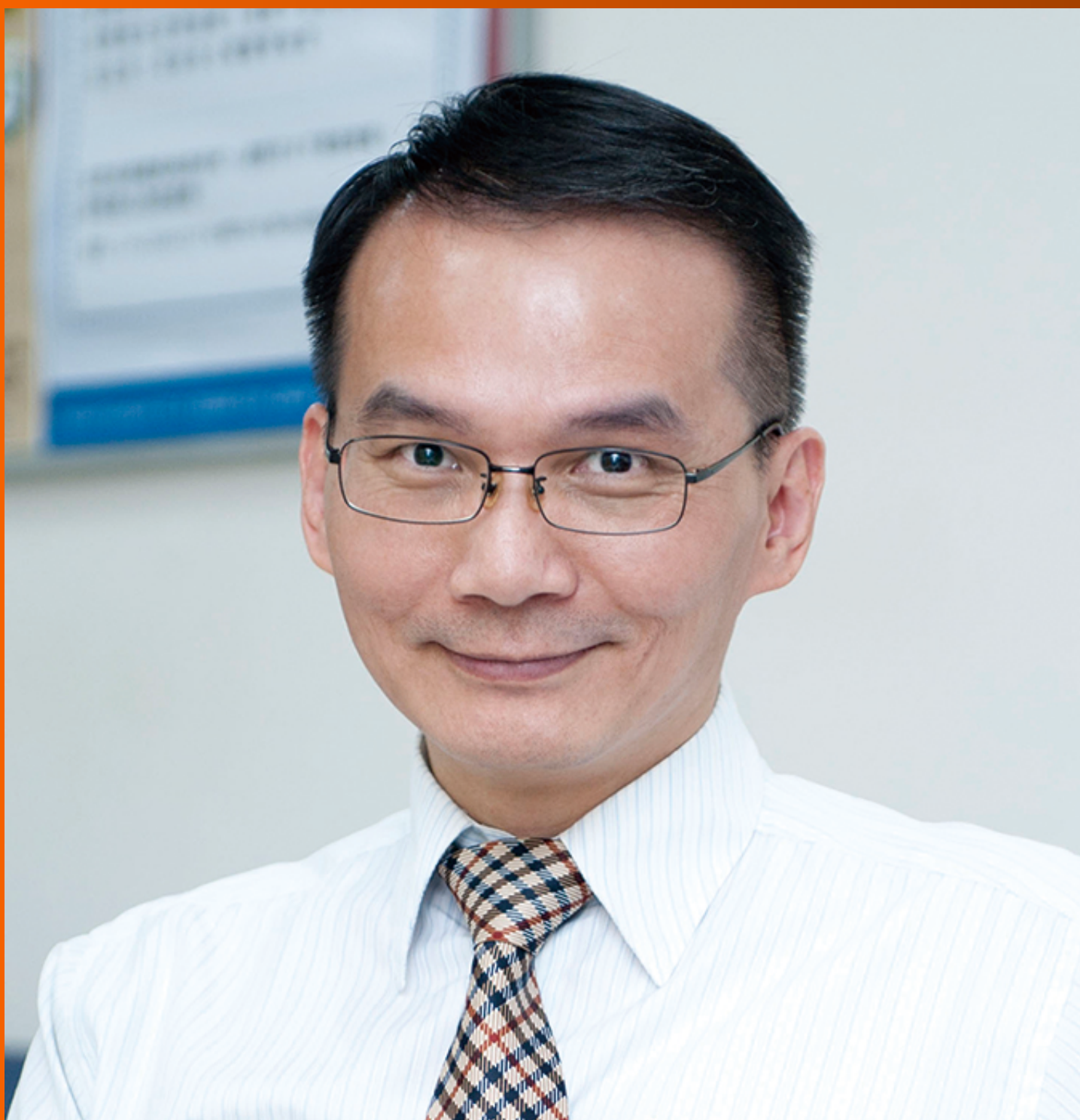


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## Retrospective Study

# Trends and prevalence of eating disorders in children and adolescents

Qi Chen, Shu Huang, Jie-Yu Peng, Huan Xu, Ping Wang, Xiao-Min Shi, Shi-Qi Li, Rui Luo, Wei Zhang, Lei Shi, Yan Peng, Xiao-Hong Wang, Xiao-Wei Tang

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## Abstract

### BACKGROUND

Eating disorders (EDs) have increasingly become a public health problem globally, especially among children and adolescents.

