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Global burden of mental disorders in children and adolescents before and during the COVID-19 pandemic: evidence from the Global Burden of Disease Study 2021

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Original Article

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Abstract

Background. Childhood and adolescence are vulnerable periods for mental disorders, and the COVID-19 pandemic has exacerbated mental health challenges in this population. We aimed to estimate changes in the global burden of mental disorders among children and adolescents before and during the pandemic.

Methods. Using data from the Global Burden of Diseases Study 2021, we analyzed incidence, prevalence, and years lived with disability (YLDs) for mental disorders in individuals aged 5–24. Annual percent changes in age-standardized rates were calculated, and a Bayesian age–period–cohort model estimated the expected and additional burden based on pre-pandemic trends.

Results. In 2021, an estimated 123.0 million new cases of mental disorders were reported among children and adolescents, with an 11.8% average annual increase in the age-standardized incidence rate during the pandemic. Anxiety disorders, which previously ranked third, became the leading cause of nonfatal disability (12.9 million [8.0–19.3] YLDs), while depressive disorders rose to fourth place (10.9 million [6.8–16.5] YLDs). The burden grew in most regions, especially among females, those aged 15–24, and in high sociodemographic index (SDI) areas. Based on pre-pandemic data, we estimated an additional burden of 795.0, 165.9, and 622.8 new cases per 100,000 population for total mental disorders, anxiety disorders, and depressive disorders globally in 2021, respectively. Spearman correlation analysis showed a significant positive correlation between additional burden and SDI levels.

Conclusions. These findings highlight the increased burden of mental disorders among children and adolescents during the pandemic, emphasizing the need for targeted post-pandemic mental health support.

Introduction

Mental disorders are among the leading contributors to the global health-related burden. The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) has identified mental disorders as one of the principal causes of global health burden (GBD 2019 Mental Disorders Collaborators, 2022; GBD 2021 Diseases and Injuries Collaborators, 2024). Furthermore, a growing body of evidence indicates that the onset of mental disorders predominantly occurs during youth, with a peak around the age of 14 (Baranne & Falissard, 2018; Copeland, Shanahan, Costello, & Angold, 2011; Paus, Keshavan, & Giedd, 2008; Solmi et al., 2022). Children and adolescents afflicted by mental disorders frequently experience detrimental personal outcomes, including impaired cognition, academic performance, interpersonal functioning, and physical health (Barnes, Eisenberg, & Resnick, 2010; Clayborne, Varin, & Colman, 2019). Moreover, these conditions significantly increase the risk of developing psychopathology in adulthood (National Academies of Sciences et al., 2019).

The emergence of the COVID-19 pandemic in 2020 has prompted numerous new questions regarding its impact on the mental health of children and adolescents, both through its direct psychological effects and its long-term economic and social consequences (Kola et al., 2021). Beyond the direct health implications of the COVID-19 infection, the pandemic has altered many determinants of the mental health of young people. Increased screen time, school closures and disruptions, reduced physical activity, and limited access to school-based mental health support have all likely exerted significant influence on the mental health of children and adolescents (Xie et al., 2020). Although some studies have explored the global epidemiology of mental disorders associated with the COVID-19 pandemic (COVID-19 Mental Disorders Collaborators, 2021; Kola et al., 2021; Pirkis et al., 2021), the study based on the children and adolescent population is insufficient. A study conducted among children and adolescents in the United States showed that

the prevalence of anxiety problems, depression, learning disability, developmental delay, and speech or other language problems increased during the COVID-19 pandemic (Leeb et al., 2024). The meta-analysis based on 23 population studies also revealed the high prevalence of mental health problems among children and adolescents during the COVID-19 pandemic, especially among females and adolescents (Ma et al., 2021). However, a proportion of these data also show that some children with prior and/or ongoing mental health disorders have had reduced symptoms during some period of the pandemic (Cost et al., 2022; Raw et al., 2021). Due to the lack of comparable data support, it remains unclear whether the differences in these findings are attributable to the varying impacts of the COVID-19 pandemic on children and adolescents, national and individual differences, or the influence of social determinants of health-related issues. Moreover, any changes in the risk of mental disorders related to COVID-19 are likely to be dynamic. It is partial to estimate the effect of the pandemic on mental disorders before the end of the pandemic. However, in the post-pandemic era, with sufficient global disease survey data, it is time to conduct a retrospective assessment of the epidemiology of mental health during COVID-19 among children and adolescents.

The GBD 2021 provides an invaluable opportunity for a nuanced understanding of the impact of the COVID-19 pandemic on mental disorders in children and youth. In this report, we leverage the most recent global health data from the GBD 2021 study to compare the global burden of incidence, prevalence, and nonfatal disability associated with mental disorders in children and adolescents before and during the COVID-19 pandemic. Given that the burden of mental disorders maintained a steady trend prior to the pandemic, we employ a method based on the Bayesian age–period–cohort (BAPC) model to estimate expected trends for 2020 and 2021 using data from 1990 to 2019. The additional disease burden during the COVID-19 pandemic is calculated by subtracting the estimated burden from the actual burden. We further quantify the burden of mental disorders in children and adolescents by sex, age, and region for the year 2021.

Methods

Data sources

The GBD 2021 study encompasses the global burden of 371 diseases and injuries, across 204 countries and territories from 1990 to 2021 (GBD 2021 Diseases and Injuries Collaborators, 2024). The integrated data in GBD 2021 encompass not only published literature but also national health survey data, disease registries, notification data, and hospital inpatient records. Citations for all data sources used in the GBD 2021 estimations are provided in a searchable format through a web tool (https://ghdx.healthdata.org/gbd-2021/sources). Data obtained from systematic reviews were tested and adjusted for biases using DisMod-MR version 2.1, a hierarchical Bayesian meta-regression modeling tool aggregating data from various sources to generate internally consistent estimates of prevalence and incidence by age, sex, location, and year. Countries and territories are grouped into epidemiological 'GBD regions' based on geographic, economic, and health system similarities. Estimates for countries with limited data may draw on trends from neighboring nations with comparable sociodemographic profiles. Additionally, three COVID-19 impact indicators were tested as independent variables to adjust for the pandemic's effects: human mobility, daily COVID-19 infection rates, and daily excess mortality rates (COVID-19 Mental Disorders Collaborators, 2021). For each COVID-19 impact indicator, the average daily estimate between the start date of the survey minus the recall period of the assessment tool and the end date of the survey was calculated and applied to each estimate informing the model. The GBD study received approval from the University of Washington Institutional Review Board, and no identifiable data were used.

Study population and data collection

The developmental period spanning childhood to early adulthood involves rapid neurobiological and societal transitions. Given these dynamics, extending the upper age limit of adolescence to 24 years is critical for studying mental disorders, as it aligns with the prolonged trajectory of brain development and psychosocial adaptation in modern societies (Sawyer, Azzopardi, Wickremarathne, & Patton, 2018). Accordingly, we analyzed the incidence, prevalence, and years lived with disability (YLDs) of mental disorders in individuals aged 5–24 years across 204 countries and territories. Data were compared between the pre-pandemic period (2019) and the COVID-19 pandemic period (2020–2021), with a focus on disorders showing the most significant changes, particularly anxiety and depressive disorders. Diagnostic definitions and cataloging codes are detailed in the Supplementary Material.

