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Global and Regional Trends in Autism Burden from 1990 to 2021: A Data Re-Analysis and Prediction from the Global Burden of Disease Study

Lingping Zhu[1,2], Haiyan Zhang[1], Lili Wang[1], Xuefeng Yang[1]

[1]The Affiliated Nanhua Hospital, Department of General Practice, Hengyang Medical School, University of South China, Hengyang, Hunan, 421001, People's Republic of China; [2]School of Public Health, Fudan University, Shanghai, 200433, People's Republic of China

Correspondence: Lingping Zhu, Email zlp597@aliyun.com

Objective: This study aims to investigate global incidence rates and disability-adjusted life-years (DALYs) for autism spectrum disorder (ASD) from 1990 to 2021 and forecast trends for the next 25 years.

Methods: Utilizing data from the Global Burden of Disease (GBD) study, we examined global and country-specific ASD incidence, prevalence, and burden. We also calculated age-standardized prevalence, analyzed by sex, age groups, sociodemographic index (SDI) regions, and GBD regions, and made predictions for the future.

Results: In 2021, the GBD reported global age-standardized ASD incidence and prevalence at 0.019% and 0.788%, respectively. High-income Asia-Pacific had the highest burden, while Tropical Latin America had the lowest. From 1990 to 2021, global age-standardized prevalence rose by 1.95%, and incidence by 5.20%. Females and low-middle SDI regions saw the most significant increases in incidence, while the Caribbean and Serbia saw decreases. High-income Asia Pacific and Japan experienced the largest prevalence increases, and Middle SDI, East Asia, high-income Asia Pacific, and Equatorial Guinea saw the most significant DALY increases, with Oceania showing the largest decrease. Predictive models forecast continued increases in incidence, prevalence, and DALYs from 2022 to 2046.

Conclusion: ASD incidence, prevalence, and DALYs are rising annually, with notable increases in females and middle-low income countries and a decline in the Caribbean. Tailored screening and interventions based on regional rates are essential for improving the health of individuals with autism.

Keywords: ASD, 2021, incidence, GBD, trend

Introduction

Autism, also known as autism spectrum disorder (ASD), is a complex neurodevelopmental disorder characterized by impairments in social interaction and communication skills along with repetitive and restricted behavioral patterns.[1] ASD substantially affects the development and social progress of children. In the United States, approximately 2.3% of children aged 8 years and 2.2% of adults are affected by ASD, with the prevalence increasing from 1.1% in 2008 to 2.3% in 2018.[2] Over the past few decades, the global incidence of ASD has been increasing annually.[3] The estimated prevalence of ASD among 8-year-old children was 14.6% in 2012, with a significantly higher prevalence in boys (23.6%) than in girls (5.3%).[4] The overall prevalence of ASD among 8-year-old children in the United States was 27.6 per 1,000 children (or 1 in every 36 children) in 2020, with a 3.8-fold higher prevalence in boys than in girls (43.0 vs 11.4). Overall, the prevalence of ASD was lower in non-Hispanic white children (24.3) and children of two or more races (22.9) than in non-Hispanic black or African American (Black), Hispanic, and non-Hispanic Asian or Pacific Islander children (29.3, 31.6, and 33.4, respectively).[5] This indicates that racial differences and sex are influential factors in ASD prevalence. Although the prevalence rates are higher in both boys and girls, with a significantly higher prevalence in males than in females,[6] the generalizability of this trend across recent global studies remains uncertain.

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Additionally, based community reports of Autism and Developmental Disabilities Monitoring (ADDM) Network,[7] states with more advanced economies, such as California and New Jersey, have higher rates of ASD. This seems to suggest a correlation between ASD prevalence and economic status. However, the lower prevalence of ASD in underdeveloped countries may be related to stigma and parents' tendency to enroll their children in regular schools rather than in special education schools.[8,9] The lack of screening, diagnostic resources, and early educational services may contribute to lower incidence rates in underdeveloped regions.[10] With increased awareness and economic development, it is possible that the prevalence of ASD in these areas will increase. There is currently a comprehensive review of ASD from 1990 to 2021.[11] Although this review provides some insights, it lacks necessary detail and precision, and it does not include predictive analytics. Therefore, further exploration of the GBD 2021 data is necessary.

To address these issues, we used the GDB database for data analysis. The GBD data includes ASD-related data from a majority of countries worldwide. The GBD 2021 quantified health losses from 371 diseases and injuries across 204 countries and regions, encompassing indicators such as prevalence, severity of disease, and mortality rates, to provide a comprehensive assessment of the disease burden (GBD 2021 Nervous System Disorders Collaborators, 2024). We conducted an epidemiological analysis of ASD data from 1990 to 2021 and predicted future trends based on these findings.

Methods

GBD Source

The GBD 2021 results database is available on the GBD Collaborative Network website (http://ghdx.healthdata.org). GBD 2021 estimated 371 diseases and injuries, including 95 communicable, maternal, neonatal, and nutritional diseases; 234 non-communicable diseases; and 40 injuries. The database covers 21 locations below the national level and 25 age groups, including individuals of both sexes comprising data from the years 1990 to 2021 (GBD 2021 Diseases and Injuries Collaborators, 2024). it provides essential information on incidence, prevalence, and other metrics. Based on these data, we calculated incidence rates (new cases rate within a time frame), prevalence rates (total cases rate at a specific moment or period), disability-adjusted life years (DALYs; quantifying years of life lost due to premature death and years lived with disability), and the expected annual percentage change (EAPC, an indicator measuring the average annual growth rate of a variable over a period of time). Additionally, the 95% confidence intervals account for uncertainties arising from data collection, parameter estimation processes, modeling, and other sources.

GBD is an international network comprising over 10,000 collaborators from more than 150 countries and regions that provides, reviews, or analyzes available data to generate GBD indicators. GBD 2021 estimates for 204 countries and regions were performed in accordance with accurate and transparent health assessment reporting guidelines, divided into 21 regions and 7 super regions. GBD regions and super regions include countries and regions that are geographically close, epidemiologically similar, and have similar distributions of causes of death. National estimates were conducted for 21 countries and regions: Brazil, China, Ethiopia, India, Indonesia, Italy, Iran, Japan, Kenya, Mexico, New Zealand, Nigeria, Norway, Pakistan, the Philippines, Poland, Russia, South Africa, Sweden, the United Kingdom, and the United States. With the exception of New Zealand (conducted by Maori), Sweden (Stockholm and non-Stockholm areas), the United Kingdom (conducted by local government authorities), Kenya (at the county level), and the Philippines (at the provincial level), subnational analyses were conducted for each country's first-level administrative divisions. The GBD 2019 study expanded its coverage to encompass all WHO member countries. Since the database provides information that does not involve specific patient data, our team has obtained an exemption from the Institutional Review Board of The Affiliated Nanhua Hospital.

Sociodemographic Index (SDI)

SDI (Sociodemographic Index) is calculated by integrating three factors: time-lag adjusted per capita income, average educational attainment in individuals aged 15+, and fertility rates among women aged ≤25 years. The SDI is used to comprehensively reflect the socioeconomic development status of countries or regions on a scale from 0 to 1. Higher values indicate better socioeconomic development.[12] In this study, countries and regions were categorized into the

following five groups based on the SDI value: low (< 0.46), low-medium (0.46–0.60), medium (0.61–0.69), medium-high (0.70–0.81), and high (> 0.81). Additionally, GBD research divides the world into 21 regions based on geographic proximity and epidemiological homogeneity.[13]

Statistical Methods

Subgroup, trend, and time-series analyses were performed using R software (version 4.2.1, R Core Team, Vienna, Austria and JD_GBDR (V2.28, Jingding Medical Technology Co., Ltd.). The R packages used included ggplot2,[14] ggsci,[15] cowplot,[16] ggmap,[17] rgdal,[18] maps,[19] dplyr,[20] and data\ table.[21] Incidence, prevalence, and DALYs refer to the incidence, prevalence, and disability-adjusted life-years, respectively. To enable a direct comparison of data across regions, we processed demographic information using the same standard age composition. The estimated annual percentage change (EAPC) was used to illustrate the average annual change in incidence, and linear regression models were mainly used for trend analyses. Cluster analysis categorized trends from 1990 to 2021 into four types: minor increase, remained stable or minor decrease, significant decrease, and significant increase. Time series analysis was performed using the fpp2 package to perform the autoregressive integrated moving average (ARIMA) and ES (Exponential Smoothing State Space Model) methods. ARIMA is a statistical approach used to predict future data trends. The ARIMA model comprises three components: autoregression (AR), integrated (I), and moving average (MA). The AR component represents the relationship between the current and previous values, the MA component represents the relationship between the current value and random error terms, and I stabilizes the data, making it easier to model. This method captures the temporal characteristics and randomness of the data, allowing for effective forecasting. The ES method is a smoothing technique based on exponential weighting that can adapt well to changes in data trends and seasonal variations.

Results

Global ASD Prevalence from 1990 to 2021

The global age-standardized ASD incidence rate in 2021 was 0.019% (95% CI = 0.016–0.022), with an estimated 1,163,706 cases (981,645–1,371,347). From 1990 to 2021, the EAPC was 0.13 (0.11–0.14) (Table 1). The age-standardized global prevalence was 0.788% (95% CI = 0.664–0.927), with 61,823,540 cases (52,067,673–72,711,238). The EAPC from 1990 to 2021 was 0.07 (0.07–0.08). The global age-standardized DALYs rate per 100,000 individuals (95% CI) in 2021 was 0.148% (0.100–0.208), with an EAPC of 0.08 (0.08–0.09) from 1990 to 2021. The age-standardized ASD incidence rate in females was 0.012 (0.010–0.014), with 366,725 cases (307,178–434,604) and EAPC of 0.16 (0.14–0.19) between 1990 and 2021 (Figure 1). The global age-standardized ASD incidence rate in

Table 1 Austism Number Cases and Incidence of Global, Sex, Age, SDI and GBD Region in 1990 and 2021

	Number of Incidence Cases (95% UI) in 1990	The Age-Standardized Incidence Rate/100000 (95% UI) in 1990	Number of Incidence Cases (95% UI) in 2021	The Age-Standardized Incidence Rate/100000 (95% UI) in 2021	EAPC (95% CI)
Global	1146018 (962,460–1,357,586)	17.88 (15.02–21.19)	1,163,706 (981,645–1,371,347)	18.81 (15.87–22.17)	0.13 (0.11–0.14)
Sex					
Female	366725 (307,178–434,604)	11.88 (9.95–14.07)	379,248 (318,177–451,109)	12.7 (10.65–15.1)	0.16 (0.14–0.19)
Male	779293 (657,120–918,996)	23.47 (19.79–27.68)	784,458 (663,007–919,062)	24.52 (20.72–28.73)	0.11 (0.1–0.12)
Age					
<5 years	1146018 (962,460–1,357,586)	184.86 (155.25–218.99)	1,163,706 (981,645–1,371,347)	176.81 (149.15–208.36)	−0.08 (−0.16–0.01)
SDI region					
High-middle SDI	155680 (130,418–184,534)	17.74 (14.86–21.02)	103,434 (86,790–121,573)	18.39 (15.43–21.62)	0.06 (0.02–0.1)
High SDI	139945 (118,066–163,974)	23.28 (19.64–27.28)	115,683 (97,298–136,204)	23.38 (19.66–27.52)	−0.02 (−0.05–0.01)
Low-middle SDI	313454 (264,099–371,703)	16.86 (14.21–20)	332,081 (279,474–390,235)	17.8 (14.98–20.92)	0.15 (0.14–0.16)
Low SDI	212580 (178,735–250,347)	20.02 (16.83–23.57)	354,224 (298,241–417,802)	20.5 (17.26–24.18)	0.08 (0.07–0.08)
Middle SDI	323429 (271,579–383,493)	16.14 (13.56–19.14)	257,392 (216,237–303,497)	16.82 (14.13–19.83)	0.09 (0.07–0.11)

(*Continued*)

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Table 1 (Continued).