### AIM

To estimate the burden of EDs in children and adolescents (ages 5-19 years) at the global, regional, and national levels.

### METHODS

Retrieved from Global Burden of Disease Study 2019 for EDs, including anorexia nervosa and bulimia nervosa, we extracted the disability-adjusted life years (DALYs) and prevalence rates with 95% uncertainty intervals between 1990-2019. The temporal trends of the DALYs and prevalence rates of EDs were assessed according to the estimated annual percentage changes.

### RESULTS

In our study, we found that the burden of EDs continuously increased globally



from 1990 to 2019. Although females accounted for more EDs cases, the burden of EDs in males had a greater increment. Meanwhile, the burden of EDs was associated with the high sociodemographic index (SDI) over the past 30 years and the human development indexes in 2019.

## CONCLUSION

EDs, predominantly in high-income countries, are rising globally, especially in Asia, highlighting the need for resource planning and medical policy prioritization across all SDI quintiles.

**Key Words:** Eating disorders; Global Burden of Disease Study 2019; Children and adolescents; Epidemiology; Prevalence

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**Core Tip:** This study offered a comprehensive assessment of the global burden of eating disorders (EDs) among children and adolescents over three decades using data from the Global Burden of Disease Study 2019. We observed a continuous increase in the disability-adjusted life years and prevalence rates of anorexia nervosa and bulimia nervosa worldwide. Notably, while EDs predominantly affected females, the relative increase in burden was more significant among males. The study highlighted an association between higher sociodemographic index regions and increased EDs burden, underscoring the need for targeted healthcare strategies across varying socioeconomic landscapes.

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## INTRODUCTION

Eating disorders (EDs), which are characterized by abnormal eating habits, overconcern with body image and weight-control behaviors, are severe psychiatric illnesses that include anorexia nervosa (AN), bulimia nervosa (BN), and binge eating disorder (BED). With the highest mortality rate among all psychiatric disease, AN is a serious mental disorder typified by starvation and malnutrition[1]. BN is characterized by repetitive episodes of binge eating followed by compensatory actions to avoid weight gain[2]. In addition to the impairment in psychosocial functioning and physical health, compared with those without these disorders, people with EDs have higher health care costs, and for those who die prematurely, lost lifetime income[3].

EDs can affect people of all ages, genders, ethnicities, sexual orientations, and geographic locations. There is evidence of sex differences, as females have an 8 times greater likelihood of having AN or BN than males, and periods of elevated risk of onset, including childhood and adolescence. These disorders can lead to significant impairments in cognitive development, physical health, and psychosocial function, which can go undetected for months or even years. At the same time, there has been a 25% increase in the prevalence of EDs globally[4,5]. Thus, focusing on children and adolescents is essential for implementing early intervention strategies and improving long-term outcomes.

The Global Burden of Disease (GBD) Study 2019, a comprehensive global effort, involves the measurement of the burden of mental disorders using disability-adjusted life years (DALYs) to assess the disparity between the current health status and an ideal situation where the entire population is disease free to an advanced age.

In this study, we used GBD 2019 data to estimate the trends and annual changes in DALYs and the prevalence of EDs in children and adolescents at the regional, national, and global levels. Furthermore, we determined the association between the burden of EDs and level of development as quantified by human development indices (HDIs).

## MATERIALS AND METHODS

### Data sources

Covering 204 countries and regions, GBD 2019 offered a comprehensive assessment of the global health burden of 369 diseases and injuries from 1990 to 2019. Details on the general methods used are available on the official website (GBD, Institute for Health Metrics and Evaluation; [healthdata.org](http://healthdata.org)). The GBD 2019 divided 204 countries into 21 regions, and these countries or territories were stratified into five regions based on the sociodemographic index (SDI): Low, low-middle, middle, high-middle, and high. Furthermore, the HDIs of all countries were obtained from the official website (Human Development Index, Human Development Reports; [undp.org](http://undp.org))[6].

The burden of EDs was quantified by the rates of DALYs and prevalence rates retrieved from the Global Health Data Exchange query tool (VizHub, GBD Results; [healthdata.org](http://healthdata.org)), with 95% uncertainty intervals (95% UIs) calculated according to the GBD 2019 global age-standard population. We also described the burden of EDs subdivided type: AN

and BN.