The sociodemographic index (SDI) is calculated to represent a comprehensive measure of development status, capturing the social and economic factors that influence health outcomes (GBD 2021 Diseases and Injuries Collaborators, 2024). It is derived from three key indicators: the total fertility rate for those under 25 years of age (TFU25), mean education for those 15 years old and older (EDU15+), and the lag-distributed income (LDI) per capita. The composite SDI is the geometric mean of these three indices:

$$SDI = \sqrt[3]{I_{TFU25} \times I_{Educ} \times I_{\ln LDI}}.$$

All 204 countries and territories were subsequently stratified into five groups by using country-level estimates of SDI for the year 2019: low, low-middle, middle, high-middle, and high. The details of SDI and each indicator calculation can be found in the Supplementary Material.

Statistical analysis

A descriptive analysis was conducted to examine the changes in incidence, prevalence, and YLDs of mental disorders among children and adolescents aged 5–24 years from 2019 to 2021. We compared the total number and age-standardized rates (per 100,000 population) of mental disorders across various demographic groups, including sex, age, SDI, regions, and countries. Since the GBD study does not provide aggregate data for the 5–24 years age group, we calculated the age-standardized rates using an equation based on four age-specific rates (5–9, 10–14, 15–19, and 20–24 years) and the world standard population as defined in the GBD study:

$$Age\ standardized\ rate = \frac{\sum_{i=1}^{A} a_{iw_i}}{\sum_{i=1}^{A} w_i},$$

where a_i is the age-specific rate, w_i is the weight in the same age subgroup of the chosen reference standard population (in which i denotes the ith age class), and A is the upper age limit.

To evaluate the global ranking of disability attributable to mental disorders, we computed the age-standardized rates of YLDs and disability-adjusted life years (DALYs) for all level 3 diseases in

children and adolescents. To analyze global trends in the burden of mental disorders and identify the diseases with the most significant changes during the pandemic, a joinpoint regression analysis was conducted. Annual percent changes (APCs) derived from joinpoint regression were used to estimate the temporal trends of age-standardized rates from 2019 to 2021. The APC value reflects the annual rate of change (increase, decrease, or no change). If the APC estimates and their 95% confidence intervals were both greater than 0 (or both less than 0), the corresponding rate was considered to be in an upward (or downward) trend.

Finally, given that the burden of mental disorders maintained a steady trend prior to the pandemic, we employed the BAPC model to estimate the expected burden of mental disorders in the absence of the pandemic's effects, using data from 1990 to 2019. The BAPC model provides a robust framework for disentangling the complex interplay of age, period, and cohort effects in health-related data analysis. This model is particularly advantageous for projecting disease burden as it does not rely on parametric assumptions. To estimate the model parameters efficiently, we employed the integrated nested Laplace approximation (INLA) method, which delivers high accuracy in approximating marginal posterior distributions. To account for temporal continuity, we adopted the second-order random walk (RW2) as smoothing priors for age, period, and cohort effects, assuming independent mean-zero normal distributions for the second differences of all temporal effects. The BAPC mod was conducted by R packages 'BAPC' and 'INLA'(Riebler & Held, 2017). We calculated the additional burden during the COVID-19 pandemic by subtracting the estimated expected burden from the actual burden recorded in the GBD data. Additionally, Spearman correlation analysis was conducted to assess the relationship between the additional burden and the SDI.

This study followed the Strengthening the Reporting of Observational Studies in Epidemiology reporting guidelines. Statistical analyses were performed using R statistical software (version 4.3.3) and the Joinpoint Regression Program (version 5.1.0).

Results

Global trends of mental disorders

The joinpoint regression analysis revealed a stable worldwide age-standardized rate of YLDs for total mental disorders among children and adolescents from 1990 to 2019 (Supplementary Figure S1). However, a notable increase was observed between 2019 and 2021, corresponding with the COVID-19 pandemic. Among the 10 types of mental disorders, anxiety disorders and depressive disorders presented sharp upward trends compared with total mental disorders.

Globally, the burden of mental disorders increased sharply in the young population during the COVID-19 pandemic. The incidence of total mental disorders among children and adolescents rose by 22.4% during the COVID-19 pandemic, increasing from 100.5 million in 2019 to 120.4 million in 2020 and further to 123.0 million in 2021. The age-standardized incidence rate (ASIR) of mental disorders for this age group increased by 20.6%, rising from 3,922.4 per 100,000 population in 2019 to 4,661.2 and 4,730.1 per 100,000 population in 2020 and 2021, respectively, with an APC of 11.8% (Table 1). Specifically, the ASIR of anxiety disorders increased by 25.1%, from 661.7 per 100,000 population in 2019 to 794.9 in 2020 and 827.9 per 100,000 population in 2021. Similarly, the incidence of depressive disorders rose by 28.6%, from 2,233.4 per 100,000 population in 2019 to 2,838.7 in 2020 and 2,873.1 in 2021. The nonfatal burden (YLDs) of mental disorders increased significantly from 35.4 million in 2019 to 39.7 million and 40.6 million in 2020 and 2021, respectively.

Anxiety disorders emerged as a leading contributor to nonfatal disability (YLDs) among children and adolescents during the pandemic. We compared the rank and count changes of level 3 diseases in children and adolescents, including 10 types of mental disorders, based on their contribution to nonfatal and fatal burdens (YLDs: quantifying nonfatal health loss; DALYs: quantifying both years lost to premature mortality and YLDs) between 2019 and 2021 (Figure 1 and Supplementary Figure S2). Anxiety disorders rose from third place in 2019 (10.28 million [6.32–15.34]) to second place in 2020 (12.33 million [7.60–18.41]) and ascended to first place in 2021 (12.92 million [7.95–19.32]), while depressive disorders moved from fifth place (8.58 million [5.36–12.91]) to fourth place in 2020 (10.70 million [6.64–16.19]) and remind fourth place in 2021 (10.89 million [6.75–16.50]) (Figure 1). Even in terms of DALYs, anxiety and depressive disorders among children and adolescents saw significant rises. Anxiety disorders ascended from the fourth rank in 2019 to the second rank in 2021, while depressive disorders moved from the seventh rank to the fifth rank during the same period (Supplementary Figure S2). Other types of mental disorders exhibited either minimal increases or maintained stable counts for risk-attributable YLDs or DALYs during this timeframe.

Similarly, the prevalence of mental disorders among individuals aged 5–24 years showed a noticeable increasing trend. The age-standardized prevalence rate of mental disorders, anxiety disorders, and depressive disorders increased with APCs of 5.0%, 12.0%, and 11.5%, respectively (Supplementary Table S1).

Global trends of mental disorders by sex, age, and SDI group

During the COVID-19 pandemic, the global burden of mental disorders among children and adolescents demonstrated significant increases, with notable disparities by sex, age group, and SDI levels. Among females, the ASIR of total mental disorders rose from 4,359.3 to 5,361.1 per 100,000 population, while for males, it increased from 3,503.4 to 4,126.4 per 100,000 population (Table 1). Consequently, the age-standardized rate of YLDs increased from 1,441.8 to 1,664.6 per 100,000 population for females and 1,321.0 to 1,456.6 per 100,000 population for males, with APCs of 8.2% and 5.7%, respectively. Although females experienced a higher increase in incidence and YLDs of total mental disorders, the rise in anxiety disorders was smaller compared with males (APC for incidence: 13.2% in females vs. 13.4% in males; APC for YLDs: 11.8% in females vs. 12.1% in males), whereas depressive disorders saw a greater increase in females (APC for incidence: 14.9% in females vs. 14.7% in males; APC for YLDs: 13.3% in females vs. 13.1% in males).