	Number of Incidence Cases (95% UI) in 1990	The Age-Standardized Incidence Rate/100000 (95% UI) in 1990	Number of Incidence Cases (95% UI) in 2021	The Age-Standardized Incidence Rate/100000 (95% UI) in 2021	EAPC (95% CI)
GBD region					
Advanced Health System	205077 (172,704–240,589)	22.6 (19.03–26.51)	159,841 (134,494–187,547)	22.79 (19.18–26.74)	0.01 (−0.01–0.03)
Africa	274438 (230,669–323,212)	21.36 (17.96–25.16)	442,201 (372,617–520,975)	21.41 (18.04–25.23)	0.01 (0–0.01)
African Region	236117 (198,819–278,038)	21.89 (18.44–25.78)	392,270 (330,531–462,151)	21.84 (18.4–25.73)	0 (−0.01–0)
America	147162 (123,848–174,005)	19.22 (16.17–22.72)	129,515 (109,240–152,768)	19.04 (16.06–22.46)	0.01 (−0.02–0.04)
Andean Latin America	9111 (7649–10,813)	16.18 (13.59–19.21)	9550 (8002–11,345)	16.06 (13.46–19.08)	−0.02 (−0.04–0.01)
Asia	615138 (516,295–729,740)	16.11 (13.52–19.11)	512,341 (431,252–603,252)	16.79 (14.13–19.76)	0.06 (0.04–0.08)
Australasia	3940 (3295–4650)	25.82 (21.6–30.48)	4541 (3784–5428)	26.4 (22–31.56)	0.13 (0.1–0.16)
Basic Health System	411510 (345,004–488,010)	16.03 (13.44–19.01)	309,216 (259,367–364,896)	16.46 (13.8–19.42)	0.05 (0.03–0.08)
Caribbean	7057 (5918–8378)	16.34 (13.7–19.4)	6100 (5121–7230)	15.99 (13.43–18.96)	−0.06 (−0.07–0.05)
Central Africa	32825 (27,752–38,500)	21.87 (18.49–25.65)	58,577 (49,368–69,121)	21.73 (18.31–25.64)	−0.02 (−0.02–0.02)
Central Asia	19687 (16,478–23,217)	20.86 (17.46–24.6)	20,660 (17,343–24,272)	21.04 (17.66–24.71)	0.04 (0.03–0.05)
Central Europe	17764 (14,999–20,900)	21.52 (18.17–25.32)	10,875 (9142–12,816)	21.62 (18.17–25.47)	0 (−0.01–0.01)
Central Latin America	42889 (36,036–50,888)	17.9 (15.04–21.24)	33,120 (27,902–39,001)	17.67 (14.89–20.81)	−0.01 (−0.03–0)
Central Sub-Saharan Africa	26977 (22,686–31,661)	21.89 (18.41–25.69)	46,460 (39,131–55,047)	21.73 (18.31–25.75)	−0.03 (−0.03–0.03)
Commonwealth High Income	16241 (13,697–19,099)	20.69 (17.45–24.33)	15,900 (13,399–18,841)	21.65 (18.24–25.65)	0.15 (0.13–0.17)
Commonwealth Low Income	78819 (66,237–93,260)	18.28 (15.36–21.63)	93,212 (78,441–109,579)	19.86 (16.71–23.35)	0.23 (0.22–0.24)
Commonwealth Middle Income	306758 (258,048–362,833)	17.16 (14.43–20.29)	364,802 (306,850–429,676)	18.37 (15.46–21.64)	0.18 (0.17–0.2)
East Asia	166835 (139,642–196,894)	14.55 (12.17–17.17)	81,323 (67,880–96,443)	14.74 (12.3–17.48)	−0.05 (−0.1–0)
East Asia & Pacific - WB	294530 (246,781–348,226)	15.98 (13.39–18.89)	192,126 (161,535–226,007)	16.39 (13.78–19.28)	−0.01 (−0.05–0.03)
Eastern Africa	84371 (71,073–99,164)	21.7 (18.28–25.5)	125,948 (106,067–147,404)	21.73 (18.3–25.43)	0 (0–0)
Eastern Europe	30243 (25,464–35,540)	21.07 (17.74–24.76)	18,523 (15,562–22,036)	21.48 (18.05–25.55)	0.06 (0.06–0.07)
Eastern Mediterranean Region	111031 (93,357–131,462)	17.4 (14.63–20.6)	141,892 (119,405–167,468)	17.18 (14.46–20.28)	−0.02 (−0.04–0)
Eastern Sub-Saharan Africa	95120 (80,254–112,013)	22.12 (18.66–26.04)	144,956 (122,421–169,985)	22.09 (18.66–25.91)	−0.01 (−0.01–0.01)
Europe	107743 (90,715–126,919)	20.34 (17.12–23.96)	78,562 (65,993–92,293)	20.53 (17.25–24.12)	0.03 (0.03–0.04)
Europe & Central Asia - WB	122774 (103,483–144,681)	20.39 (17.19–24.03)	95,989 (80,660–112,778)	20.61 (17.32–24.21)	0.04 (0.03–0.05)
European Region	124092 (104,604–146,229)	20.37 (17.18–24.01)	97,810 (82,208–114,914)	20.56 (17.28–24.15)	0.03 (0.03–0.04)
High-income Asia Pacific	30991 (26,205–36,152)	32.64 (27.6–38.07)	19,607 (16,564–23,003)	34.31 (28.99–40.26)	0.17 (0.14–0.19)
High-income North America	53470 (45,129–62,834)	24.34 (20.55–28.61)	47,970 (40,550–56,638)	24.61 (20.8–29.05)	0.07 (0.04–0.1)
Latin America & Caribbean - WB	94251 (79,065–112,008)	17.15 (14.39–20.39)	81,713 (68,602–96,378)	16.81 (14.11–19.82)	−0.03 (−0.06–0.01)
Limited Health System	461240 (388,198–545,052)	17.62 (14.83–20.82)	562,717 (472,902–660,919)	18.84 (15.84–22.13)	0.18 (0.17–0.2)
Middle East & North Africa - WB	71675 (60,049–84,826)	18.05 (15.12–21.36)	75,737 (63,823–88,939)	18.01 (15.18–21.15)	0.01 (−0.01–0.03)
Minimal Health System	67260 (56,706–79,774)	21.65 (18.26–25.68)	131,040 (110,336–153,825)	21.32 (17.95–25.03)	−0.03 (−0.04–0.01)
North Africa and Middle East	95286 (79,806–112,721)	18.13 (15.19–21.45)	102,935 (86,590–120,978)	17.99 (15.13–21.14)	−0.01 (−0.02–0.01)
North America	53462 (45,122–62,826)	24.34 (20.54–28.6)	47,964 (40,545–56,632)	24.61 (20.8–29.05)	0.07 (0.04–0.1)
Northern Africa	33866 (28,322–39,979)	18.19 (15.21–21.47)	39,030 (32,764–45,769)	18.04 (15.15–21.16)	0 (−0.03–0.04)
Oceania	1744 (1463–2071)	16.18 (13.58–19.22)	3295 (2777–3921)	16.05 (13.52–19.1)	−0.02 (−0.04–0)
Region of the Americas	147162 (123,848–174,005)	19.22 (16.17–22.72)	129,515 (109,240–152,768)	19.04 (16.06–22.46)	0.01 (−0.02–0.04)
South-East Asia Region	286905 (241,350–340,449)	15.76 (13.26–18.7)	256,667 (216,000–302,451)	16.72 (14.07–19.7)	0.13 (0.1–0.16)
South Asia	259885 (218,745–307,826)	15.77 (13.27–18.67)	252,179 (211,753–296,624)	16.66 (13.99–19.59)	0.1 (0.07–0.13)
South Asia - WB	266684 (224,404–315,935)	15.81 (13.3–18.72)	264,759 (222,174–311,609)	16.69 (14–19.64)	0.1 (0.08–0.13)
Southeast Asia	93748 (78,876–111,038)	15.82 (13.31–18.73)	85,469 (71,881–101,173)	15.85 (13.33–18.76)	0.02 (0.01–0.04)
Southern Africa	38312 (32,241–45,145)	22.1 (18.6–26.04)	53,594 (45,347–63,068)	21.84 (18.48–25.7)	−0.05 (−0.05–0.04)
Southern Latin America	12080 (10,149–14,279)	23.82 (20.01–28.15)	9010 (7564–10,629)	24.21 (20.32–28.56)	0.02 (−0.02–0.06)
Southern Sub-Saharan Africa	17118 (14,423–20,213)	22.03 (18.56–26.01)	17,147 (14,437–20,231)	21.94 (18.47–25.88)	−0.01 (−0.01–0)
Sub-Saharan Africa - WB	241346 (203,107–283,737)	21.9 (18.43–25.75)	404,329 (340,589–475,587)	21.81 (18.37–25.65)	0 (−0.01–0)
Tropical Latin America	23360 (19,477–27,571)	14.5 (12.09–17.11)	24,145 (20,210–28,596)	14.61 (12.23–17.3)	0.03 (0.01–0.05)
Western Africa	85064 (71,433–100,198)	22.03 (18.5–25.94)	165,052 (139,516–194,350)	21.88 (18.5–25.77)	0.01 (0–0.02)
Western Europe	44334 (37,312–52,221)	19.93 (16.77–23.47)	39,611 (33,375–46,430)	20.09 (16.93–23.55)	0.01 (−0.01–0.03)
Western Pacific Region	236142 (197,611–278,942)	16.05 (13.43–18.95)	142,936 (120,283–168,640)	16.63 (13.99–19.62)	−0.02 (−0.08–0.04)
Western Sub-Saharan Africa	94378 (79,302–110,985)	22.01 (18.49–25.88)	186,231 (157,400–218,999)	21.86 (18.47–25.7)	0.01 (0–0.01)
World Bank High Income	161457 (136,094–189,280)	23.31 (19.65–27.33)	132,439 (111,455–155,280)	23.32 (19.62–27.34)	−0.01 (−0.03–0.01)
World Bank Low Income	143618 (120,835–169,079)	21.14 (17.79–24.89)	231,981 (195,126–272,644)	21.19 (17.82–24.9)	0.01 (0.01–0.02)
World Bank Lower Middle Income	518016 (436,025–613,635)	17.1 (14.39–20.25)	586,488 (493,368–691,648)	18.08 (15.21–21.32)	0.16 (0.15–0.17)
World Bank Upper Middle Income	321992 (269,237–381,567)	16.09 (13.46–19.07)	211,904 (177,601–249,010)	16.64 (13.94–19.55)	0.06 (0.02–0.09)

Abbreviations: SDI, Sociodemographic Index; EAPC, Estimated Annual Percentage Change.

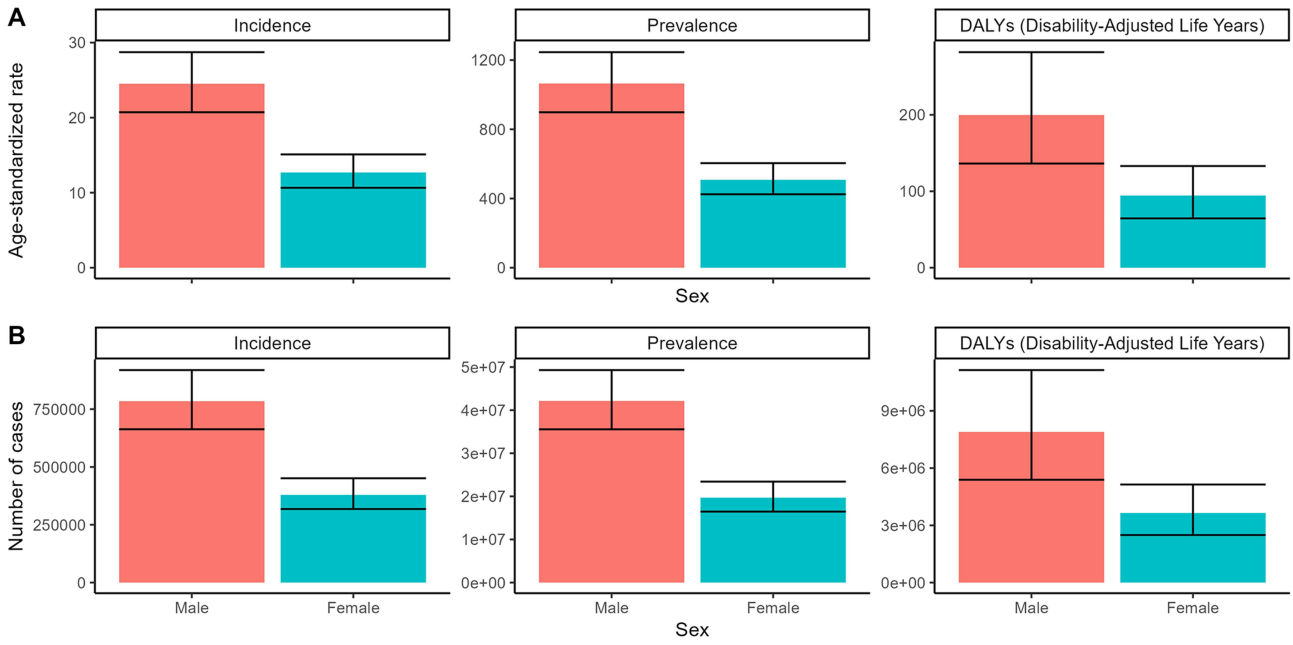

Figure 1 The global autism Age-standardized incidence, prevalence and DALYs of Male and Female in 2021. (**A**) Age-standardized rate; (**B**) Number of cases.
Abbreviation: DALYs, Disability Adjusted Life Years.