### Definition of EDs

EDs were defined based on the criteria from the International Classification of Diseases (ICD) and the diagnostic and statistical manual of mental disorders (DSM), including different versions of the ICD (ICD-9 and ICD-10) and DSM (DSM-5, DSM-III, DSM-III-R, DSM-IV, and DSM-IV-TR). There were no EDs cases before the age of 5 years, as assumed by the GBD 2019, which was in accordance with the corresponding cause in the EDs death model. Considering that the GBD 2019 has no precisely designated age categories (*i.e.*, age < 10 is considered a child, age 10-19 is considered an adolescent), we divided the children and adolescents into three groups by age: 5-9 years, 10-14 years, and 15-19 years[7,8].

### Statistical analysis

The estimated annual percentage change (EAPC) was evaluated to clarify the secular trends in the burden of EDs more fully. When calculating the EAPC, the calendar year used as the variable X and ln (rate) used as the variable Y were fitted to a regression line:  $Y = \alpha + \beta x + \varepsilon$ , where the EAPC was calculated  $[100 \times (\exp(\beta) - 1)]$  with its 95%UI obtained from the fitted regression model. An upward trend could be considered if the EAPC > 0 and 95%UI > 0. Conversely, a downward trend could be considered if the EAPC < 0 and 95%UI < 0. Otherwise, the rates were regarded as stable.

Along with the EAPCs and HDIs in 2019, the associations between the EAPCs and rates in 1990 were assessed at the national level using Pearson's correlation analysis and scatterplots. The HDIs indicate the availability and quality of medical services in each country.

R (version 4.1.3, R core team) was used to perform all the statistical procedures. All *P* values < 0.05 were considered statistically significant.

## RESULTS

### Burden of EDs at the global level

As shown in Table 1, the DALY rate of EDs at the global level gradually increased from 11.03 (95%UI: 6.12-17.72) per 100000 people in 1990 to 12.92 (95%UI: 7.12-20.97) per 100000 people in 2019, with an EAPC of 0.68 (95%UI: 0.62-0.73; Figure 1). Moreover, an increasing trend was also observed in the prevalence rate from 116.66 (95%UI: 79.78-172.01) in 1990 per 100000 people to 137.36 (95%UI: 93.24-203.11) in 2019 per 100000 people, with an average rate of 0.68 (95%UI: 0.63-0.73; Figure 1).

As shown in Supplementary Table 1, the DALY rate of AN at the global level gradually increased from 4.99 (95%UI: 2.78-8.35) per 100000 people in 1990 to 5.66 (95%UI: 3.15-9.62) per 100000 people in 2019, indicating an increase of 0.57 (95%UI: 0.51-0.62; Supplementary Figure 1). The global prevalence rate of AN increased from 53.36 (95%UI: 34.86-79.10) per 100000 people in 1990 to 60.67 (95%UI: 39.31-89.93) per 100000 people in 2019, indicating an increase of 0.56 per year (95%UI: 0.52-0.61; Supplementary Figure 1). The DALY rate of BN at the global level gradually increased from 6.03 (95%UI: 2.91-11.14) per 100000 people in 1990 to 7.26 (95%UI: 3.51-13.60) per 100000 people in 2019 (Supplementary Table 2), with an EAPC of 0.76 (95%UI: 0.70-0.82; Supplementary Figure 2). The global prevalence rate of BN increased from 65.29 (95%UI: 35.91-112.75) per 100000 people in 1990 to 78.81 (95%UI: 43.27-136.07) per 100000 people in 2019, indicating an increase of 0.75 per year (95%UI: 0.70-0.81; Supplementary Figure 2).

The rate of DALYs [17.60 (95%UI: 9.89-28.34) *vs* 8.51 (95%UI: 4.71-14.12) per 100000 people], and prevalence [187.84 (95%UI: 128.69-278.59) *vs* 89.82 (95%UI: 60.03-134.94) per 100000 people] of EDs in 2019 among females was higher than that among males. However, men had greater increases than women did in terms of DALYs and the prevalences of EDs (Table 1), AN (Supplementary Table 1), and BN (Supplementary Table 2). We also analyzed these indices in different age groups in terms of EDs (Figure 2), AN (Supplementary Figure 3), and BN (Supplementary Figure 4). The highest DALY and prevalence rates concerning EDs and its subtypes were reported among those aged 15-19 years.

The highest DALY and prevalence rates concerning EDs and its subtypes in 2019 were found in the high-SDI region. All the SDI regions in the observed period showed an increasing trend in these indices, with the greatest increases observed in the middle-SDI and low-middle-SDI regions in terms of EDs (Figure 1), AN (Supplementary Figure 1), and BN (Supplementary Figure 2).