In the age level, in contrast to the overall age group, the increases in incidence, prevalence, and nonfatal burden of mental disorders among individuals aged 5–24 years were more pronounced during the same period (Supplementary Figure S3). The incidence of mental disorders rose across all subgroups aged 5–24 years: 5–9 years (from 13.3 to 14.9 million), 10–14 years (from 24.3 to 29.1 million), 15–19 years (from 30.5 to 38.5 million), and 20–24 years (from 32.3 to 40.7 million). The most rapid increase in ASIR was observed in teenagers and young adults (APC: 7.6% for 15–19 years; 7.9% for 20–24 years). Notably, teenagers aged 15–19 years had the highest ASIR of anxiety disorders (870.3 per 100,000 population) in 2021, with an APC of 14.0% from 2019 to 2021. However, the burden of anxiety disorders in children under

Table 1. The incidence and YLDs of mental disorders, anxiety disorders, and depressive disorders and APC in children and adolescents from 2019 to 2021

	Incidence							YLDs						
	Number of cases (million)			Age-standardized rate (per 100,000 population)			APC (%)	Number of cases (million)			Age-standardized rate (per 100,000 population)			APC (%)
	2019	2020	2021	2019	2020	2021	2019–2021	2019	2020	2021	2019	2020	2021	2019–2021
Mental disorders														
Global	100.5 (77.4–127.9)	120.4 (91.9–15.4)	123.1 (93.9–157.5)	3,922.4 (3,021.2–4,990.4)	4,661.2 (3,561.6–5,965.5)	4,730.1 (3,610.0–6,050.8)	11.8 (8.5–15.2)	35.4 (25.5–47.0)	39.7 (28.4–52.9)	40.6 (29.0–54.2)	1,380.5 (992.1–1,833.7)	1,536.1 (1,098.3–2,045.4)	1,558.5 (1,112.7–2,080.8)	7.0 (5.4–8.7)
Sex														
Female	54.6 (41.6–70.5)	66.7 (50.4–86.5)	68.1 (51.5–88.4)	4,359.3 (3,325.7–5,622.8)	5,285.1 (3,998.7–6,850.7)	5,361.1 (4,052.9–6,952.6)	13.1 (9.6–16.7)	18.1 (12.8–24.3)	20.7 (14.6–27.8)	21.2 (14.9–28.5)	1,441.8 (1,022.0–1,941.4)	1,636.2 (1,151.8–2,203.4)	1,664.6 (1,173.4–2,241.2)	8.2 (6.4–10.2)
Male	45.9 (35.5–57.8)	53.7 (41.2–68.1)	54.9 (42.2–69.6)	3,503.4 (2,710.5–4,410.0)	4,064.0 (3,119.7–5,153.7)	4,126.4 (3,173.4–5,228.6)	10.2 (7.1–13.5)	17.3 (12.6–22.8)	19.0 (13.8–25.1)	19.4 (14.0–25.6)	1,321.0 (956.5–1,738.1)	1,439.7 (1,040.2–1,898.5)	1,456.6 (1,048.7–1,921.6)	5.7 (4.4–7.1)
Age group														
5–9	13.3 (10.6–16.3)	14.5 (11.7–17.8)	14.9 (11.9–18.2)	1,971.3 (1,563.7–2,419.2)	2,134.9 (1,711–2,616.6)	2,162.1 (2,650.0–1,727.9)	5.2 (4.3–6.2)	3.9 (2.8–5.1)	4.2 (3.0–5.5)	4.3 (3.0–5.6)	578.3 (415.8–758.7)	616.4 (440.5–814.2)	622.3 (443.4–825.8)	4.0 (3.2–4.8)
10–14	24.3 (18.8–29.9)	28.4 (21.8–35.2)	29.1 (22.3–36.1)	3,720.7 (2,883.3–4,588.6)	4,300.3 (3,307.3–5,333.1)	4,361.3 (3,351.5–5,414.3)	8.8 (6.4–11.2)	8.6 (6.1–1.2)	9.6 (6.7–13.0)	9.8 (6.8–13.4)	1,323.2 (930.3–1,802.0)	1,450.3 (1,013.7–1,975.6)	1,470.0 (1,027.2–2,010.8)	5.5 (3.9–7.0)
15–19	30.5 (23.3–38.4)	37.5 (28.1–47.2)	38.5 (28.8–48.3)	4,992.0 (3,800.5–6,275.9)	6,078.4 (4,552.2–7,653.7)	6,165.9 (4,617.9–7,746.2)	13.3 (10.0–16.8)	10.9 (7.9–14.5)	12.4 (8.9–16.4)	12.7 (9.1–16.9)	1,786.0 (1,294.3–2,367.8)	2,008.6 (1,446.7–2,650.7)	2,038.2 (1,465.7–2,695.1)	7.6 (6.2–9.0)
20–24	32.3 (24.7–43.3)	39.9 (30.3–53.9)	40.7 (30.9–54.9)	5,434.2 (4,156.7–7,271.3)	6,699.0 (5,093.3–9,046.7)	6,809.1 (5,167.0–9,193.4)	13.2 (11.3–15.1)	11.9 (8.7–15.7)	13.5 (9.8–17.9)	13.8 (9.9–18.3)	2,008.7 (1,455.8–2,633.7)	2,271.6 (1,639.9–3,006.8)	2,310.2 (1,664.6–3,062.3)	7.9 (7.5–8.4)
Anxiety disorders														
Global	16.8 (11.2–23.4)	20.4 (13.6–28.4)	21.4 (14.2–29.9)	661.7 (442.2–922.5)	794.9 (531.2–1,107.7)	827.9 (550.8–1,156.7)	13.3 (11.5–15.1)	10.3 (6.3–15.3)	12.3 (7.6–18.4)	12.9 (8.0–19.3)	400.8 (246.4–598.3)	477.5 (294.2–712.9)	496.4 (305.4–742.6)	11.9 (9.5–14.4)
Sex														
Female	9.8 (6.5–13.7)	11.9 (7.9–16.6)	12.5 (8.3–17.5)	792.8 (529.5–1,110.6)	954.1 (636.8–1,334.0)	995.2 (661.8–1,394.4)	13.2 (11.2–15.3)	6.2 (3.8–9.2)	7.5 (4.6–11.1)	7.8 (4.8–11.6)	496.5 (307.1–736.3)	592.6 (366.7–880.4)	617.0 (379.9–917.4)	11.8 (8.4–15.3)
Male	7.0 (4.7–9.7)	8.5 (5.6–11.7)	8.9 (5.9–12.3)	537.5 (359.0–746.3)	644.0 (429.4–893.7)	669.2 (445.0–930.8)	13.4 (11.4–15.4)	4.1 (2.5–6.1)	4.9 (3.0–7.3)	5.1 (3.1–7.7)	309.7 (189.1–465.9)	368.0 (225.1–553.6)	381.6 (232.8–574.9)	12.1 (10.7–13.4)
Age group														
5–9	3.7 (2.5–5.3)	4.5 (3.0–6.4)	4.7 (3.2–6.7)	549.1 (373.3–784.2)	660.8 (446.1–943.5)	683.4 (458.7–978.2)	12.4 (9.4–15.4)	1.1 (0.7–1.7)	1.3 (0.8–2.0)	1.4 (0.8–2.1)	162.6 (96.3–247.3)	195.8 (114.7–298.3)	202.7 (118.0–310.3)	12.5 (9.6–15.5)
10–14	4.9 (3.7–6.4)	5.9 (4.5–7.7)	6.2 (4.7–8.1)	746.7 (565.7–977.6)	891.5 (679.7–1,167.5)	925.1 (704.1–1,213.4)	11.9 (8.9–15.1)	2.7 (1.6–4.0)	3.2 (1.9–4.8)	3.4 (2.0–5.1)	409.0 (245.2–611.7)	486.5 (292.5–728.7)	503.7 (302.0–760.9)	12.1 (9.6–14.7)
15–19	4.2 (2.7–5.9)	5.1 (3.3–7.2)	5.4 (3.5–7.6)	691.6 (445.2–963)	832.8 (533.6–1,166.2)	870.3 (553.7–1,221.5)	14.0 (11.2–16.8)	3.2 (2.0–4.8)	3.9 (2.4–5.7)	4.1 (2.5–6.0)	526.0 (328.4–779.5)	625.5 (392.1–930.3)	649.7 (407.9–962.3)	11.3 (8.4–14.3)
20–24	4.0 (2.3–5.9)	4.8 (2.8–7.0)	5.1 (2.9–7.4)	671.4 (381.9–987)	809.3 (462.8–1,179.8)	849.6 (485.2–1,243.4)	13.3 (12.3–14.2)	3.3 (2.1–4.9)	3.9 (2.5–5.8)	4.1 (2.6–6.1)	553.2 (346.6–824.8)	658.5 (414.3–977.0)	688.5 (432.2–1,023.3)	12.8 (11.7–13.9)
Depressive disorders														
Global	57.8 (40.2–81.8)	74.0 (51.3–104.4)	75.4 (52.2–106.4)	2,233.4 (1,550.7–3,158.8)	2,838.7 (1,965.0–4,006.2)	2,873.1 (1,987.9–4,055.2)	14.8 (13.6–16.0)	8.6 (5.4–12.9)	10.7 (6.6–16.2)	10.9 (6.7–16.5)	330.5 (206.5–497.5)	410.1 (254.1–620.4)	414.5 (256.8–628.3)	13.2 (12.2–14.1)