men was 0.025% (0.021–0.029) in 2021, with 784,458 cases (663,007–919,062), and the EAPC from 1990 to 2021 was 0.11 (0.1–0.12). The age-standardized ASD prevalence in females was 0.508 (0.425–0.604), with 19,689,661 cases (16,462,872–23,416,673) and EAPC of 0.09 (0.08–0.1) between 1990 and 2021. The age-standardized ASD prevalence in males was 1.065 (0.898–1.246), with 42,133,879 cases (35,549,495–49,294,565), and the EAPC from 1990 to 2021 was 0.06 (0.06–0.07). The age-standardized DALYs rate per 100,000 (95% CI) in 2021 was 0.148 (0.100–0.208), with an EAPC of 0.08 (0.08–0.09) from 1990 to 2021. The global ASD age-standardized DALYs rate in females per 100,000 (95% CI) in 2021 is 0.094% (0.065–0.133), with an EAPC of 0.1 (0.09–0.11) from 1990 to 2021. The global ASD age-standardized DALYs rate in males per 100,000 (95% CI) in 2021 was 0.200% (0.136–0.282), with an EAPC of 0.07 (0.07–0.08) from 1990 to 2021. Detailed values for the incidence, prevalence, DALYs, and number of cases in males and females are shown in Tables 1–3, and the trends are illustrated in Figure S1.

Variations in Age Prevalence from 1990 to 2021

The age-standardized incidence rate for children aged < 5 years in 2021 was 0.177% (0.149–0.208), with an EAPC of −0.08 (−0.16–0.01) from 1990 to 2021, indicative of a declining trend. The age-standardized prevalence for children aged < 5 years was 0.878% (0.739–1.035), with an EAPC of 0.1 (0.09–0.11) from 1990 to 2021, indicating the highest observed prevalence in this age group. For individuals aged ≥ 95 years, the age-standardized prevalence was 0.176% (0.112–0.258), exhibiting the most rapid growth rate with an EAPC of 1.54 (1.53–1.56) from 1990 to 2021. The age-standardized DALYs among children aged < 5 years was 0.169% (0.115–0.237), with an EAPC of 0.13 (0.12–0.14) from 1990 to 2021, exhibiting the slowest growth rate. The age-standardized DALYs for individuals aged ≥ 95 years was 0.028% (0.017–0.043), exhibiting the most rapid growth rate with an EAPC of 1.48 (1.47–1.5) from 1990 to 2021. Trends in age-standardized incidence, prevalence, and DALYs from 1990 to 2021 are shown in Figure 2, with detailed values for 1990 and 2021 summarized in Tables 1–3, and Figure S2.

SDI Prevalence from 1990 to 2021

In 2021, the age-standardized incidence rate in regions with high SDI was 0.023% (0.020–0.028), making it the region with the highest incidence rate, and the EAPC from 1990 to 2021 was −0.02 (−0.05–0.01), indicating the most rapid decline. Low-middle SDI regions exhibited the most rapid average growth, with an age-standardized incidence rate of

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Table 2 Austism Number Cases and Prevalence of Global, Sex, Age, SDI and GBD Region in 1990 and 2021

	Number of Prevalence Cases (95% UI) in 1990	The Age-Standardized Prevalence Rate/100000 (95% UI) in 1990	Number of Prevalence Cases (95% UI) in 2021	The Age-Standardized Prevalence Rate/100000 g(95% UI) in 2021	EAPC (95% CI)
Global	41929996 (35,349,448–49,633,546)	773.25 (651.35–914.71)	61,823,540 (52,067,673–72,711,238)	788.34 (663.76–927.21)	0.07 (0.07–0.08)
Sex					
Female	13349055 (11,142,957–15,864,043)	497.32 (414.72–590.83)	19,689,661 (16,462,872–23,416,673)	508.08 (424.62–604.33)	0.09 (0.08–0.1)
Male	28580940 (24,105,174–33,702,935)	1046.01 (883.1–1233.08)	42,133,879 (35,549,495–49,294,565)	1064.71 (898.47–1245.7)	0.06 (0.06–0.07)
Age					
<5 years	5280984 (4,431,768–6,250,170)	851.86 (714.87–1008.19)	5,776,990 (4,866,465–6,810,367)	877.73 (739.39–1034.74)	0.1 (0.09–0.11)
5–9 years	4848675 (4,073,795–5,723,075)	830.92 (698.13–980.77)	5,861,519 (4,942,505–6,894,127)	853.14 (719.38–1003.43)	0.12 (0.1–0.13)
10–14 years	4388638 (3,698,027–5,184,030)	819.26 (690.34–967.74)	5,606,055 (4,728,896–6,581,795)	840.95 (709.37–987.31)	0.11 (0.1–0.12)
15–19 years	4182362 (3,520,103–4,946,274)	805.19 (677.69–952.26)	5,185,365 (4,372,351–6,086,212)	831.01 (700.72–975.39)	0.09 (0.08–0.11)
20–24 years	3910409 (3,291,729–4,620,444)	794.66 (668.93–938.95)	4,899,809 (4,131,439–5,745,809)	820.52 (691.85–962.19)	0.08 (0.06–0.1)
25–29 years	3533582 (2,972,689–4,175,288)	798.33 (671.61–943.31)	4,768,910 (4,011,192–5,592,515)	810.57 (681.78–950.55)	0.07 (0.05–0.09)
30–34 years	3098310 (2,604,270–3,668,426)	803.87 (675.69–951.79)	4,823,728 (4,053,340–5,662,970)	798 (670.55–936.83)	0.02 (0–0.05)
35–39 years	2790471 (2,345,232–3,313,765)	792.2 (665.8–940.76)	4,453,162 (3,746,269–5,242,198)	793.98 (667.94–934.66)	0.01 (−0.01–0.04)
40–44 years	2281286 (1,916,659–2,704,528)	796.31 (669.03–944.05)	3,944,563 (3,324,042–4,657,038)	788.52 (664.48–930.94)	−0.04 (−0.06–0.01)
45–49 years	1812036 (1,520,596–2,146,319)	780.39 (654.88–924.36)	3,650,661 (3,076,103–4,309,607)	770.99 (649.65–910.15)	−0.06 (−0.08–0.04)
50–54 years	1621506 (1,360,606–1,915,817)	762.81 (640.07–901.26)	3,345,041 (2,810,907–3,947,679)	751.82 (631.77–887.27)	−0.06 (−0.09–0.04)
55–59 years	1366689 (1,143,771–1,612,549)	737.95 (617.59–870.71)	2,900,842 (2,425,070–3,421,920)	733.04 (612.81–864.72)	0 (−0.02–0.03)
60–64 years	1134869 (939,784–1,334,065)	706.6 (585.14–830.63)	2,301,053 (1,910,658–2,709,002)	718.97 (596.99–846.44)	0.06 (0.04–0.08)
65–69 years	785444 (647,676–923,967)	635.42 (523.97–747.49)	1,826,905 (1,506,791–2,156,439)	662.3 (546.25–781.77)	0.16 (0.14–0.18)
70–74 years	458047 (376,292–542,385)	541.04 (444.47–640.65)	1,240,193 (1,019,197–1,471,770)	602.51 (495.14–715.01)	0.34 (0.32–0.36)
75–79 years	272449 (220,327–327,825)	442.61 (357.93–532.57)	671,616 (544,299–807,970)	509.25 (412.71–612.63)	0.51 (0.48–0.55)
80–84 years	119327 (93,004–148,243)	337.31 (262.9–419.05)	365,059 (287,977–448,612)	416.81 (328.8–512.21)	0.74 (0.7–0.77)
85–89 years	36650 (26,845–48,053)	242.54 (177.65–318)	149,107 (112,289–192,249)	326.12 (245.59–420.48)	1.03 (1–1.06)
90–94 years	7154 (4875–10,165)	166.94 (113.76–237.21)	43,369 (30,483–59,005)	242.43 (170.4–329.83)	1.28 (1.26–1.3)
95+ years	1107 (670–1682)	108.69 (65.77–165.18)	9592 (6113–14,067)	175.99 (112.15–258.09)	1.54 (1.53–1.56)
SDI region					
High-middle SDI	8301430 (6,971,718–9,847,647)	777.19 (652.71–922.06)	10,045,486 (8,419,995–11,895,394)	796.49 (668.01–941.36)	0.11 (0.1–0.12)
High SDI	8972557 (7,567,751–10,578,501)	1038.81 (875.46–1223.08)	11,056,986 (9,259,242–13,087,468)	1057 (887.17–1248.84)	0.06 (0.05–0.08)
Low-middle SDI	8496267 (7,125,138–10,072,685)	698.66 (585.96–828.18)	14,051,075 (11,803,670–16,488,637)	716.95 (601.88–841.51)	0.08 (0.07–0.08)
Low SDI	4210210 (3,540,870–4,983,755)	789.11 (663.27–936.77)	9,543,180 (8,011,930–11,232,297)	809.1 (679.47–951.25)	0.08 (0.07–0.08)
Middle SDI	11909533 (10,029,100–14,130,928)	669.36 (563.76–793.44)	17,078,128 (14,382,176–20,164,787)	703.96 (592.93–831.21)	0.17 (0.16–0.18)
GBD region					
Advanced Health System	12990526 (10,964,619–15,269,212)	1001.35 (844.24–1176.17)	15,025,803 (12,605,126–17,742,386)	1026.76 (862.07–1207.94)	0.09 (0.08–0.11)
Africa	5656557 (4,753,547–6,677,609)	848.49 (712.68–1003.24)	12,558,402 (10,555,368–14,744,420)	866.78 (728.8–1016.97)	0.07 (0.07–0.07)
African Region	4696298 (3,945,520–5,538,439)	871.24 (732.26–1029.3)	10,754,521 (9,053,456–12,607,525)	885.91 (745.51–1037.19)	0.05 (0.05–0.06)
America	6190018 (5,206,462–7,321,169)	858.55 (722.5–1015.67)	8,632,250 (7,265,743–10,188,491)	853.74 (719.67–1007.16)	0 (−0.01–0.01)
Andean Latin America	262167 (219,787–312,866)	663.53 (556.59–792.24)	455,160 (380,330–541,452)	684.26 (571.59–814.13)	0.1 (0.1–0.11)
Asia	23056533 (19,363,305–27,286,760)	709.76 (596.09–839.16)	33,291,200 (27,983,185–39,014,585)	724.24 (608.83–848.89)	0.07 (0.07–0.08)
Australasia	233589 (194,335–276,313)	1162.13 (967.34–1374.82)	357,327 (297,947–426,205)	1191 (993.05–1422.73)	0.08 (0.08–0.09)
Basic Health System	15769556 (13,242,084–18,720,239)	665.45 (557.56–790.23)	21,742,720 (18,229,858–25,632,744)	701.47 (588.52–827.31)	0.19 (0.18–0.2)
Caribbean	247324 (207,053–294,010)	687.39 (575.29–816.98)	320,815 (268,947–382,574)	682.49 (572.14–813.77)	−0.01 (−0.02–0.01)
Central Africa	617214 (517,550–735,370)	866 (725.86–1031.38)	1,566,451 (1,311,928–1,856,156)	887.27 (743.86–1049.18)	0.08 (0.07–0.09)
Central Asia	625276 (524,332–739,890)	876.88 (736.06–1038)	858,328 (720,725–1,011,956)	886.03 (744.24–1044.38)	0.05 (0.04–0.06)
Central Europe	1155444 (976,289–1,361,825)	934.71 (789.43–1101.84)	1,055,437 (879,991–1,249,997)	964.38 (809.99–1140.6)	0.11 (0.11–0.11)
Central Latin America	1275976 (1,072,627–1,515,111)	745.71 (628.42–887.36)	1,917,271 (1,614,924–2,268,960)	758.59 (639.01–897.84)	0.06 (0.05–0.06)
Central Sub-Saharan Africa	507732 (429,071–604,524)	865.32 (729.89–1031.01)	1,281,661 (1,073,126–1,516,828)	885.37 (739.7–1046.54)	0.07 (0.06–0.08)
Commonwealth High Income	978063 (822,580–1,156,393)	903.47 (760.53–1067.34)	1,360,411 (1,140,002–1,608,794)	969.81 (814.27–1146.28)	0.24 (0.22–0.26)
Commonwealth Low Income	1610198 (1,350,969–1,905,198)	722.65 (605.94–854.21)	3,096,227 (2,600,690–3,639,039)	762.98 (640.94–900.51)	0.16 (0.15–0.17)
Commonwealth Middle Income	8865581 (7,446,848–10,478,776)	721.44 (606.15–852.4)	15,752,932 (13,237,481–18,493,252)	733.98 (616.74–861.8)	0.05 (0.04–0.05)
East Asia	7670293 (6,401,272–9,090,627)	618.25 (515.62–732.31)	9,470,370 (7,884,683–11,279,497)	660.67 (549.41–785.94)	0.24 (0.22–0.27)
East Asia & Pacific - WB	13500834 (11,286,477–15,942,685)	713.81 (596.67–842.39)	17,230,507 (14,454,540–20,385,367)	736.38 (617.87–869.69)	0.12 (0.11–0.14)
Eastern Africa	1603130 (1,348,478–1,884,036)	857.61 (722.78–1007.48)	3,575,805 (3,007,836–4,186,494)	877.2 (738.32–1024.62)	0.07 (0.07–0.08)
Eastern Europe	2016644 (1,691,870–2,375,404)	906.09 (760.78–1067.25)	1,828,389 (1,532,203–2,170,232)	928.54 (779.82–1102.3)	0.09 (0.08–0.1)
Eastern Mediterranean Region	2829218 (2,376,463–3,351,659)	719.93 (603.78–854.68)	5,643,385 (4,724,323–6,684,483)	731.13 (612.87–865.9)	0.05 (0.05–0.06)
Eastern Sub-Saharan Africa	1782239 (1,498,551–2,101,195)	874.61 (735.84–1031.59)	4,016,785 (3,385,223–4,713,345)	893.46 (752.45–1045.25)	0.07 (0.06–0.07)
Europe	6957906 (5,880,210–8,211,538)	885.79 (748.03–1044.93)	7,267,730 (6,093,990–8,578,197)	902.47 (757.56–1062.7)	0.07 (0.07–0.08)