### Burden of EDs at the regional level

As shown in Table 1, at the regional level, Australasia recorded the highest DALY (59.45, 95%UI: 34.84-95.13 per 100000 people) and prevalence (642.40, 95%UI: 458.62-902.39 per 100000 people) rates of EDs. There was an increasing trend in all geographic regions in the past 30 years in the DALY and prevalence rates, except for Eastern Europe and Central Sub-Saharan Africa. The greatest increase in these indices was observed in East Asia (EAPC for DALYs = 1.98, 95%UI: 1.72-2.25; EAPC for prevalence = 1.97, 95%UI: 1.73-2.22), followed by South Asia (EAPC for DALYs = 1.42, 95%UI: 1.34-1.5; EAPC for prevalence = 1.44, 95%UI: 1.36-1.52).

In 2019, Australasia had the highest DALY and prevalence rates for AN (DALYs = 22.55, 95%UI: 13.12-36.74; prevalence = 243.99, 95%UI: 168.36-341.27 per 100000 people; Supplementary Table 1) and BN (DALYs = 36.90, 95%UI: 19.96-64.25; prevalence = 402.81, 95%UI: 258.27-632.07, per 100000 people; Supplementary Table 2). Similar to EDs, there was an increasing trend in all geographic regions in the past 30 years in the DALY and prevalence rates for AN and BN, except for Eastern Europe and Central Sub-Saharan Africa. The most significant increase in these indices was detected in East Asia in terms of AN (EAPC for DALYs = 1.77, 95%UI: 1.54-2.00; EAPC for prevalence = 1.73, 95%UI: 1.52-1.94) and

