002	25
Psychologists	0.56	0.004	25	0.67	0.001	21
Nurses	0.35	0.091	24	0.43	0.044	22
Social workers	0.16	0.580	14	0.21	0.539	11
ESG Index	-0.04	0.817	39	-0.15	0.368	38
Healthcare Index	0.11	0.587	25	0.34	0.107	24
Quality of Life Index	0.37	0.067	26	0.53	0.008	24

N, the number of countries included. Some microstates (eg, San Marino) were not included in the analysis because data were unavailable. Bold values indicate P<0.05. DALY, disability-adjusted life year; ESG, Environmental, Social and Governance.

conditions, such as depression. Anxiety disorders are also at the top of the list of mental health problems that are easily overlooked. Also, previous studies focused on the overall situation of the whole population, but the stressors and coping methods of adolescents' anxiety are usually different from those of adults, which are determined by the traits of adolescence.

The ASIRs of anxiety disorders were highest in Portugal (1990 and 2019) and lowest in Uzbekistan (1990 and 2019) among the 204 analysed countries and regions. Mexico had the largest annualised growth of ASIR from 1990 to 2019. The highest DALY was observed in Portugal, while India had the lowest. The largest increase in DALY was observed in Ireland (estimated APC: 1.07) in 1990 and 2019. A systematic understanding of the exact change pattern of anxiety disorder burden could help policy-makers allocate limited medical resources rationally and develop adapted prevention and treatment strategies.

The incidence rates of adolescent anxiety disorders were highest in developed countries in northern Europe (Portugal, Norway and Ireland) and Asia (Iran) in both 1990 and 2019. The incidence rates were lowest in developing Asian countries (Uzbekistan, Kyrgyzstan and Kazakhstan), which is consistent with global anxiety surveys and research.⁴⁰ The higher incidence rates observed in northern Europe may be attributed partly to increasing mental health literacy, less stigma^{41 42} and improved access to mental health services.⁴³ For instance, the population of Póvoa de Varzim in northern Portugal exhibited above-average levels of mental health literacy, with stigma decreasing as mental health literacy increased.⁴⁰ Furthermore, some studies suggest that the geographical phenomena of cold weather and lack of sunlight in winter may exacerbate anxiety problems.⁴⁴ Regarding Iran, evidence suggests that individuals with lower socioeconomic status have worse health outcomes.⁴⁵ Illiteracy and low levels of education marginalise people, limiting their access to available mental health services and hindering the achievement of important community

goals, such as promoting health and accessing social support and healthcare services.^{46 47}

Asian countries such as Uzbekistan, Kyrgyzstan and Kazakhstan have shown lower incidence rates of anxiety disorders. One possible explanation for this is that the cultural pathways to developing such disorders differ between Asian and Western people. For example, from the perspective of cultural values and social expectations, Asian cultures tend to place a greater emphasis on collectivism, harmony and respect for authority.⁴⁸ These cultural norms can lead to higher levels of stress and anxiety when individuals struggle to meet these expectations. In contrast, Western cultures emphasise individualism, self-expression and personal freedom, which may contribute to a more open approach to discussing mental health issues.⁴⁹ As a result, Asian and Western countries showed different levels and incidences of anxiety disorders.

The extent to which specific factors contribute to a diagnosis may be partly influenced by an individual's identification with one culture over another.⁵⁰ Additionally, the low incidence of anxiety disorders among adolescents in certain regions could be attributed to conflicts in the Central Asia region, where conflicts between countries result in a neglect of adolescents' mental health.⁵¹ The study revealed that anxiety rates rise in conflict areas^{24 52} and that children who have experienced war are more susceptible to anxiety. However, obtaining precise data from these areas can be challenging.³⁴

The ASIR increased the most in Mexico, followed by Ireland and Lebanon. The present results also showed that the changing trends of anxiety disorder burden (DALYs) vary considerably among countries, with the highest growth rate of DALY in Ireland, followed by Lebanon and Mexico. The ASIR increased significantly in the regions with a high Sociodemographic Index, as well as in high-income Latin America (ie, Mexico). The rapid increases in the ASIR of anxiety disorders in these regions could be due to high levels of economic development,

education and social pressure leading to more concern about adolescent anxiety disorders.