(*Continued*)

Table 1. (*Continued*)

	Incidence							YLDs						
	Number of cases (million)			Age-standardized rate (per 100,000 population)			APC (%)	Number of cases (million)			Age-standardized rate (per 100,000 population)			APC (%)
	2019	2020	2021	2019	2020	2021	2019–2021	2019	2020	2021	2019	2020	2021	2019–2021
Sex														
Female	35.1 (24.5–49.7)	45.0 (31.3–63.6)	45.8 (31.8–64.7)	2,773.9 (1,934.5–3,928.3)	3,538.2 (2,455.0–4,999.5)	3,573.6 (2,480.1–5,054.0)	14.9 (14.4–15.5)	5.2 (3.2–7.8)	6.5 (4.0–9.7)	6.6 (4.1–9.9)	407.6 (255.6–613.6)	507.4 (316.0–766.5)	511.8 (318–773.0)	13.3 (12.7–13.8)
Male	22.8 (15.7–32.0)	28.9 (19.9–40.9)	29.6 (20.3–41.8)	1,717.6 (1,186.0–2,414.4)	2,171.3 (1,492.7–3,066.6)	2,204.9 (1,514.5–3,114.1)	14.7 (12.5–16.9)	3.4 (2.1–5.1)	4.2 (2.6–6.4)	4.3 (2.7–6.6)	256.9 (159.0–386.3)	317.1 (194.6–480.3)	321.6 (197.9–489.3)	13.1 (11.3–14.9)
Age group														
5–9	1.2 (0.6–1.9)	15.4 (8.1–2.5)	15.7 (8.2–2.5)	175.2 (93.7–281.3)	226.3 (118.8–363.2)	228.3 (119.1–366)	16.1 (10.7–21.8)	0.13 (0.06–0.23)	0.17 (0.08–0.30)	0.17 (0.08–0.31)	19.4 (9.4–34.6)	24.8 (11.6–44.3)	25.0 (11.6–44.7)	15.2 (10.1–20.6)
10–14	10.1 (6.5–14.6)	13.1 (8.3–19.2)	13.4 (8.5–19.7)	1,551.9 (1,002.3–2,236.7)	1,987.0 (1,267.4–2,910.8)	2,013.7 (1,282.0–2,955.0)	15.9 (11.0–21.0)	1.2 (0.7–1.9)	1.6 (0.9–2.5)	1.6 (1.0–2.5)	191.3 (113.8–289.9)	241.4 (141.1–371.2)	244.4 (143.7–374.3)	14.9 (14.0–15.7)
15–19	21.2 (14.6–28.9)	27.2 (18.6–36.7)	27.8 (19.0–37.5)	3,468.5 (2,389.2–4,714.7)	4,414.3 (3,017.6–5,950.8)	4,463.1 (3,049.2–6,015.6)	16.2 (11.2–21.4)	3.1 (2.0–4.7)	3.9 (2.4–5.9)	4.0 (2.5–6.0)	507.4 (320.6–763.8)	631.4 (395.7–956)	637.7 (399.8–969.3)	14.4 (10.4–18.5)
20–24	25.3 (18.4–36.5)	32.1 (23.5–46.0)	32.5 (23.8–46.6)	4,254.8 (3,095.7–6,131.2)	5,380.5 (3,936.4–7,713)	5,448.6 (3,987.8–7,808)	14.5 (11.9–17.2)	4.1 (2.6–6.1)	5.0 (3.2–7.5)	5.1 (3.2–7.7)	688.3 (436.1–1,027.2)	846.4 (534.2–1,264.2)	855.6 (538.7–1,281.3)	12.6 (10.4–14.8)

Note: Values in parentheses are 95% uncertainty intervals (for number and rates) or 95% confidence intervals (for APC). APC is based on age-standardized rates. APC, Annual percent change; SDI, sociodemographic index; YLDs, years lived with disability.

10 years old should not be overlooked. During the pandemic, the incidence of anxiety in children aged 5–9 years increased by 1 million, and the ASR of YLDs showed the second-fastest increase, with an APC of 12.5% (Table 1).

Additionally, mental disorders demonstrated striking increases across all SDI levels, with the most significant changes occurring in high SDI regions (Figure 2 and Supplementary Figure S4). Compared with the APC from 2010 to 2019, the incidence, prevalence, and YLDs of mental disorders increased markedly from 2019 to 2021 across all SDI levels for both females and males, particularly in regions with high SDI (APC for incidence: 14.1%; APC for YLDs: 9.1%; APC for prevalence: 5.0%). The most rapid increases in incidence and YLDs for anxiety and depressive disorders were also observed in high-SDI regions, further highlighting the disproportionate burden among high-SDI countries.

Regional trends of mental disorders

From 2019 to 2021, 20 out of the 21 GBD regions showed a notable increase in ASIR and YLDs of mental disorders among children and adolescents, except for East Asia (APC, −0.2%) (Figures S5 and S6 and Supplementary Table S4). The most rapid increases in incidence and YLDs were observed in Andean Latin America (APC: 22.8% for incidence; 15.8% for YLDs), followed by High-Income North America (APC: 17.2% for incidence; 11.4% for YLDs) and Eastern Europe (APC: 16.8% for incidence; 11.1% for YLDs). Consequently, High-Income North America surpassed Australasia to become the region with the highest ASIR in 2021 (9,696.5 per 100,000 population), followed by Australasia (8,607.1 per 100,000 population) and Western Europe (7,536.4 per 100,000 population). Despite a relatively low APC of YLDs in Australasia (2.3%), it remained the region with the highest YLD rate in 2021.