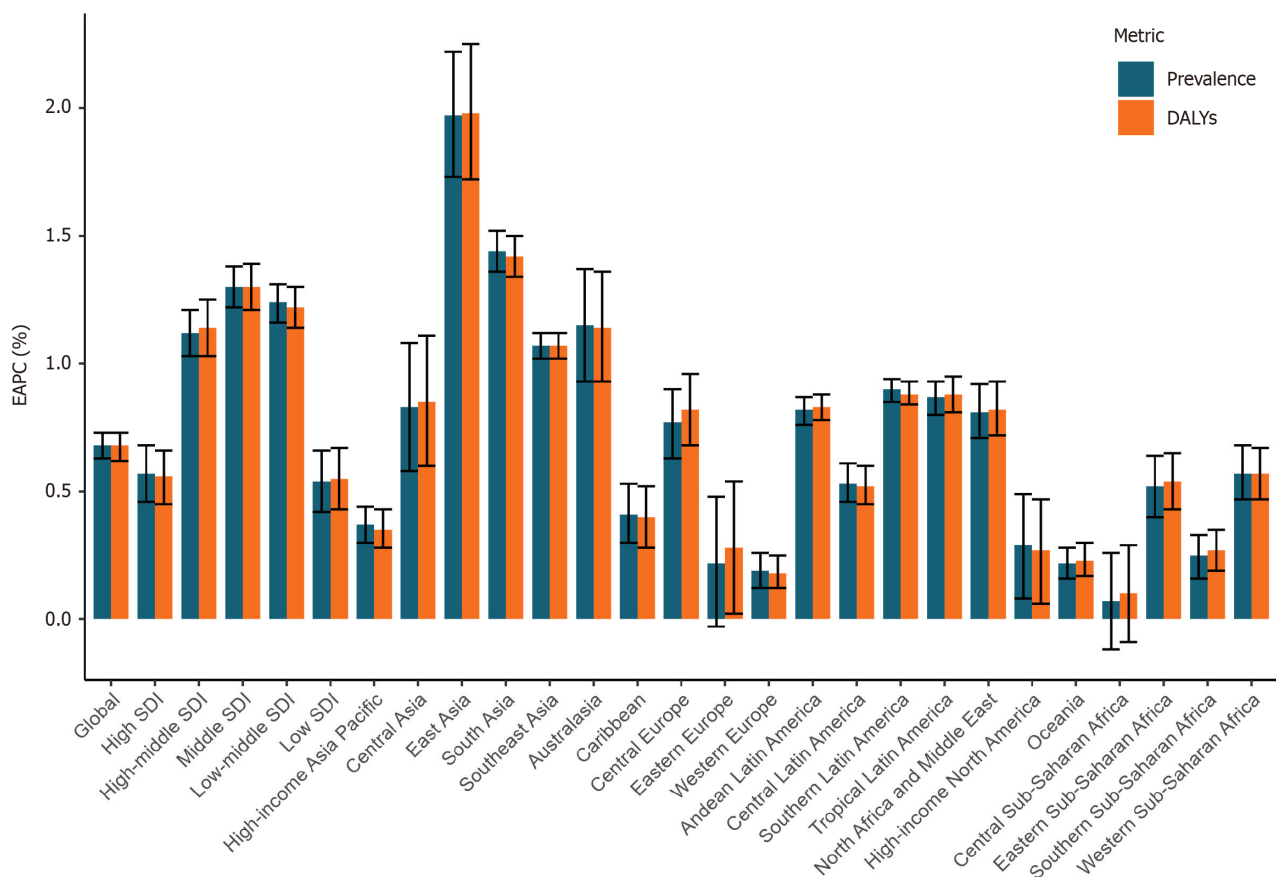


**Table 1 Rates of prevalence and disability-adjusted life-years of eating disorders in 2019 and their temporal trend from 1990 to 2019 at global and regional levels**

	Prevalence (95%UI)		DALYs (95%UI)			
	Rate in 1990 (per 100000 population)	Rate in 2019 (per 100000 population)	EAPC (1990-2019)	Rate in 1990 (per 100000 population)	Rate in 2019 (per 100000 population)	EAPC (1990-2019)
Global	116.66 (79.78-172.01)	137.36 (93.24-203.11)	0.68 (0.63-0.73)	11.03 (6.12-17.72)	12.92 (7.12-20.97)	0.68 (0.62-0.73)
Sex						
Male	74.37 (50.29-110.67)	89.82 (60.03-134.94)	0.78 (0.73-0.84)	7.09 (3.91-11.72)	8.51 (4.71-14.12)	0.78 (0.72-0.85)
Female	160.91 (111.16-237.28)	187.84 (128.69-278.59)	0.64 (0.59-0.69)	15.15 (8.57-24.17)	17.60 (9.89-28.34)	0.64 (0.58-0.69)
Aetiology						
Anorexia nervosa	53.63 (34.86-79.10)	60.67 (39.31-89.93)	0.56 (0.52-0.61)	4.99 (2.78-8.35)	5.66 (3.15-9.62)	0.57 (0.51-0.62)
Bulimia nervosa	65.29 (35.91-112.75)	78.81 (43.27-136.07)	0.75 (0.70-0.81)	6.03 (2.91-11.14)	7.26 (3.51-13.60)	0.76 (0.70-0.82)
Socio-demographic index						
High SDI	299.36 (207.55-448.68)	348.17 (239.80-519.36)	0.57 (0.46-0.68)	28.11 (16.03-45.81)	32.45 (18.25-53.04)	0.56 (0.45-0.66)
High-middle SDI	140.06 (96.78-208.68)	180.32 (122.09-268.88)	1.12 (1.03-1.21)	13.25 (7.35-21.47)	17.02 (9.44-27.79)	1.14 (1.03-1.25)
Middle SDI	92.70 (62.71-137.46)	127.24 (85.94-190.46)	1.30 (1.22-1.38)	8.82 (4.90-14.31)	12.03 (6.59-19.62)	1.30 (1.21-1.39)
Low-middle SDI	76.24 (51.53-112.46)	106.44 (72.15-158.41)	1.24 (1.16-1.31)	7.22 (4.02-11.58)	10.02 (5.54-16.18)	1.22 (1.14-1.30)
Low SDI	68.49 (46.47-100.95)	80.38 (53.89-118.39)	0.54 (0.42-0.66)	6.47 (3.58-10.44)	7.58 (4.20-12.28)	0.55 (0.43-0.67)
Region						
High-income Asia Pacific	285.39 (196.42-419.28)	320.41 (220.92-478.15)	0.37 (0.30-0.44)	27.11 (15.26-43.7)	30.48 (17.14-49.63)	0.35 (0.28-0.43)
Central Asia	92.37 (63.29-136.71)	98.59 (66.23-145.22)	0.83 (0.58-1.08)	8.79 (4.82-14.56)	9.41 (5.24-15.38)	0.85 (0.60-1.11)
East Asia	68.76 (45.77-102.21)	102.83 (68.86-153.09)	1.97 (1.73-2.22)	6.67 (3.63-10.73)	9.93 (5.55-16.12)	1.98 (1.72-2.25)
South Asia	70.42 (47.56-103.77)	105.56 (71.36-156.29)	1.44 (1.36-1.52)	6.68 (3.7-10.85)	9.93 (5.51-16.06)	1.42 (1.34-1.50)
Southeast Asia	68.95 (46.53-101.56)	94.80 (63.78-137.60)	1.07 (1.02-1.12)	6.56 (3.69-10.67)	9.01 (5.00-14.43)	1.07 (1.02-1.12)
Australasia	532.55 (358.55-822.91)	642.40 (458.62-902.39)	1.15 (0.93-1.37)	49.69 (27.35-84.76)	59.45 (34.84-95.13)	1.14 (0.93-1.36)
Caribbean	144.60 (96.82-219.61)	149.19 (102.06-223.98)	0.41 (0.3-0.53)	13.61 (7.61-21.96)	14.00 (7.67-23.33)	0.40 (0.28-0.52)
Central Europe	116.32 (78.80-175.62)	139.85 (94.41-210.18)	0.77 (0.63-0.90)	10.90 (5.94-17.80)	13.2 (7.22-21.69)	0.82 (0.68-0.96)
Eastern Europe	117.66 (79.92-175.80)	117.20 (80.21-172.70)	0.22 (-0.03-0.48)	11.29 (6.31-18.24)	11.26 (6.33-17.97)	0.28 (0.02-0.54)
Western Europe	381.80 (269.38-568.79)	400.24 (273.13-603.52)	0.19 (0.12-0.26)	35.72 (20.50-58.66)	37.28 (20.88-61.76)	0.18 (0.12-0.25)
Andean Latin America	153.87 (100.49-239.82)	190.08 (125.35-297.51)	0.82 (0.76-0.87)	14.43 (7.79-24.44)	17.91 (9.79-30.26)	0.83 (0.78-0.88)
Central Latin America	147.26 (99.41-222.31)	170.20 (116.58-255.62)	0.53 (0.46-0.61)	13.88 (7.60-22.96)	16.02 (8.79-26.23)	0.52 (0.45-0.60)