(*Continued*)

Table 2 (Continued).

	Number of Prevalence Cases (95% UI) in 1990	The Age-Standardized Prevalence Rate/100000 (95% UI) in 1990	Number of Prevalence Cases (95% UI) in 2021	The Age-Standardized Prevalence Rate/100000 g(95% UI) in 2021	EAPC (95% CI)
Europe & Central Asia - WB	7395393 (6,253,498–8,730,015)	885.17 (748.03–1044.53)	7,920,716 (6,647,411–9,354,510)	901.12 (756.93–1061.98)	0.07 (0.07–0.07)
European Region	7456316 (6,304,181–8,801,556)	884.72 (747.56–1043.96)	8,019,188 (6,730,233–9,471,633)	900 (756.23–1060.78)	0.07 (0.06–0.07)
High-income Asia Pacific	2475304 (2,088,848–2,899,501)	1442.14 (1217.6–1688.66)	2,681,978 (2,253,495–3,157,801)	1559.53 (1311.3–1832.39)	0.25 (0.23–0.27)
High-income North America	2964103 (2,498,734–3,501,887)	1072.08 (904.82–1265.08)	3,892,297 (3,248,391–4,605,299)	1097.16 (919.18–1296.68)	0.1 (0.08–0.13)
Latin America & Caribbean - WB	3253382 (2,736,864–3,873,957)	720.14 (606.09–856.82)	4,763,564 (4,006,581–5,646,492)	726.36 (610.82–861.09)	0.03 (0.03–0.03)
Limited Health System	11898987 (9,997,218–14,072,308)	722.17 (606.75–853.96)	21,917,488 (18,405,895–25,669,865)	742.79 (624.18–870.11)	0.08 (0.08–0.09)
Middle East & North Africa - WB	2035807 (1,709,825–2,406,297)	759.93 (637.22–898.91)	3,750,633 (3,154,791–4,426,890)	776.32 (652.44–916.06)	0.07 (0.07–0.08)
Minimal Health System	1230927 (1,032,900–1,466,790)	854.24 (716.96–1016.83)	3,088,844 (2,588,455–3,636,928)	865.32 (723.68–1017.55)	0.05 (0.04–0.05)
North Africa and Middle East	2667505 (2,236,579–3,150,684)	755.54 (633.94–893.03)	4,884,140 (4,104,186–5,765,658)	771.8 (648.48–910.69)	0.07 (0.07–0.08)
North America	2963887 (2,498,512–3,501,670)	1072.02 (904.76–1265.02)	3,892,114 (3,248,232–4,605,100)	1097.11 (919.16–1296.64)	0.1 (0.08–0.13)
Northern Africa	947745 (789,529–1,121,543)	754.88 (628.65–895.12)	1,644,098 (1,380,720–1,938,997)	769.11 (645.61–906.95)	0.06 (0.06–0.06)
Oceania	46427 (38,901–54,939)	678.31 (568.57–803.5)	96,966 (81,551–116,331)	673.2 (566.15–807.01)	−0.03 (−0.03–0.02)
Region of the Americas	6190018 (5,206,462–7,321,169)	858.55 (722.5–1015.67)	8,632,250 (7,265,743–10,188,491)	853.74 (719.67–1007.16)	0 (−0.01–0.01)
South-East Asia Region	9231924 (7,737,819–10,938,927)	679.72 (569.86–804.68)	14,329,586 (12,060,141–16,827,762)	689.34 (580.33–809.62)	0.04 (0.03–0.05)
South Asia	7795864 (6,537,961–9,216,359)	681.98 (571.95–806.02)	12,848,945 (10,802,916–15,015,893)	686.16 (576.62–801.99)	0.01 (0–0.02)
South Asia - WB	7997829 (6,707,378–9,453,570)	682.94 (572.76–807.01)	13,252,845 (11,142,735–15,494,373)	687.45 (577.62–803.82)	0.01 (0.01–0.02)
Southeast Asia	3201991 (2,696,864–3,790,421)	663.62 (559.77–784.78)	4,784,650 (4,024,215–5,673,822)	682.98 (574.58–809.75)	0.1 (0.09–0.11)
Southern Africa	871285 (731,837–1,034,712)	881.01 (740.13–1048.94)	1,703,509 (1,432,096–1,994,976)	892.54 (750.94–1046.93)	0.04 (0.03–0.05)
Southern Latin America	516198 (432,594–614,214)	1035.24 (867.49–1231.97)	700,575 (586,987–826,296)	1056.55 (885.87–1245.37)	0.05 (0.04–0.05)
Southern Sub-Saharan Africa	488296 (410,059–576,133)	890.22 (746.83–1049.8)	741,683 (623,701–878,038)	903.63 (760.08–1069.17)	0.06 (0.04–0.07)
Sub-Saharan Africa - WB	4724005 (3,971,219–5,575,226)	871.11 (732.19–1028.28)	10,944,024 (9,210,458–12,831,440)	884.3 (743.72–1035.65)	0.05 (0.05–0.05)
Tropical Latin America	960545 (799,233–1,140,397)	608.68 (506.46–723.02)	1,381,083 (1,156,544–1,646,422)	614.52 (514.73–732.29)	0.03 (0.03–0.04)
Western Africa	1617182 (1,357,883–1,900,301)	880.28 (738.8–1037.12)	4,068,540 (3,420,294–4,805,412)	885.69 (743.66–1045.16)	0.02 (0.01–0.03)
Western Europe	3247150 (2,744,661–3,836,563)	876.83 (740.75–1034.33)	3,672,369 (3,082,109–4,334,850)	896.6 (751.64–1054.5)	0.09 (0.08–0.09)
Western Pacific Region	11277581 (9,426,672–13,315,201)	723.29 (604.16–853.8)	14,161,867 (11,861,717–16,791,895)	750.54 (628.69–888.95)	0.14 (0.13–0.16)
Western Sub-Saharan Africa	1789928 (1,503,876–2,104,809)	879.6 (737.7–1035.65)	4,577,312 (3,847,537–5,399,715)	886.16 (745.12–1045.59)	0.03 (0.02–0.03)
World Bank High Income	10460711 (8,838,072–12,302,523)	1036.81 (875.22–1217.62)	12,511,348 (10,508,660–14,775,420)	1060.87 (890.99–1247.5)	0.09 (0.07–0.1)
World Bank Low Income	2728999 (2,295,451–3,233,429)	829.47 (695.41–983.1)	6,193,519 (5,202,881–7,285,612)	851.84 (715.7–999.36)	0.09 (0.09–0.1)
World Bank Lower Middle Income	14868398 (12,486,538–17,606,100)	715.16 (600.8–846.82)	25,446,353 (21,395,979–29,956,699)	730.58 (614.58–860.21)	0.06 (0.06–0.07)
World Bank Upper Middle Income	13831719 (11,576,588–16,432,278)	679.89 (569.15–807.24)	17,623,487 (14,782,180–20,875,859)	711.39 (597.47–841.63)	0.17 (0.16–0.18)

Abbreviations: SDI, Sociodemographic Index; EAPC, Estimated Annual Percentage Change.

Table 3 Austism Number Cases and DALYs of Global, Sex, Age, SDI and GBD Region in 1990 and 2021

	Number of DALYs Cases (95% UI) in 1990	The Age-Standardized DALYs Rate/100000 (95% UI) in 1990	Number of DALYs Cases (95% UI) in 2021	The Age-Standardized DALYs Rate/100000 (95% UI) in 2021	EAPC (95% CI)
Global	7868387 (5,351,164–11,069,617)	144.51 (98.3–203.28)	11,544,038 (7,842,315–16,288,865)	147.56 (100.21–208.16)	0.08 (0.08–0.09)
Sex					
Female	2488810 (1,714,941–3,506,510)	92.39 (63.7–130.09)	3,647,200 (2,492,450–5,139,412)	94.45 (64.55–133.02)	0.1 (0.09–0.11)
Male	5379577 (3,669,209–7,561,979)	195.93 (133.71–274.94)	7,896,838 (5,388,268–11,137,855)	199.8 (136.29–281.96)	0.07 (0.07–0.08)
Age					
<5 years	1010859 (687,189–1,419,351)	163.06 (110.85–228.95)	1,113,595 (756,819–1,562,446)	169.2 (114.99–237.39)	0.13 (0.12–0.14)
5–9 years	931318 (636,381–1,310,658)	159.6 (109.06–224.61)	1,129,791 (767,076–1,591,202)	164.44 (111.65–231.6)	0.13 (0.12–0.14)
10–14 years	839763 (575,216–1,184,708)	156.76 (107.38–221.16)	1,074,673 (724,429–1,513,402)	161.21 (108.67–227.02)	0.11 (0.1–0.12)
15–19 years	796264 (542,868–1,119,477)	153.3 (104.51–215.52)	988,072 (667,651–1,389,761)	158.35 (107–222.73)	0.1 (0.09–0.11)
20–24 years	740451 (503,091–1,042,237)	150.47 (102.24–211.8)	928,297 (628,035–1,308,251)	155.45 (105.17–219.08)	0.09 (0.07–0.11)
25–29 years	664742 (451,947–937,475)	150.18 (102.11–211.8)	898,053 (609,591–1,264,383)	152.64 (103.61–214.91)	0.08 (0.06–0.1)
30–34 years	579874 (394,395–821,213)	150.45 (102.33–213.07)	904,004 (616,860–1,277,149)	149.55 (102.05–211.28)	0.03 (0.01–0.06)
35–39 years	519446 (354,304–734,723)	147.47 (100.58–208.58)	829,035 (562,319–1,170,076)	147.81 (100.26–208.62)	0.02 (0–0.04)
40–44 years	421585 (289,677–592,767)	147.16 (101.12–206.91)	729,517 (496,701–1,025,322)	145.83 (99.29–204.96)	−0.03 (−0.05–0)
45–49 years	332326 (227,263–467,088)	143.12 (97.88–201.16)	670,336 (457,577–940,973)	141.57 (96.64–198.73)	−0.06 (−0.07–0.04)
50–54 years	294989 (200,915–413,557)	138.77 (94.52–194.55)	609,305 (416,883–849,407)	136.95 (93.7–190.91)	−0.06 (−0.08–0.03)

(*Continued*)

Table 3 (Continued).