Significant increases in the incidence of anxiety and depressive disorders were seen in various regions. Andean Latin America, Central Europe, and Eastern Europe experienced APC exceeding 20% in the incidence of both anxiety and depressive disorders, while Central Latin America, High-Income North America, Southern Latin America, and Southern Sub-Saharan Africa saw APC over 20% in the incidence of depressive disorders (Supplementary Figure S5 and Supplementary Table S4).

National trends of mental disorders

At the national level, Greenland reported the highest ASIR of mental disorders among children and adolescents (13,325.0 per 100,000 population) in 2021, followed by the United States (9,972.3 per 100,000 population) and Greece (9,438.4 per 100,000 population). Portugal had the highest ASR of YLDs (2,975.2 per 100,000 population) in 2021, followed by Greenland (2,922.1 per 100,000 population) and Lebanon (2,787.5 per 100,000 population) (Figure 3 and Supplementary Table S6). For specific mental disorders, the highest ASIRs for anxiety disorders and depressive disorders were observed in Portugal and Bolivia, respectively, while the highest age-standardized YLD rates for anxiety and depressive disorders were recorded in Greenland and the United States, respectively (Supplementary Tables S7 and S8 and Supplementary Figures S8–S12). The greatest increases in both incidence and YLDs of mental disorders were observed in Bolivia (APC: 26.68% for incidence; 18.54% for YLDs). Bolivia, Peru, Bulgaria, and Belarus experienced APCs exceeding 30% in the incidence of both anxiety and depressive disorders.

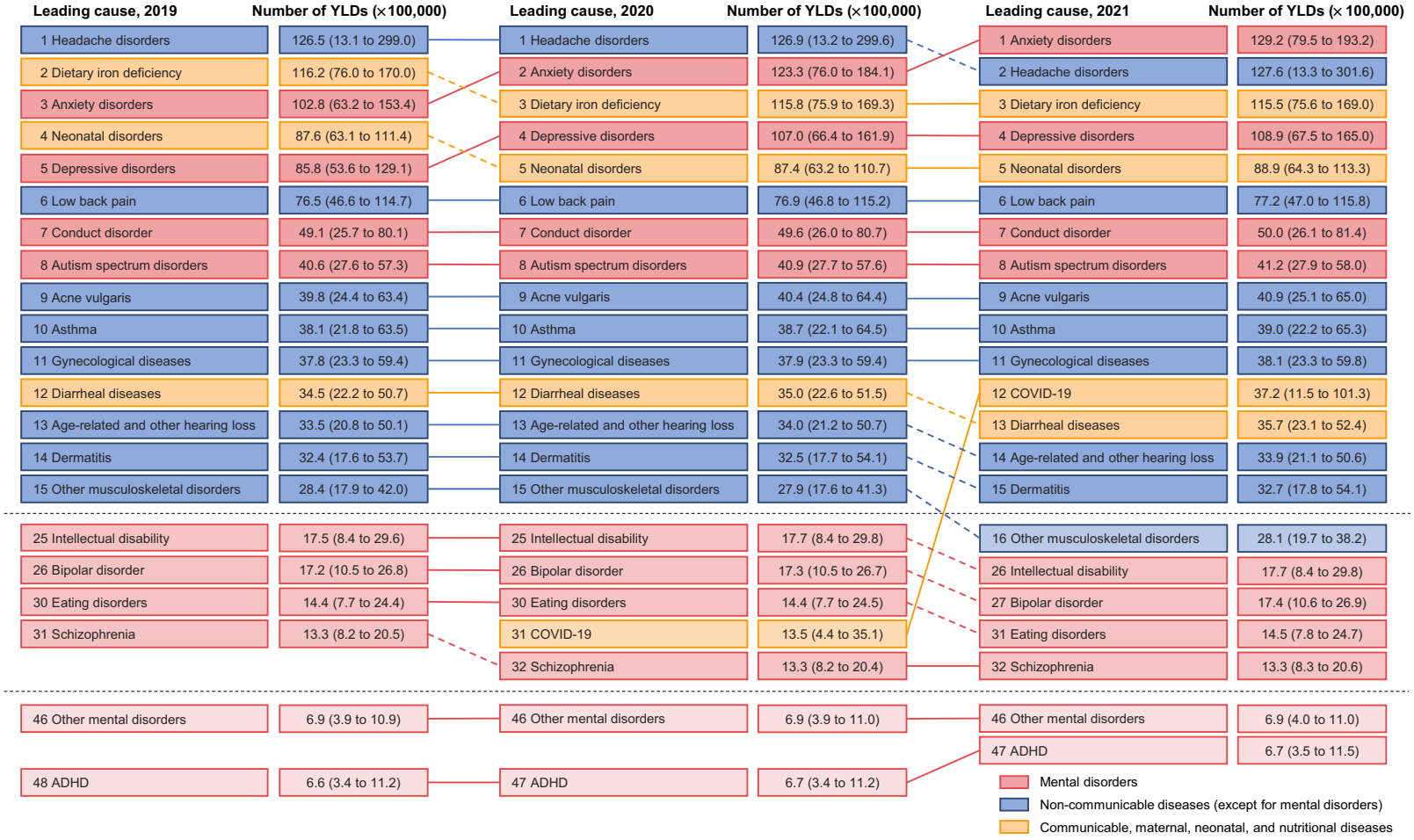

Figure 1. Leading 15 level 3 causes and all level 3 mental disorders contributing to global YLDs among children and adolescents from 2019 to 2021. Causes are connected by lines between time periods, where solid lines represent an increase or no change in rank and dashed lines represent a decrease in rank. *Note:* ADHD, attention-deficit/hyperactivity disorder; YLDs, years lived with disability.