Ireland's noteworthy changes in ASIR and DALY trends could be linked to its high-level economic conditions, social pressures, cultural environment and high self-awareness of anxiety symptoms. Experts generally agree that educational pressure or social media are common sources of anxiety among adolescents with high levels of anxiety. The pursuit of academic excellence among young students may stem from broader social and cultural norms. Additionally, the rapid dissemination of unfounded rumours and gossip through digital channels can exacerbate anxiety in young people.⁵³ In Lebanon, cultural factors may contribute to the increasing adolescent anxiety.⁵⁴ Lebanon is considered a more collectivistic society compared with many Western societies, favouring behaviours characterised by withdrawal and modesty.⁴⁸ Individuals in such societies tend to be highly conscious of the presence of others that operate on high moral ground.⁵⁵ Excessive focus on societal norms and expectations can cultivate feelings of falling short and contribute to anxiety.⁵⁵ Furthermore, political instability and warfare have led to deaths, casualties and displacements in Lebanon, which have had a profound psychological impact on civilians. According to the study, the 30-day prevalence of psychiatric disorders was 26.1%, with 13.1% of Lebanese adolescents experiencing anxiety.⁵⁶

The socioeconomic and cultural contextual information in the mentioned countries is shown in online supplemental table S7. The socioeconomic and cultural level of European countries is relatively high, and the per capita GDP (US\$40 755) and school enrolment rate (80%) are higher than the global average (GDP: US\$12 647.5; school enrolment rate: 42%), while the social, economic and cultural level of Asia is relatively low.

Regarding the relationship between health service resources and anxiety disorders, the number of mental health nurses was positively associated with anxiety disorder burden. This correlation suggests that enhanced access to healthcare resources may facilitate the identification of adolescent anxiety disorders. This contrasts with previous research indicating that insufficient health service utilisation contributes to an increased incidence of anxiety disorders.⁵⁷ Additionally, the positive correlation between disease burden and QoL confirms that mental health issues become more pronounced when fundamental living conditions are met and addressed. This is also in line with Maslow's hierarchy of needs theory,⁵⁸ which posits that lower-level basic needs must be met first before higher-level needs (such as psychological needs) can be fulfilled. These findings suggest that anxiety disorders among adolescents may be underestimated, particularly in low-income or low-QoL countries.

Limitations

This study analyses the temporal and spatial trends in adolescents' burden of anxiety disorders. However, it is also subject to some limitations. First, the data were

obtained from the GBD database, in which anxiety disorders are classified into panic disorder, agoraphobia, specific phobia, social phobia, obsessive-compulsive disorder, post-traumatic stress disorder and generalised anxiety disorder. Our analysis was based on this classification method without further subdivision, limiting our ability to assess the prevalence of specific anxiety disorders among adolescents. Second, it is inevitable that some microstates (eg, San Marino) may have missing data, potentially introducing deviations in the results. Third, there may be potential biases due to discrepancies in the mental health service data available, which were collected from different years and might not have been uniformly obtained across geographical regions. This variation may weaken the influence of some factors that change over time on anxiety. Future research could explore specific subtypes of anxiety disorders or investigate the effectiveness of interventions in different cultural contexts. Local health authorities could establish and implement standardised common protocols for microstate data collection. These results may contribute to a more nuanced and comprehensive understanding of anxiety disorders, allowing for targeted interventions and policies to improve mental health outcomes among adolescents globally.

Implications

Despite these limitations, our study offers valuable insights into the policy implications concerning countries or territories grappling with a heavy burden of anxiety disorders among adolescents. This knowledge can inform future efforts aimed at reducing incidence rates. For example, in developed countries, there is a pressing need to prioritise adolescent anxiety disorders and implement timely screening and appropriate intervention. Also, our study highlights the underestimation of anxiety disorders in conflict-ridden countries and regions. Policymakers and practitioners should consider the impact of diverse cultural backgrounds and countries' characteristics when designing interventions for adolescent anxiety disorder. For instance, adolescents in Asian countries may be more susceptible to anxiety resulting from unfulfilled societal expectations, whereas adolescents in developed countries like Ireland are more likely to experience anxiety disorders due to academic pressure or the influence of social media. Also, our findings suggest that the Centres for Disease Control and Prevention in low-income and middle-income countries should popularise mental health knowledge and raise awareness of anxiety disorders.

CONCLUSION

The incidence and global burden of anxiety disorders in adolescents have continued to decrease over the past 30 years. However, the incidence of anxiety disorders and the disease burden among adolescents in developed countries are still increasing steadily, with low-income and middle-income countries suffering from a lack of mental

health resources and neglect of adolescent anxiety. Given the large variations in the burden by geographical location, mental health initiatives should be designed and implemented based on the specific development status as well as the cultural and regional characteristics of each country.

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