	Number of DALYs Cases (95% UI) in 1990	The Age-Standardized DALYs Rate/100000 (95% UI) in 1990	Number of DALYs Cases (95% UI) in 2021	The Age-Standardized DALYs Rate/100000 (95% UI) in 2021	EAPC (95% CI)
55–59 years	245913 (169,236–340,198)	132.78 (91.38–183.69)	522,274 (359,523–726,503)	131.98 (90.85–183.59)	0.01 (−0.02–0.04)
60–64 years	201660 (139,668–279,657)	125.56 (86.96–174.12)	408,487 (281,069–570,357)	127.63 (87.82–178.21)	0.06 (0.04–0.09)
65–69 years	137401 (94,099–190,236)	111.16 (76.13–153.9)	319,260 (219,230–445,941)	115.74 (79.48–161.67)	0.16 (0.14–0.19)
70–74 years	78712 (53,820–109,351)	92.97 (63.57–129.16)	212,943 (145,123–296,170)	103.45 (70.5–143.88)	0.34 (0.32–0.36)
75–79 years	45984 (31,689–64,117)	74.7 (51.48–104.16)	113,240 (77,610–158,345)	85.86 (58.85–120.06)	0.51 (0.48–0.54)
80–84 years	19797 (13,478–27,721)	55.96 (38.1–78.36)	60,449 (41,243–85,362)	69.02 (47.09–97.46)	0.73 (0.7–0.77)
85–89 years	5970 (3980–8484)	39.51 (26.34–56.14)	24,260 (16,557–34,559)	53.06 (36.21–75.59)	1.03 (1–1.06)
90–94 years	1154 (735–1725)	26.93 (17.15–40.25)	6929 (4571–10,191)	38.73 (25.55–56.97)	1.25 (1.23–1.27)
95+ years	178 (103–286)	17.52 (10.16–28.1)	1518 (931–2333)	27.85 (17.08–42.8)	1.48 (1.47–1.5)
SDI region					
High-middle SDI	1558810 (1,062,324–2,198,989)	145.95 (99.46–205.82)	1,870,636 (1,283,602–2,637,309)	149.98 (102.81–211.41)	0.12 (0.11–0.13)
High SDI	1675311 (1,153,040–2,336,379)	195 (134.18–272.18)	2,039,244 (1,402,970–2,848,881)	197.87 (136.14–276.33)	0.06 (0.04–0.07)
Low-middle SDI	1592281 (1,096,805–2,244,889)	129.9 (89.59–182.8)	2,633,269 (1,788,418–3,697,132)	133.94 (90.98–188.04)	0.1 (0.09–0.1)
Low SDI	786675 (544,352–1,109,792)	146.11 (101.28–205.15)	1,795,739 (1,229,370–2,535,527)	150.86 (103.45–212.08)	0.11 (0.1–0.12)
Middle SDI	2247820 (1,524,658–3,165,425)	125.63 (85.32–176.72)	3,196,076 (2,163,936–4,515,251)	132.25 (89.53–186.65)	0.18 (0.17–0.19)
GBD region					
Advanced Health System	2423749 (1,664,338–3,386,171)	187.77 (128.91–262.7)	2,772,835 (1,908,510–3,866,620)	192.22 (132.2–267.9)	0.09 (0.08–0.1)
Africa	1060855 (730,074–1,497,762)	157.69 (108.76–221.86)	2,364,115 (1,606,497–3,329,203)	161.73 (110.04–227.04)	0.09 (0.09–0.1)
African Region	880006 (604,250–1,237,854)	161.72 (111.32–226.62)	2,025,005 (1,379,883–2,852,528)	165.25 (112.85–232.38)	0.08 (0.08–0.09)
America	1158363 (793,206–1,624,943)	160.22 (109.72–224.82)	1,597,536 (1,089,385–2,240,514)	159.1 (108.47–223.29)	0 (−0.01–0.01)
Andean Latin America	49443 (33,619–69,538)	124.27 (84.44–174.38)	85,530 (57,762–120,400)	128.5 (86.85–180.92)	0.12 (0.11–0.12)
Asia	4339398 (2,949,456–6,105,993)	132.88 (90.37–186.66)	6,224,807 (4,229,135–8,809,052)	135.85 (92.27–192.07)	0.08 (0.08–0.09)
Australasia	43363 (29,954–60,392)	216.66 (149.69–301.73)	66,006 (45,662–93,212)	222.63 (154–314.31)	0.09 (0.08–0.09)
Basic Health System	2980786 (2,031,226–4,204,986)	125.18 (85.36–176.42)	4,072,393 (2,765,675–5,736,160)	132.1 (89.68–185.81)	0.2 (0.19–0.21)
Caribbean	46475 (31,845–65,212)	128.66 (88.23–180.49)	59,774 (40,541–83,420)	127.53 (86.45–178.12)	−0.01 (−0.02–0.01)
Central Africa	115326 (80,099–161,196)	160.04 (111.33–224.46)	294,822 (200,530–418,102)	165.23 (112.36–233.34)	0.11 (0.1–0.13)
Central Asia	117929 (79,958–165,161)	164.48 (111.59–230.63)	161,331 (109,690–228,533)	166.43 (113.16–235.64)	0.06 (0.05–0.07)
Central Europe	215366 (147,013–301,194)	175.07 (119.47–245.25)	194,783 (134,725–272,380)	181.04 (125.2–252.95)	0.12 (0.12–0.13)
Central Latin America	240950 (166,889–339,190)	139.53 (96.56–196.46)	358,883 (242,903–507,855)	142.22 (96.18–201.27)	0.06 (0.06–0.06)
Central Sub-Saharan Africa	94796 (66,178–133,560)	159.71 (111.53–225.55)	241,038 (164,257–340,305)	164.69 (112.41–231.89)	0.11 (0.09–0.12)
Commonwealth High Income	182428 (125,384–253,145)	169.54 (116.71–235.61)	251,642 (172,361–353,424)	181.71 (124.29–256.22)	0.24 (0.22–0.26)
Commonwealth Low Income	302210 (207,545–425,270)	134.31 (92.29–188.34)	582,912 (397,386–817,688)	142.75 (97.38–199.95)	0.19 (0.18–0.2)
Commonwealth Middle Income	1656808 (1,138,023–2,333,264)	133.81 (92.02–188.03)	2,945,212 (2,010,056–4,139,835)	136.79 (93.37–192.13)	0.07 (0.06–0.07)
East Asia	1454162 (985,458–2,057,248)	116.87 (79.27–165.28)	1,774,089 (1,197,771–2,499,467)	125.12 (84.47–176.31)	0.25 (0.23–0.27)
East Asia & Pacific - WB	2551073 (1,736,501–3,591,263)	134.4 (91.54–189.02)	3,224,267 (2,201,814–4,549,486)	138.96 (94.98–195.63)	0.13 (0.12–0.15)
Eastern Africa	300720 (207,490–423,174)	159.29 (110.3–223.02)	674,524 (461,139–948,067)	163.87 (112.31–230.08)	0.1 (0.1–0.11)
Eastern Europe	374961 (256,220–526,611)	169.49 (115.51–238.15)	337,179 (231,683–471,167)	173.87 (119.23–243.41)	0.1 (0.09–0.12)
Eastern Mediterranean Region	532655 (366,519–743,955)	134.33 (92.57–187.86)	1,058,001 (718,046–1,485,831)	136.32 (92.47–191.32)	0.06 (0.05–0.06)
Eastern Sub-Saharan Africa	334049 (230,022–470,394)	162.3 (112.1–227.7)	757,537 (516,796–1,069,116)	166.8 (114.11–234.89)	0.1 (0.09–0.11)
Europe	1296843 (885,365–1,825,097)	166.04 (113.38–234.04)	1,343,850 (920,756–1,872,382)	169.27 (115.8–235.92)	0.08 (0.08–0.08)
Europe & Central Asia - WB	1379389 (941,091–1,940,340)	165.9 (113.21–233.67)	1,466,805 (1,003,099–2,049,929)	169.01 (115.38–236.38)	0.08 (0.07–0.08)
European Region	1390863 (948,833–1,955,950)	165.82 (113.15–233.5)	1,485,248 (1,015,758–2,076,348)	168.81 (115.25–236.17)	0.08 (0.07–0.08)
High-income Asia Pacific	464059 (321,081–645,771)	271.65 (187.69–378.09)	495,601 (343,282–695,132)	293.92 (203.17–413.01)	0.25 (0.23–0.28)
High-income North America	551460 (380,091–766,012)	200.5 (138.2–278.78)	713,184 (493,088–997,383)	203.95 (141.1–285.5)	0.09 (0.06–0.11)
Latin America & Caribbean - WB	612054 (422,484–860,350)	134.55 (92.88–188.98)	888,697 (600,003–1,253,404)	135.91 (91.68–191.63)	0.04 (0.03–0.04)
Limited Health System	2226362 (1,529,284–3,143,637)	134.04 (92.16–188.67)	4,108,006 (2,803,118–5,778,011)	138.62 (94.62–194.7)	0.11 (0.1–0.11)
Middle East & North Africa - WB	384066 (264,358–539,580)	142.05 (97.78–198.92)	702,363 (473,460–988,509)	145.04 (97.84–203.91)	0.08 (0.07–0.08)
Minimal Health System	230001 (158,805–322,074)	158.05 (109.39–221.02)	581,731 (397,090–821,312)	161.14 (110.14–227.16)	0.07 (0.07–0.08)
North Africa and Middle East	502914 (345,825–705,164)	141.22 (97.21–197.39)	914,908 (616,066–1,286,313)	144.2 (97.15–202.52)	0.08 (0.07–0.08)
North America	551419 (380,063–765,950)	200.49 (138.19–278.76)	713,150 (493,063–997,333)	203.95 (141.1–285.49)	0.09 (0.06–0.11)
Northern Africa	178806 (122,872–251,767)	141.27 (96.97–198.2)	308,777 (207,538–432,827)	143.96 (96.79–201.79)	0.07 (0.06–0.07)
Oceania	8749 (6036–12,347)	126.72 (87.41–178.75)	18,288 (12,475–25,630)	126.07 (85.71–176.76)	−0.02 (−0.02–0.02)
Region of the Americas	1158363 (793,206–1,624,943)	160.22 (109.72–224.82)	1,597,536 (1,089,385–2,240,514)	159.1 (108.47–223.29)	0 (−0.01–0.01)
South-East Asia Region	1728285 (1,188,479–2,435,782)	126.34 (86.96–177.59)	2,677,838 (1,814,948–3,763,935)	128.79 (87.3–180.99)	0.06 (0.06–0.07)

(*Continued*)

Table 3 (Continued).