Southern Latin America	218.40 (147.13-331.21)	275.00 (181.83-418.71)	0.90 (0.85-0.94)	20.48 (11.20-34.32)	25.85 (14.07-42.95)	0.88 (0.84-0.93)
Tropical Latin America	151.49 (103.53-219.35)	188.20 (129.48-277.01)	0.87 (0.80-0.93)	14.08 (7.92-23.05)	17.48 (9.84-28.51)	0.88 (0.81-0.95)
North Africa and Middle East	148.28 (99.21-228.58)	179.56 (118.89-275.01)	0.81 (0.71-0.92)	13.88 (7.53-23.43)	16.79 (9.08-27.91)	0.82 (0.72-0.93)
High-income North America	315.82 (214.28-474.18)	356.89 (242.46-543.67)	0.29 (0.08-0.49)	29.44 (16.23-48.98)	32.87 (18.07-54.22)	0.27 (0.06-0.47)
Oceania	68.28 (44.42-100.92)	72.02 (46.08-107.19)	0.22 (0.16-0.28)	6.46 (3.58-10.67)	6.84 (3.73-11.23)	0.23 (0.17-0.30)
Central Sub-Saharan Africa	74.02 (48.53-108.66)	74.26 (49.07-111.50)	0.07 (-0.12-0.26)	6.96 (3.91-11.22)	7.01 (3.79-11.42)	0.10 (-0.09-0.29)
Eastern Sub-Saharan Africa	64.43 (43.29-95.11)	75.92 (51.59-110.99)	0.52 (0.40-0.64)	6.08 (3.40-9.80)	7.19 (4.02-11.52)	0.54 (0.43-0.65)
Southern Sub-Saharan Africa	109.01 (73.73-164.18)	114.62 (77.31-168.01)	0.25 (0.16-0.33)	10.29 (5.70-16.77)	10.84 (6.00-17.6)	0.27 (0.19-0.35)
Western Sub-Saharan Africa	75.83 (51.77-111.61)	88.52 (59.61-131.32)	0.57 (0.47-0.68)	7.18 (4.02-11.52)	8.34 (4.59-13.39)	0.57 (0.47-0.67)

EAPC: Estimated annual percentage change; DALYs: Disability-adjusted life years; 95%UI: 95% uncertainty intervals; SDI: Sociodemographic index.