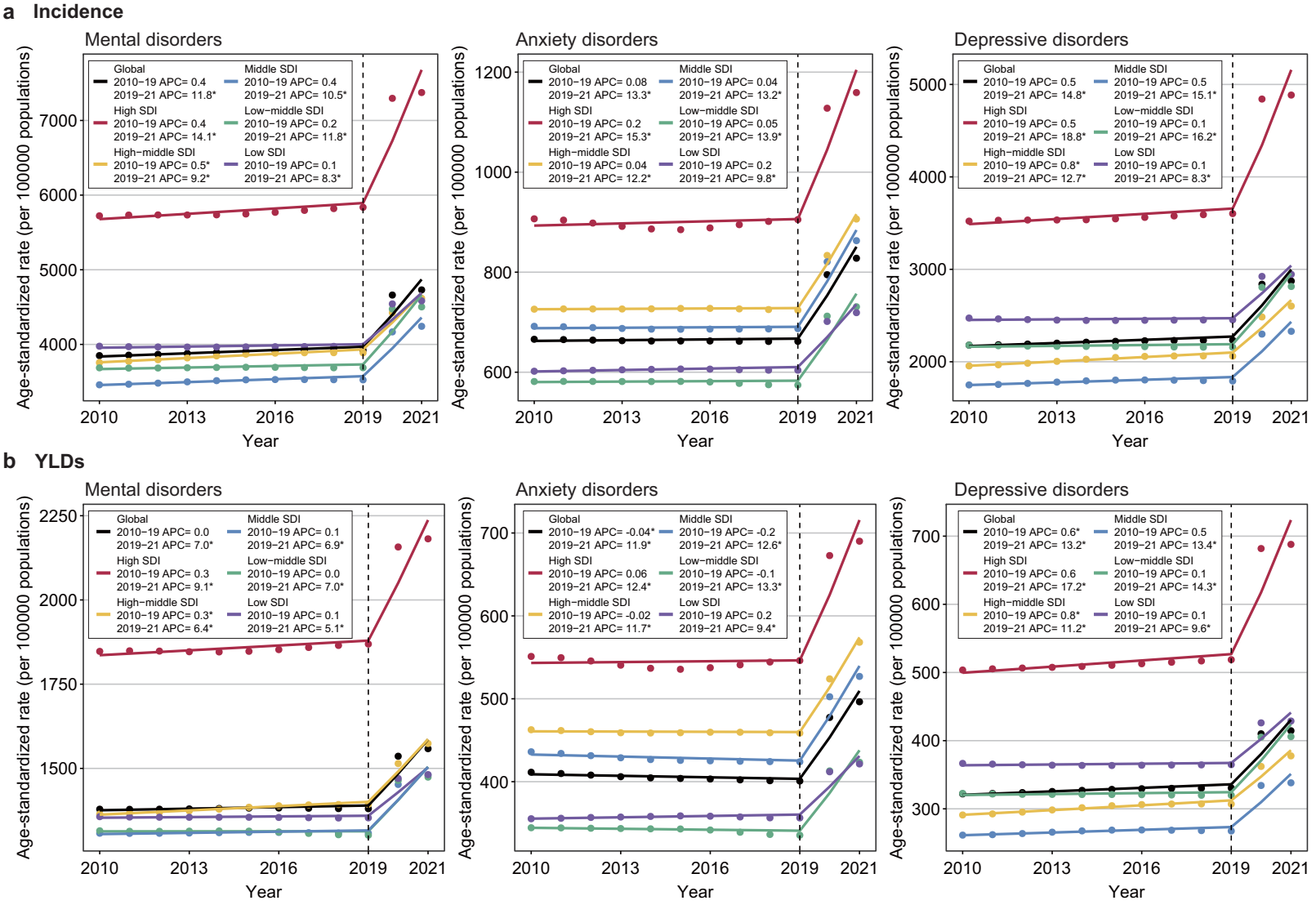

Figure 2. APC in age-standardized rate of incidence, and YLDs among children and adolescents from 2010 to 2021, by mental disorders and SDI quintile. (a) Age-standardized incidence rate; (B) age-standardized YLDs rate. *Note:* APC, annual percent change; SDI, sociodemographic index; YLDs, years lived with disability. *Indicates that the APC is significantly different from zero at the alpha = 0.05 level.

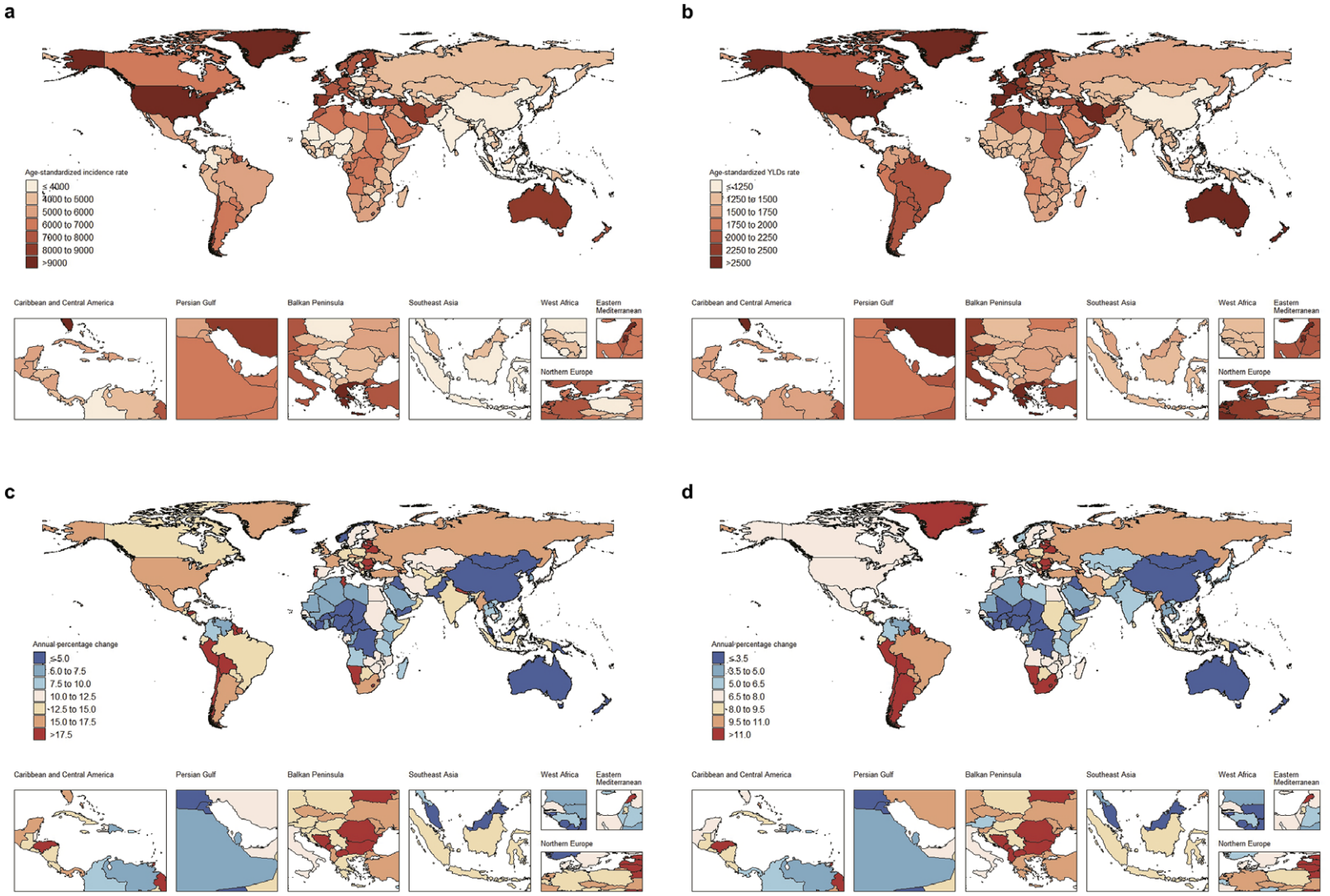

Figure 3. The age-standardized incidence and YLD rate for mental disorders in 2021, and their APCs in children and adolescents aged 5–24 years across 204 countries and territories from 2019 to 2021. Age-standardized rate of incidence (a) and YLDs (b) in 2021. APCs of age-standardized rate of incidence (c) and YLDs (d) from 2019 to 2021. *Note:* APC, annual percent change; YLDs, years lived with disability.

Additional burden of mental disorders during the COVID-19 pandemic

To examine the additional burden of mental disorders among children and adolescents during the COVID-19 pandemic, we utilized the BAPC mod to estimate the expected disease burden for 2020 and 2021 based on data from 1990 to 2019. Globally, the expected global ASIR of total mental disorders, anxiety disorders, and depressive disorders between children and adolescents in 2021 was 3,935.2 cases, 661.9 cases, and 2250.3 cases per 100,000 population, respectively. We estimated an additional burden of 795.0 cases per 100,000 population for total mental disorders, 165.9 cases per 100,000 population for anxiety disorders, and 622.8 cases per 100,000 population for depressive disorders in 2021 (Figure 4a and Supplementary Table S9). Females experienced a greater increase in the incidence of mental disorders, anxiety disorders, and depressive disorders compared to males, with additional cases of 988.7, 203.1, and 782.9 per 100,000 population, respectively, compared with 611.4, 130.6, and 469.8 per 100,000 population in males.