	Number of DALYs Cases (95% UI) in 1990	The Age-Standardized DALYs Rate/100000 (95% UI) in 1990	Number of DALYs Cases (95% UI) in 2021	The Age-Standardized DALYs Rate/100000 (95% UI) in 2021	EAPC (95% CI)
South Asia	1456554 (1,002,832–2,044,748)	126.43 (87.11–177.07)	2,399,066 (1,637,235–3,382,018)	127.86 (87.27–180.25)	0.03 (0.03–0.04)
South Asia - WB	1494448 (1,029,068–2,098,845)	126.63 (87.27–177.41)	2,474,926 (1,688,424–3,491,216)	128.11 (87.41–180.55)	0.03 (0.03–0.04)
Southeast Asia	604596 (412,518–853,227)	124.46 (84.99–174.66)	900,293 (612,066–1,272,740)	128.65 (87.45–181.69)	0.12 (0.11–0.13)
Southern Africa	163478 (112,051–231,296)	163.8 (112.48–230.07)	319,181 (216,774–448,730)	165.76 (112.7–232.45)	0.05 (0.04–0.06)
Southern Latin America	96939 (66,932–136,362)	194.17 (134.02–273.06)	130,654 (88,773–184,968)	198.18 (134.67–280.3)	0.05 (0.04–0.05)
Southern Sub-Saharan Africa	91839 (63,144–129,133)	165.99 (114.4–232.95)	138,087 (94,596–194,320)	167.72 (114.91–236.11)	0.05 (0.03–0.07)
Sub-Saharan Africa - WB	884906 (608,156–1,244,329)	161.65 (111.37–226.56)	2,060,971 (1,405,667–2,904,802)	164.92 (112.77–231.89)	0.08 (0.07–0.08)
Tropical Latin America	179905 (124,306–252,234)	113.25 (78.17–158.68)	255,968 (172,573–358,108)	114.44 (77.06–160.26)	0.05 (0.04–0.05)
Western Africa	302524 (207,127–425,312)	163.29 (112.02–229.22)	766,812 (525,679–1,078,389)	165.39 (113.5–231.95)	0.05 (0.05–0.06)
Western Europe	604909 (412,912–853,062)	164.69 (112.59–232.43)	678,957 (466,623–944,266)	168.26 (115.5–234.77)	0.09 (0.08–0.09)
Western Pacific Region	2131265 (1,451,929–2,998,175)	136.28 (92.89–191.47)	2,647,820 (1,803,027–3,737,563)	141.71 (96.57–199.53)	0.15 (0.13–0.17)
Western Sub-Saharan Africa	334968 (229,599–471,462)	163.21 (112.07–229.13)	862,884 (590,900–1,215,654)	165.49 (113.48–232.43)	0.05 (0.05–0.06)
World Bank High Income	1902686 (1,308,264–2,654,869)	194.58 (133.75–271.81)	2,264,178 (1,561,785–3,159,669)	198.62 (136.94–277.08)	0.08 (0.07–0.1)
World Bank Low Income	547633 (377,312–771,424)	153.91 (106.26–216.03)	1,230,913 (840,143–1,742,405)	158.63 (108.44–223.55)	0.11 (0.1–0.12)
World Bank Lower Middle Income	2693530 (1,846,477–3,780,155)	133.1 (91.37–186.37)	4,615,574 (3,131,886–6,484,938)	136.61 (92.72–192)	0.08 (0.08–0.09)
World Bank Upper Middle Income	2702475 (1,834,562–3,809,383)	127.82 (86.82–180.18)	3,417,020 (2,327,143–4,814,147)	133.94 (91.19–188.32)	0.18 (0.17–0.19)

Abbreviations: DALYs, Disability Adjusted life Years; SDI, Sociodemographic Index; EAPC, Estimated Annual Percentage Change.

0.018% (0.015–0.021) and an EAPC of 0.15 (0.14–0.16) from 1990 to 2021. Incidence rates for other regions are summarized in Table 1. The age-standardized prevalence in high SDI regions in 2021 was 1.1% (0.887–1.249), with an EAPC of 0.06 (0.05–0.08) from 1990 to 2021, making it the region with the highest prevalence rate. The age-standardized prevalence in the middle SDI regions was 0.704 (0.593–0.831), with an EAPC of 0.17 (0.16–0.18) from 1990 to 2021, indicating a rapid growth in prevalence rate. In 2021, the age-standardized DALYs in high SDI regions was 0.198% (0.136–0.276), with an EAPC of 0.06 (0.04–0.07) from 1990 to 2021, representing the highest DALYs but the slowest growth rate. The age-standardized DALYs in middle SDI regions was 0.132% (0.090–0.187), with an EAPC of 0.18 (0.17–0.19) from 1990 to 2021, indicating the lowest DALYs but a rapid growth rate. Trends in incidence, prevalence, DALYs, and number of cases by SDI are illustrated in Figure 3, with detailed values available in Tables 1–3 and Figure S3.

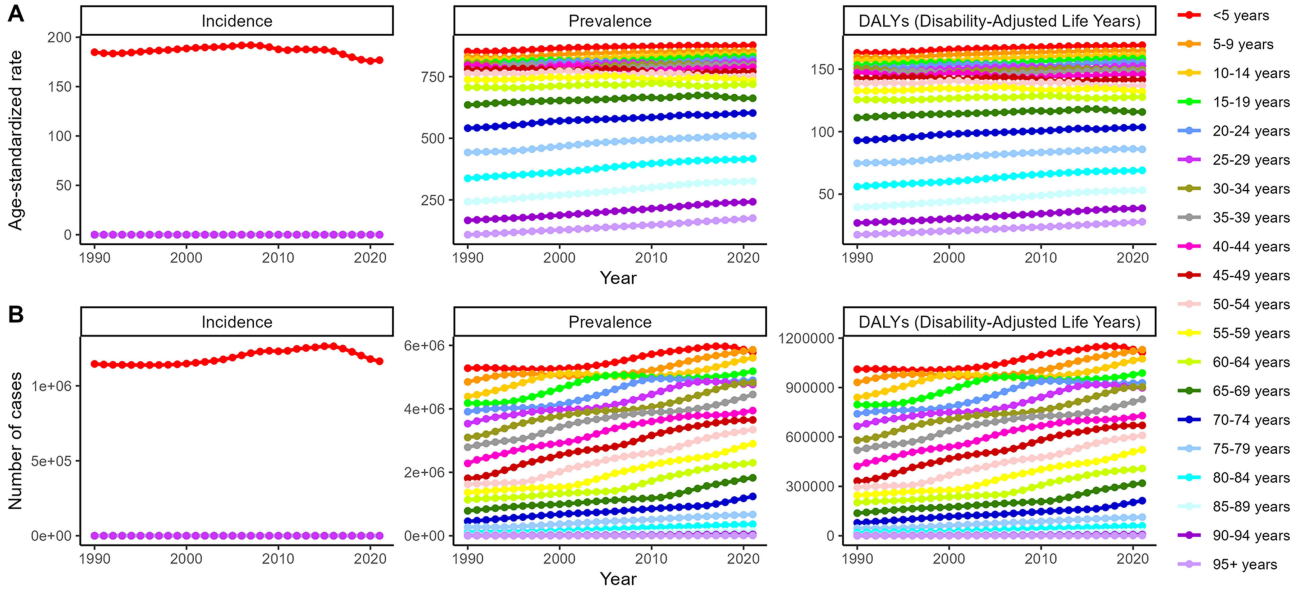

Figure 2 The global autism Age-standardized incidence, prevalence and DALYs Trends of Different age range from 1990 to 2021. DALYs. (**A**) Age-standardized rate; (**B**) Number of cases.

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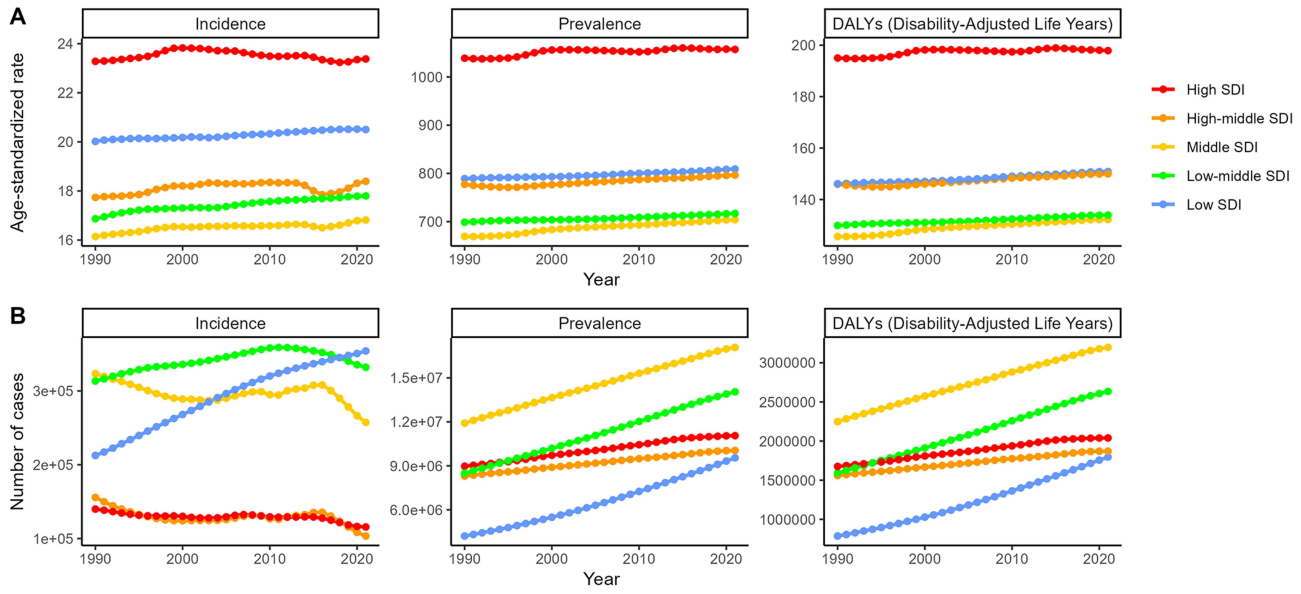

Figure 3 The global autism Age-standardized incidence, prevalence and DALYs trends of different SDI from 1990 to 2021. (**A**) Age-standardized rate; (**B**) Number of cases.

GBD Region Prevalence from 1990 to 2021

In 2021, the age-standardized incidence rate in the high-income Asia Pacific region was 0.034% (0.029–0.040), with an EAPC of 0.17 (0.14–0.19) from 1990 to 2021, making it the region with the highest incidence rate. The age-standardized incidence rate in the commonwealth low-income region was 0.020% (0.017–0.023), with an EAPC of 0.23 (0.22–0.24) from 1990 to 2021, indicating a rapid growth rate. The age-standardized incidence rate in Tropical Latin America was 0.015% (0.012–0.017), with an EAPC of 0.03 (0.01–0.05), representing the lowest incidence rate. In the Caribbean, the age-standardized incidence rate was 0.016% (0.013–0.019), with an EAPC of −0.06 (−0.07–-0.05), showing a rapid decline. In 2021, the age-standardized prevalence in the high-income Asia Pacific region was 1.560% (1.311–1.832), with an EAPC of 0.25 (0.23–0.27), indicating the highest prevalence and growth rate. The age-standardized prevalence in Tropical Latin America was 0.615% (0.515–0.732), with an EAPC of 0.03 (0.03–0.04), representing the lowest prevalence. The age-standardized prevalence in Oceania was 0.673 (0.566–0.807), with an EAPC of −0.03 (−0.03–-0.02), indicating a rapid decline. In 2021, the age-standardized DALYs in the high-income Asia Pacific region was 0.294% (0.203–0.413), with an EAPC of 0.25 (0.23–0.28), indicating a substantial impact. The age-standardized DALYs in Tropical Latin America was 0.114% (0.077–0.160), with an EAPC of 0.05 (0.04–0.05). The age-standardized DALYs in East Asia and high-income Asia Pacific were similar (0.25 [0.23–0.27] and 0.25 [0.23–0.28], respectively), with the highest growth rates. Trends in the incidence, prevalence, DALYs, and number of cases by GBD region are shown in Figure 4, with detailed values available in Tables 1–3. Additionally, we performed a cluster analysis of the regions based on the predefined categories (minor increase, remaining stable or minor decrease, significant decrease, and significant increase) (Figure S4).

Country-Wise ASD Prevalence from 1990 to 2021

Serbia experienced the most significant decline in age-standardized incidence rate from 1990 to 2021, with an EAPC of −0.47 (−1.05–0.12). Thailand exhibited the most significant increase in age-standardized incidence rate, with an EAPC of 0.32 (−0.34–0.98). Japan demonstrated the largest increase in age-standardized prevalence of 0.28 (−0.51–1.07). Equatorial Guinea experienced the most rapid growth in age-standardized DALYs, with an EAPC of 0.3 (−0.27–0.86) (Tables S1, S2, and S3). Figure 5 illustrates the trends in incidence and prevalence in Serbia, Thailand, and Japan from 1990 to 2021. The age-standardized incidence, prevalence, and DALYs for each country in 2021 are shown in Figure 6, and the EAPC and number changes are indicated on the map (Figure S5).

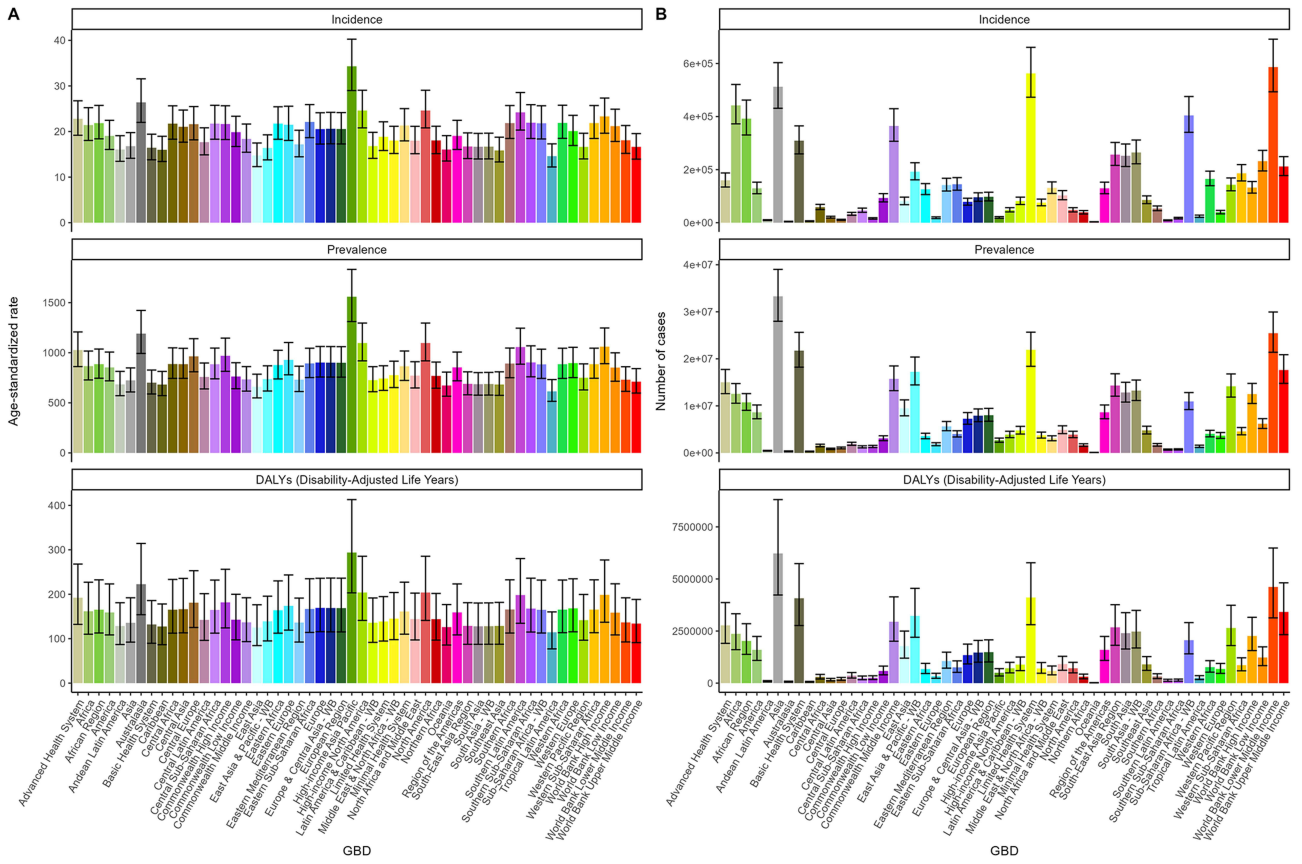

Figure 4 The Age-standardized incidence, prevalence and DALYs of Global region in 2021. (**A**) Age-standardized rate; (**B**) Number of cases.

Trends in Global ASD Prevalence from 2022 to 2046

The ARIMA and ES forecasting methods indicated a slight increase in the age-standardized incidence rate among females from 2022 to 2046. The projected rate for 2022 is 0.013%, with no anticipated change by 2046. The predicted number of newly diagnosed cases in women ranges from 346,272.7326 to 376,672.0285 in 2022 and from 287,411.8921 to 346,272.7326 in 2046. Owing to the decline in the total population, the overall annual incidence rate has decreased. The predicted age-standardized prevalence rate among females is 0.509% in 2022, with a forecast range of 0.508–0.515% in 2046. The number of age-standardized female cases predicted for 2022 ranges from 19,852,616.3 to 19,857,522.24, and is predicted to range from 21,242,458.43 to 23,949,510.15 in 2046. The predicted DALYs for females was 0.095% in 2022, with a similar rate forecasted for 2046 (0.095%). The predicted number of DALYs for females ranges from 3,673,829.016 to 3,675,192.907 in 2022, and it was predicted to range from 3,900,949.31 to 4,398,561.245 in 2046. Trend charts are shown in Figures 7 and S6 (Tables S4 and S5).

The prediction of ASD trends among males demonstrated a slight increase in the age-standardized incidence rate between 2022 and 2046. For males, the age-standardized incidence rate of ASD is predicted to be 0.025% in 2022, and it is expected to remain at 0.025% in 2046. The predicted number of newly diagnosed cases for males was between 774,788.8917 and 779,296.316 in 2022, and ranges from 692,323.2788 to 785,210.8421 in 2046. The predicted age-standardized prevalence rate for males is 1.064% in 2022 and is anticipated to range between 1.062% and 1.077% by 2046. The predicted number of age-standardized cases among males was between 42,409,207.41 and 42,678,775.02 in 2022, whereas it is forecasted to range from 44,866,655.97 to 53,939,015.57 in 2046. The predicted DALYs in males was 0.200% in 2022, and is predicted to be between 0.199% and 0.203% in 2046. The predicted number of DALY in males ranges from 7,946,470.099 to 7,949,376.882 in 2022 and is forecasted to range from 8,369,775.736 to 10,150,943.91 in 2046.

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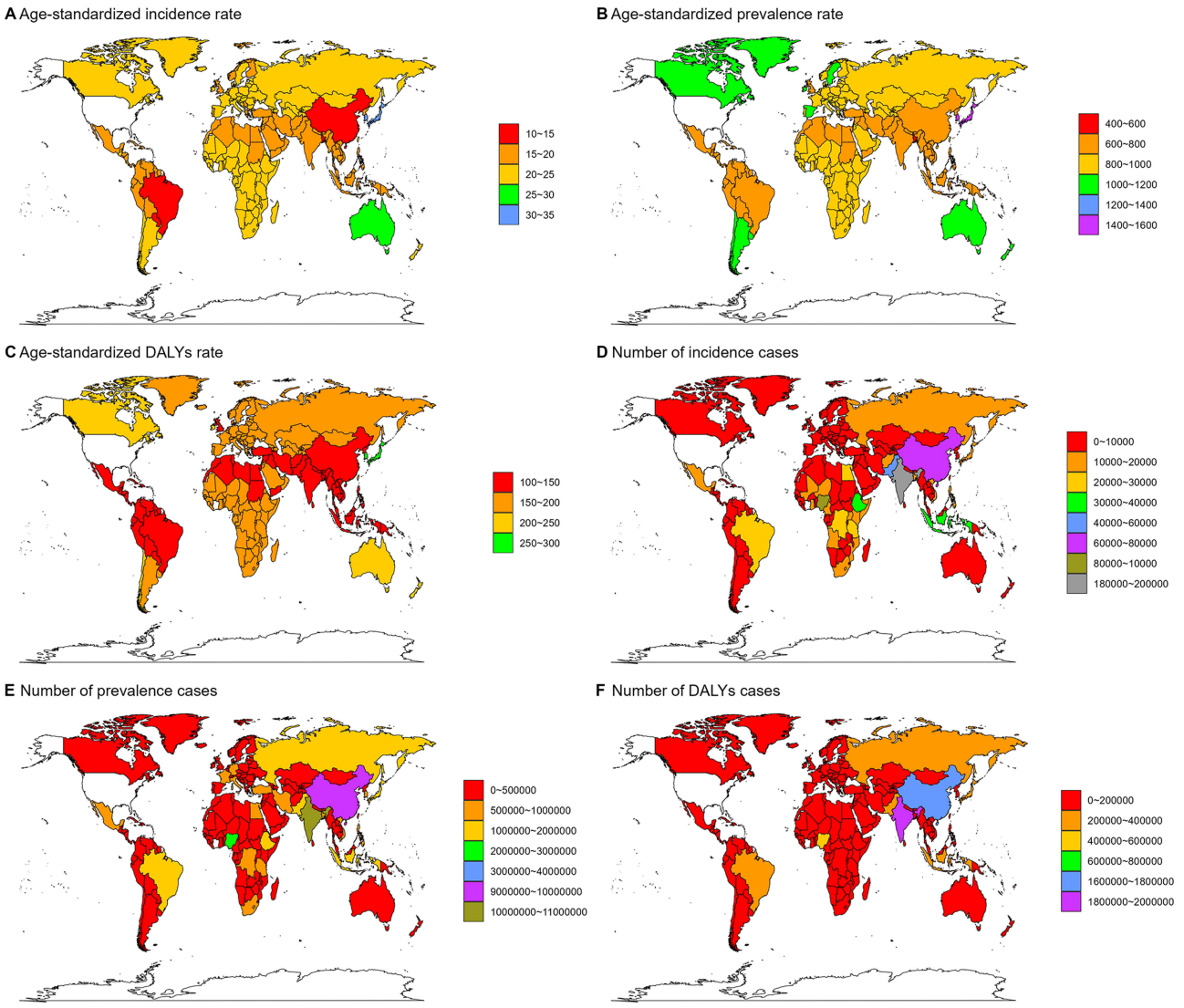

Figure 5 The world map distribution of autism Age-standardized incidence, prevalence and DALYs in 2021. (**A**) Age-standardized incidence rate; (**B**) Age-standardized prevalence rate; (**C**) Age-standardized DALYs rate; (**D**) Number of incidence cases; (**E**) Number of prevalence cases; (**F**) Number of DALYs cases.

Discussion

Our findings indicated an increasing global trend in the incidence, prevalence, and DALYs associated with ASD. The Center for Disease(CDC) reports from 2020 to 2022 indicate that the prevalence of ASD among children aged 3–17 years is 3.4%.[22] Our findings showed that the age-standardized prevalence of ASD among children aged 8 years was approximately 8.53 cases per 1,000 children in 2021, which is slightly lower than the data from the CDC. Additionally, our research indicates that the prevalence rates in high-SDI and high-income North America are 1.06% and 1.10%, respectively, aligning closely with the prevalence rates in the United States. Given the limited number of investigation sites and coverage in the CDC study, the estimates from the GBD database provide a more comprehensive reflection of global trends. This finding may also indicate that developed regions have a higher prevalence of ASD.

This study showed that the incidence of ASD is increasing in both males and females; however, the rate of increase is somewhat higher in females. Overall, the incidence, prevalence, and DALYs for males were approximately twice those for females. The lower incidence in females may currently be associated with the "female protective effect",[23] and ASD in females may manifest as more subtle quirks in social communication and less pronounced repetitive behaviors compared to males. Females are better at masking autistic tendencies and adjusting their behavior to conform to social