By age group, young adults (20–24 years) showed the highest increase in the additional incidence of total mental disorders (an additional 1,280.2 cases per 100,000 population) during the pandemic. They also experienced the largest increase in additional anxiety disorders (an additional 191.1 cases per 100,000 population), reflecting a 29.0% rise. Children aged 10–14 years saw the highest increase in additional depressive disorders (an additional 484.7 cases per 100,000 population), representing a 31.7% increase.

Regionally, Andean Latin America exhibited the highest increases in additional incidence of mental disorders (additional 1,433.9 cases per 100,000 population; 39.2%), anxiety disorders (additional 468.6 cases per 100,000 population; 53.3%), and depressive disorders (additional 974.0 cases per 100,000 population; 62.9%) among children and adolescents during the pandemic. Notably, East Asia experienced a significant decrease in the additional incidence of depressive disorders (−4.87%) (Figure 4b).

Further analysis revealed that the additional incidence of total mental disorders, anxiety disorders, and depressive disorders was significantly and positively correlated with SDI levels (mental disorders: $\rho = 0.413$, $p = 1.13 \times 10^{-9}$; anxiety disorders: $\rho = 0.469$, $p = 6.29 \times 10^{-13}$; depressive disorders: $\rho = 0.379$, $p = 3.04 \times 10^{-8}$). These results represented that the region with higher SDI levels showed a greater increase in additional incidence during the pandemic (Figure 4c). Results for additional prevalence and YLDs are presented in Supplementary Figures S13–S15.

Discussion

The COVID-19 pandemic has significantly impacted adolescent mental health; however, comprehensive studies on the disease burden of mental disorders among adolescents during the pandemic remain scarce. In this study, we analyzed changes in mental disorders among individuals aged 5–24 years using the latest GBD 2021 data and estimated the additional burden of mental disorders during the COVID-19 pandemic. We found a substantial increase in the incidence, prevalence, and burden of mental disorders, particularly anxiety and depression, among this age group during the pandemic. The increase in mental disorders was more pronounced in girls, older adolescents, and young adults (15–24 years), and regions with high SDI levels. This study is the first to systematically identify and analyze population mental health survey data to quantify changes in the incidence, prevalence, and burden of mental disorders by location, age, and sex before and during the COVID-19 pandemic.

Our findings indicate that the most significant changes in the incidence, prevalence, and nonfatal burden of mental disorders occurred among younger age groups (5–24 years) compared with the overall population, which aligns with the findings from previous literature, which indicate that younger individuals experienced a more severe deterioration in mental health during the COVID-19 pandemic (Camargo, Navarro-Tapia, Pérez-Tur, & Cardona, 2023; Young et al., 2023). This trend may be attributed to the severe disruption of global education for children (Stock, Helmer, & Heinrichs, 2022). Additionally, young adults are more likely to face unemployment during and after economic crises than older individuals (Thomson & Katikireddi, 2018).

In the population of children and adolescents, the decline in mental health was more pronounced in girls than in boys, leading to a larger gender disparity in prevalence and burden compared with before the pandemic. This observation aligns with previous regional studies (Chen et al., 2020; Magson et al., 2021; Smirni, Lavanco, & Smirni, 2020). This result may not only reflect the well-established literature highlighting sex differences in internalizing problems (Rose & Rudolph, 2006) but also highlight that girls are more likely than boys to rely on their social networks for support during significant life stressors (Kort-Butler, 2009). Consequently, the shift to online schooling and restrictions on social interaction may have disrupted adolescent girls' primary coping strategies.

Furthermore, we noticed that older adolescents and young adults (15–24 years) experienced a higher increase in mental disorders, including depression and anxiety, during the pandemic. This increase may be attributed to the natural progression of mental health issues as individuals transition from childhood into adolescence and adulthood (Merikangas et al., 2010). Adolescents, in particular, have a strong need for social contact and interpersonal relationships, which are crucial for their identity development and emotional support (Meeus & Dekoviíc, 1995; Orben, Tomova, & Blakemore, 2020). However, during the lockdown, they faced challenges such as online learning, school closures, and reduced social interactions (Liu et al., 2021). Previous studies have reported that the incidence and burden of mental disorders exhibited distinct trends during different phases of the COVID-19 pandemic (Fancourt, Steptoe, & Bu, 2021; Madigan et al., 2023; Matsumoto et al., 2023). Hence, in our analysis of adolescents and young adults, we present data from 2020 and 2021 separately to account for these temporal variations. Our findings indicate that mental disorders among adolescents and young adults increased significantly in 2020 and further escalated in 2021. This pattern contrasts with certain longitudinal cohort studies conducted in specific regions or countries, which may not reflect the same trajectory (Bouter et al., 2023; Fancourt, Steptoe, & Bu, 2021). We hypothesize that these discrepancies stem from the dynamic interplay between localized COVID-19 prevalence and containment policies, which likely influenced mental health in adolescents and young adults at a granular, month-to-month level. Notably, the GBD study, which assesses disease burden annually, may fail to capture such short-term fluctuations, thereby limiting direct comparability with studies employing finer temporal resolutions.

Additionally, our study first found that regions with higher SDI levels experienced the greatest increases in the incidence, prevalence, and burden of mental disorders. The additional incidence of mental disorders during the COVID-19 pandemic was significantly and positively correlated with SDI levels in 2021. Greenland