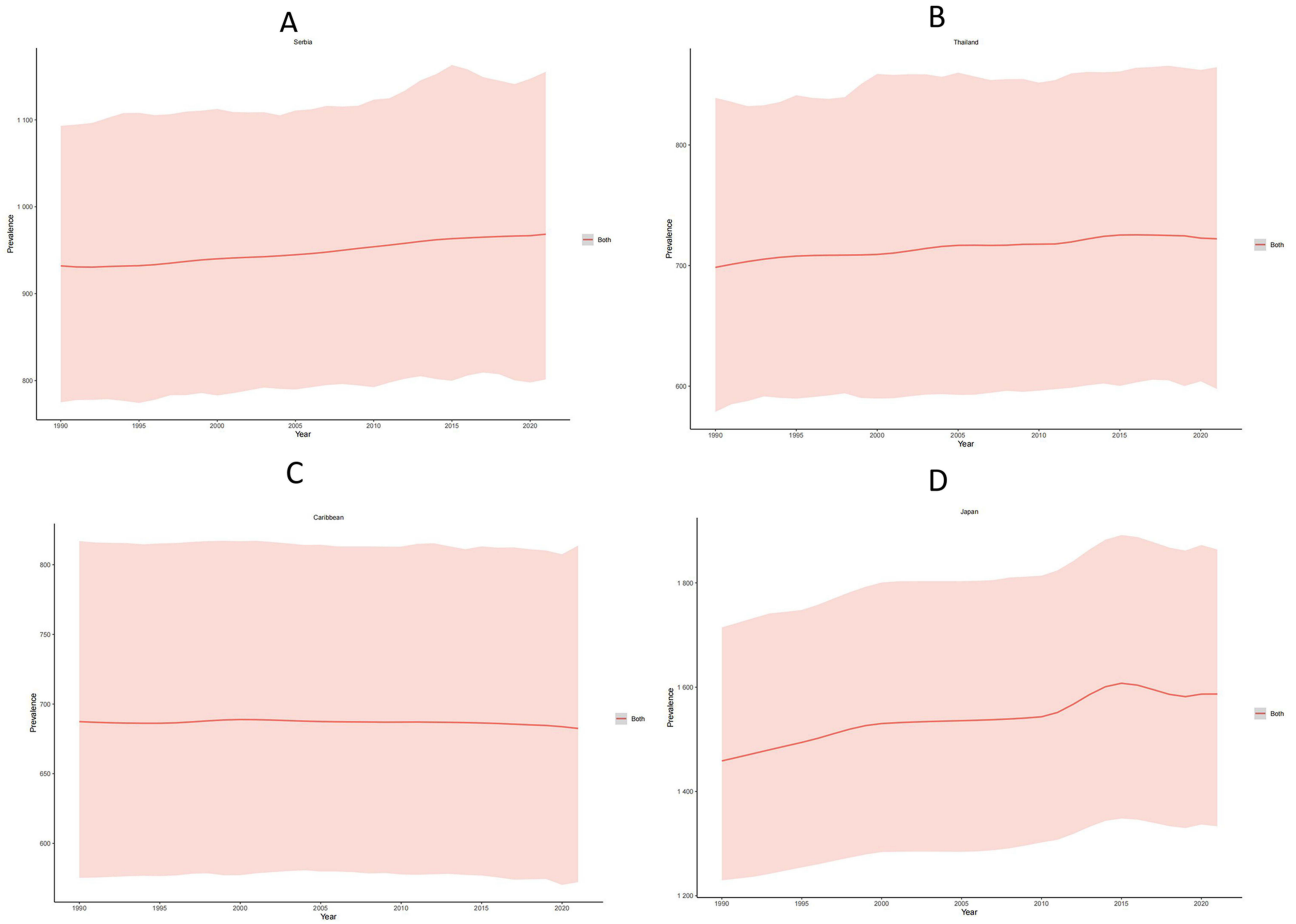

Figure 6 The autism Age-standardized prevalence rate trend of Serbia, Thailand, Caribbean and Japan from 1990 to 2021. (**A**) Serbia; (**B**) Thailand; (**C**) Caribbean; (**D**) Japan.

norms, which can lead to misdiagnosis or missed diagnosis of ASD.[24,25] Other reasons include the perception among professionals involved in ASD diagnosis that ASD predominantly affects males,[26,27] as well as the higher diagnosis rate of ASD in males with a certain physiological basis. Compared to females, the emergence of ASD traits in male brains may require a smaller cumulative effect of genetic[28] and environmental factors.[29] This hypermasculinization is reflected in the transcriptional patterns in the brain. Certain genes are more active in the cortex of typically male brains and show higher expression in both male and female individuals with ASD.[30] A study analyzing the human brain proteome found that 5.5% of the assessed genes exhibited gender-differentiated expression at both the mRNA and protein levels, impacting mental and neurological disorders.[31] This study indicates that the rapid increase in the incidence of ASD among females may be attributed to increased awareness and technological advancements, although the incidence of ASD in females may also be underestimated. The specific reasons for these manifestations require further investigation.

The relationship between the incidence of ASD and economic status remains unclear. This study indicates that regions such as high SDI, Australasia, high-income Asia Pacific, and high-income North America have high incidence rates, suggesting that developed areas generally exhibit higher incidence rates, although the growth rate has slowed over the past 30 years. This may be related to increased awareness in developed regions, accessibility to healthcare, and screening and diagnosis of impoverished children.[32] The study also found significant increases in the prevalence rates in low SDI, low-middle, middle, and high-middle SDI regions from 1990 to 2021, with the increase being particularly pronounced in the low-middle SDI regions, possibly due to increased awareness and increased screening for ASD in these areas. Interestingly, the prevalence rate in the low-SDI regions was closer to that in the high-SDI regions, and the reasons for

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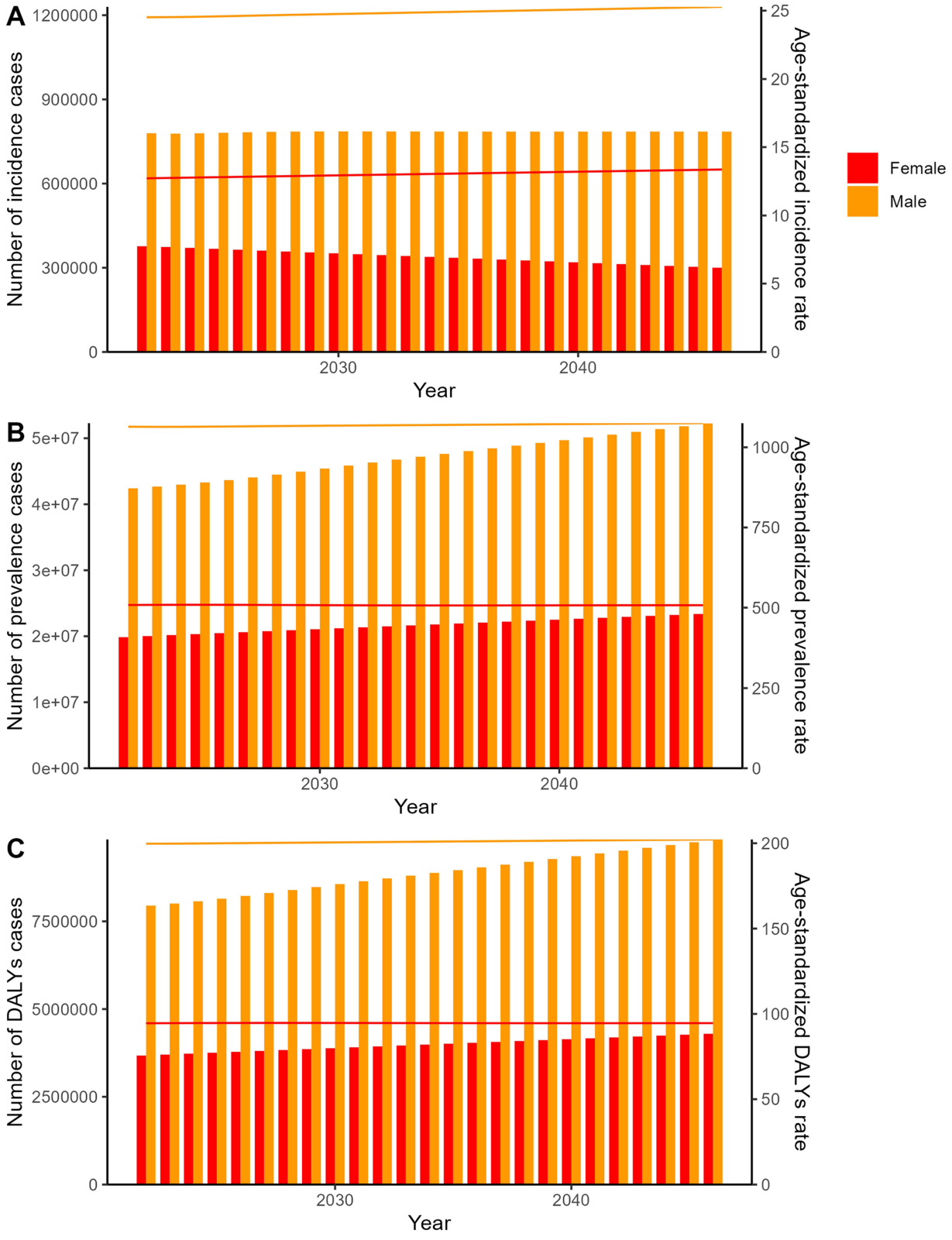

Figure 7 The global autism Age-standardized incidence, prevalence and DALYs predicted trends from 2022 to 2046 using ARIMA model. (**A**) Number of incidence cases; (**B**) Number of prevalence cases; (**C**) Number of DALYs cases.

this are worth exploring. The Caribbean region has experienced a significant decrease in prevalence over the past 30 years. Although developed regions have higher overall prevalence rates, their growth rate is not as rapid as that of underdeveloped areas. The Caribbean and Oceania are the two regions where the total number of cases has declined. This may be related to the delayed screening of ASD,[33] and it may also be associated with environmental factors. Therefore, reducing the incidence and prevalence of ASD is worthy of consideration. ASD is multifactorial, among which genetic factors play a crucial role, including fragile X syndrome, Down syndrome, Prader-Willi syndrome, genetic microdeletions, and single nucleotide polymorphisms and mutations.[34–38] In addition to these immutable genetic factors, other contributors include air pollution,[39] organophosphate and organochlorine insecticides/pesticides,[40] microplastics and additives,[41] heavy metals,[42] medications,[43] alcohol consumption,[44] diabetes mellitus,[45] maternal obesity,[46] vitamin D deficiency,[47] maternal microbiota dysfunction,[48] preeclampsia,[49] viral infections during pregnancy,[50] bacterial infections during pregnancy,[51] stress or mental disorders during pregnancy, Cesarean section, respiratory distress, and newborn seizures.[52] Regions experiencing a decrease in prevalence require further exploration.

Moreover, our study found a decreasing trend in the prevalence of ASD in Serbia, a middle-income country. Although the decrease was not significant, the prevalence was still increasing, indicating some research value. Our previous research reported an increasing prevalence in the middle-SDI regions and a decreasing prevalence in the Eastern Mediterranean Region. Mothers consuming high amounts of the Mediterranean diet have a lower incidence of neurological diseases in offspring.[53] The relationship between the Mediterranean diet and the incidence of ASD merits further investigation, and other unknown factors may have contributed to the decrease in incidence. Thailand has one of the fastest growing prevalence rates. The prevalence of ASD among children aged < 12 years in Thailand has considerably increased from 1.43 per 10,000 individuals in 1998 to 6.94 per 10,000 in 2002.[54] According to data released in 2020, Thailand currently has approximately 370,000 individuals with ASD,[55] and this increase in prevalence may be related to higher medical investments and increased screening for ASD. The continued rapid growth in the number of affected individuals in Japan may be associated with increased life expectancies and increased average maternal age.[56] Meanwhile, there may be many other unknown reasons for this.

Our study showed that the incidence of ASD in both males and females is projected to increase slightly over the next 25 years. According to our predictive models, the incidence rate in females was expected to exceed that in males by 50%. However, the two predictive models yielded inconsistent results regarding the prevalence, with one predicting an increase and the other predicting a decrease. Several factors may affect the incidence of ASD over the next 25 years. The increase in ASD could be attributed to its increasing prevalence, or more likely, it could be attributed to an increase in diagnostic reporting and assessment, as well as higher diagnosis rates among adults, females, and high-functioning individuals, indicating a greater awareness of ASD.[57] However, it is important to note that the increasing incidence of ASD may not necessarily indicate a change in its true epidemiological characteristics; rather, it reflects more accurate diagnoses and broader awareness. Therefore, future research should focus on comprehensive preventive measures for ASD, the effectiveness of social support systems, and intervention strategies, with the aim of reducing the incidence of ASD while improving the quality of life for patients.

This study had certain limitations. First, the analysis was based on data from the GBD, which means that these data were influenced by statistical information from various countries and regions worldwide. Consequently, a certain degree of error may be associated with each data point. Second, owing to differences in screening, diagnosis, and cultural factors among countries, there may be a tendency to overestimate or underestimate ASD data in certain regions. Third, the specific high-risk factors associated with numerical changes in each individual country and region could not be investigated; it presents an overview. Future studies should focus on targeted investigations in countries or regions experiencing significant changes.

Conclusions

In summary, as of 2021, the global incidence, prevalence, and number of individuals with ASD continue to increase. The growth rate of ASD incidence in female patients was higher than that in male patients. The incidence rate in high SDI countries is increasing at a slower pace than that in low-to-middle SDI countries. In the Caribbean region, both incidence

and prevalence showed a downward trend. Thailand has experienced a significant increase in ASD incidence. Given the varying situations across different regions and countries, we can adopt targeted screening and intervention measures that will enable us to provide better care for individuals with ASD.

Abbreviations

ASD, autism spectrum disorder; GBD, global burden of disease; SDI, sociodemographic index; ARIMA, autoregressive integrated moving average; ES, exponential smoothing state space; CDC, center for disease control; EAPC, estimated annual percentage change; AR, autoregression; I, integrated; MA, moving average; CI, confidence interval; DALY, disability-adjusted life years.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare no competing interests in this work.

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