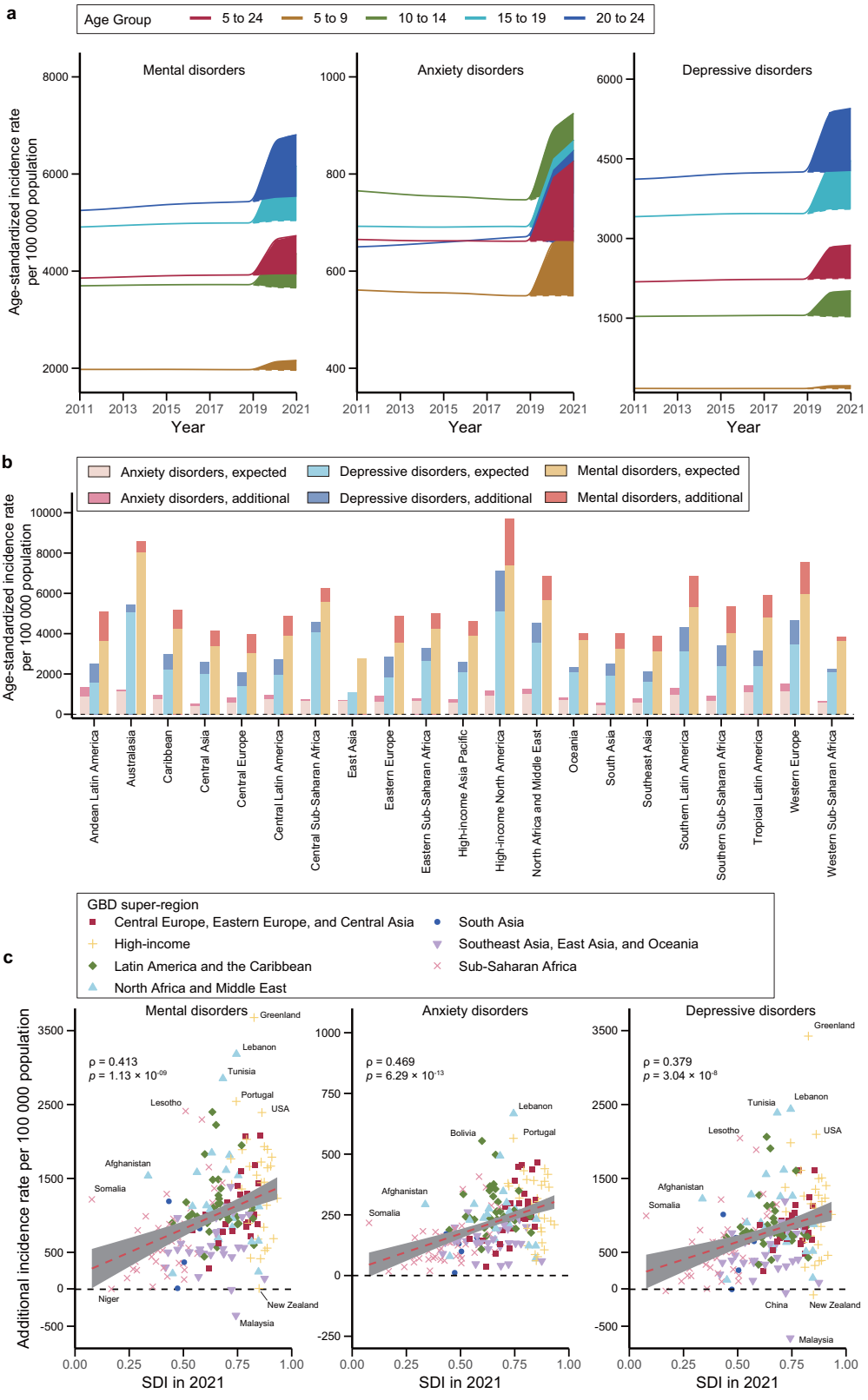

Figure 4. Global expected and additional incidence mental disorders, anxiety disorders, and depressive disorders in children and adolescents by different ages and regions, and the correlation between additional incidence and SDI level. (a) Expected and additional incidence for different age groups globally. The solid line represents the actual value in the Global Burden of Diseases Study (GBD) 2021, while the dashed lines represent the estimated expected value. The shadow range represents the additional value. (b) Expected and additional incidence for 21 GBD regions; (c) correlation between additional incidence rate and SDI levels. *Note:* SDI, sociodemographic index.

and the United States exhibit the most pronounced disease burden. These nations demonstrate elevated economic prosperity and SDI metrics, aligning with statistical correlations. The varying burden of mental disorders across countries and regions is shaped by factors such as economic and educational levels, ethnicity, local psychiatry development, healthcare diagnostic capacity, and attention to mental health. For instance, significant reforms in adolescent psychiatry and the advancement of biomedical psychiatry in the United States have led to extensive screening and higher diagnostic rates for mental disorders during the pandemic. Additionally, cultural differences, alongside customs and religious beliefs that stigmatize mental illness, contribute to underreporting and reduced help-seeking behaviors in certain regions. Therefore, estimates from these areas should be interpreted with caution, highlighting the need for better data and culturally sensitive research.

From a public health perspective, these findings highlight the increased relevance of mental health concerns among children and adolescents during the pandemic. Addressing these mental health issues in the post-COVID-19 era remains a critical global priority. Our results are consistent with previous regional epidemiological studies (Gutiérrez-Sacristán et al., 2022; Straub, Bateman, Vine, & Huybrechts, 2023) and enhance our understanding of the growing global burden of mental disorders in young people. This study offers comprehensive epidemiological evidence to inform future research, resource allocation, and targeted interventions for emerging early-life mental disorders during public health crises. Identifying risk and protective factors for mental disorders is essential in clinical practice, allowing healthcare providers to target vulnerable individuals and develop effective interventions. Understanding these factors can help in designing interventions that promote resilience and mitigate the psychological toll of such events. The COVID-19 lockdown has accelerated the development of telehealth, which may have lasting implications for mental health service provision. Telehealth expands access, especially in remote areas, reduces stigma, and offers cost-effective services. As the mental health burden grows, increased funding for mental health services and professional training is crucial, particularly for vulnerable populations. Public health strategies should also focus on promoting age-appropriate resources that support mental health. Educating young people on strategies such as improving sleep hygiene, maintaining a balanced diet, and engaging in mental healthcare can help prevent the negative psychological effects of crises. These efforts should be integrated into public health campaigns and school programs to foster resilience and healthy coping mechanisms, thus reducing the long-term mental health impact of pandemics on children and adolescents.

Our study has several limitations. First, the quality of GBD data sources varied, with significant gaps, particularly in low- and middle-income countries, where healthcare systems may be underdeveloped and health data limited. Disease burden estimates for data-poor countries rely heavily on covariates and regional trends, which may fail to capture unique local factors, such as cultural stigma or unmeasured confounders. Second, GBD 2021 did not include data on different races, which limits the generalizability of our findings. Research indicates that the risk of mental disorders varies across ethnic groups, influenced by genetic and cultural factors (Alvarez et al., 2019). This emphasizes the need for studies on how the COVID-19 pandemic has affected mental disorder risk among adolescents from diverse ethnic backgrounds. Moreover, the reliability of BAPC projections depends on the quality of historical data. While the RW2 prior offers temporal smoothing, it may not capture complex nonlinear or interaction effects, potentially introducing bias. Therefore, the additional burden cannot be fully attributed to COVID-19, as the exact burden of mental disorders in the world without the pandemic is unknown. Finally, using 2021 data is also a limitation, as they reflect the ongoing pandemic, and the current situation may differ, necessitating further evaluation of the mental health burden in the post-pandemic era. Future longitudinal studies spanning the pandemic, combined with the application of innovative computational methods to assess the COVID-19 burden, may help alleviate some of the errors and limitations inherent in the current study.

In summary, the global burden of mental disorders among children and adolescents, especially anxiety and depressive disorders, increased significantly during the COVID-19 pandemic. This impact was particularly pronounced among females, individuals aged 15–24 years, and regions with high SDI. Our findings underscore the urgent need for policymakers, educational systems, and mental health professionals to develop targeted interventions to support families with children and adolescents affected by mental disorders in the post-COVID-19 era.

Supplementary material. The supplementary material for this article can be found at http://doi.org/10.1017/S0033291725000649.

Data availability statement. The data utilized in this study are openly accessible through the Global Health Data Exchange GBD Results Tool, accessible at https://ghdx.healthdata.org/.

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Author contribution. All authors contributed substantially to this work. Concept and design: Y.L., Y.R., L.T., and Q.M.; Acquisition, analysis, or interpretation of data: all authors; Drafting of the manuscript: Y.L. and L.T.; Critical revision of the manuscript for important intellectual content: all authors; Statistical analysis: Y.L. and L.T.; Funding acquisition: Q.M.; Supervision: L.T. and Q.M. All authors read and approved the final manuscript.

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Competing interests. The authors declare that they have no competing interests.

Ethical standard. The GBD study received approval from the University of Washington Institutional Review Board, and no identifiable data were used.

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