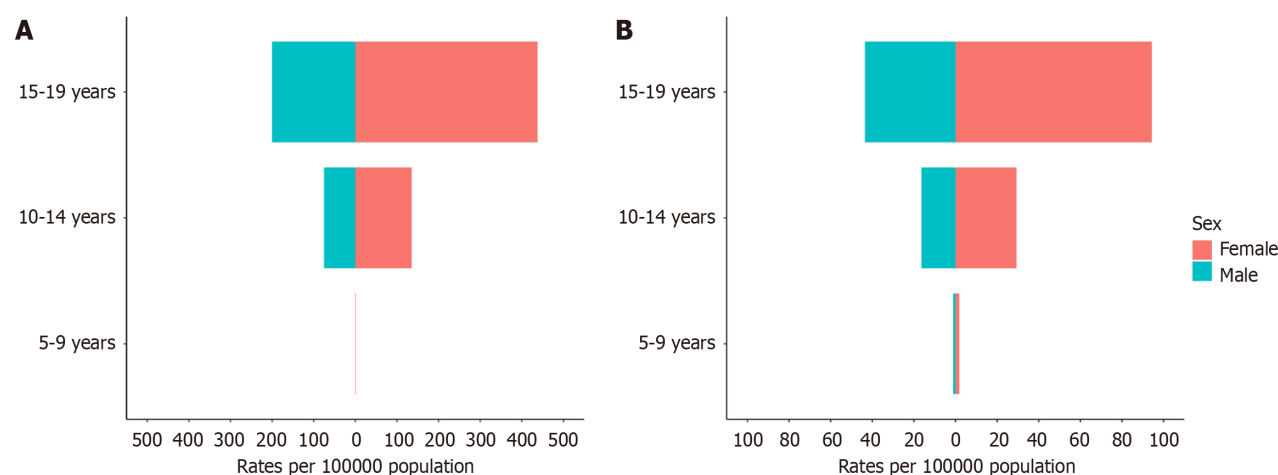


**Figure 1** Estimated annual percentage change of prevalence and disability-adjusted life years for eating disorders at the global and regional levels. EAPC: Estimated annual percentage change; DALYs: Disability-adjusted life years; SDI: Sociodemographic index.

BN (EAPC for DALYs = 2.21, 95%UI: 1.92-2.51; EAPC for prevalence = 2.19, 95%UI: 1.92-2.46), followed by South Asia.

### Burden of EDs at the national level

At the national level, as listed in [Supplementary Table 3](#), the highest DALY and prevalence rates of EDs in 2019 were reported in Monaco, followed by Australia and Spain ([Figure 3A and C](#)). An increasing trend was detected in the DALY



**Figure 2** Prevalence rates and disability-adjusted life years rates of eating disorders in different age groups globally. A: Prevalence rates; B: Disability-adjusted life years rates.

and prevalence rates of EDs in 204 countries and territories. The three countries with the greatest increase from 1990 to 2019 were Equatorial Guinea, Turkey, and China (Figure 3B and D).

As presented in Supplementary Table 4, the highest DALY and prevalence rates of AN in 2019 were found in Australia, followed by Monaco and Spain (Supplementary Figure 5A and Supplementary Figure 6A). As presented in Supplementary Table 5, Monaco, Australia, and Spain were the three countries with the highest DALY and prevalence rates of BN in 2019 (Supplementary Figure 7A and Supplementary Figure 8A). During the observed period, increasing trends were detected in the DALY and prevalence rates of AN and BN in 204 countries and territories. The three countries with the greatest increase due to AN were Equatorial Guinea, the Netherlands, and China (Supplementary Figure 5B and Supplementary Figure 6B), whereas Equatorial Guinea, Turkey, and China had the highest EAPCs in DALYs and prevalence of BN (Supplementary Figure 7B and Supplementary Figure 8B).

### Relationship between SDI levels and burden estimates of EDs

The associations between SDI levels and burden estimates of EDs for each geographic region during the observation period are presented in Figure 4; positive associations are shown. In the past 30 years, the number of SDIs has increased in all geographic regions. There was a slight increase in the burden estimates, as the SDIs increased when the SDIs were less than 0.67. Conversely, a more rapid increase with increasing SDIs was detected in burden estimates when the SDIs were above 0.67.

### Influencing factors of the EAPC

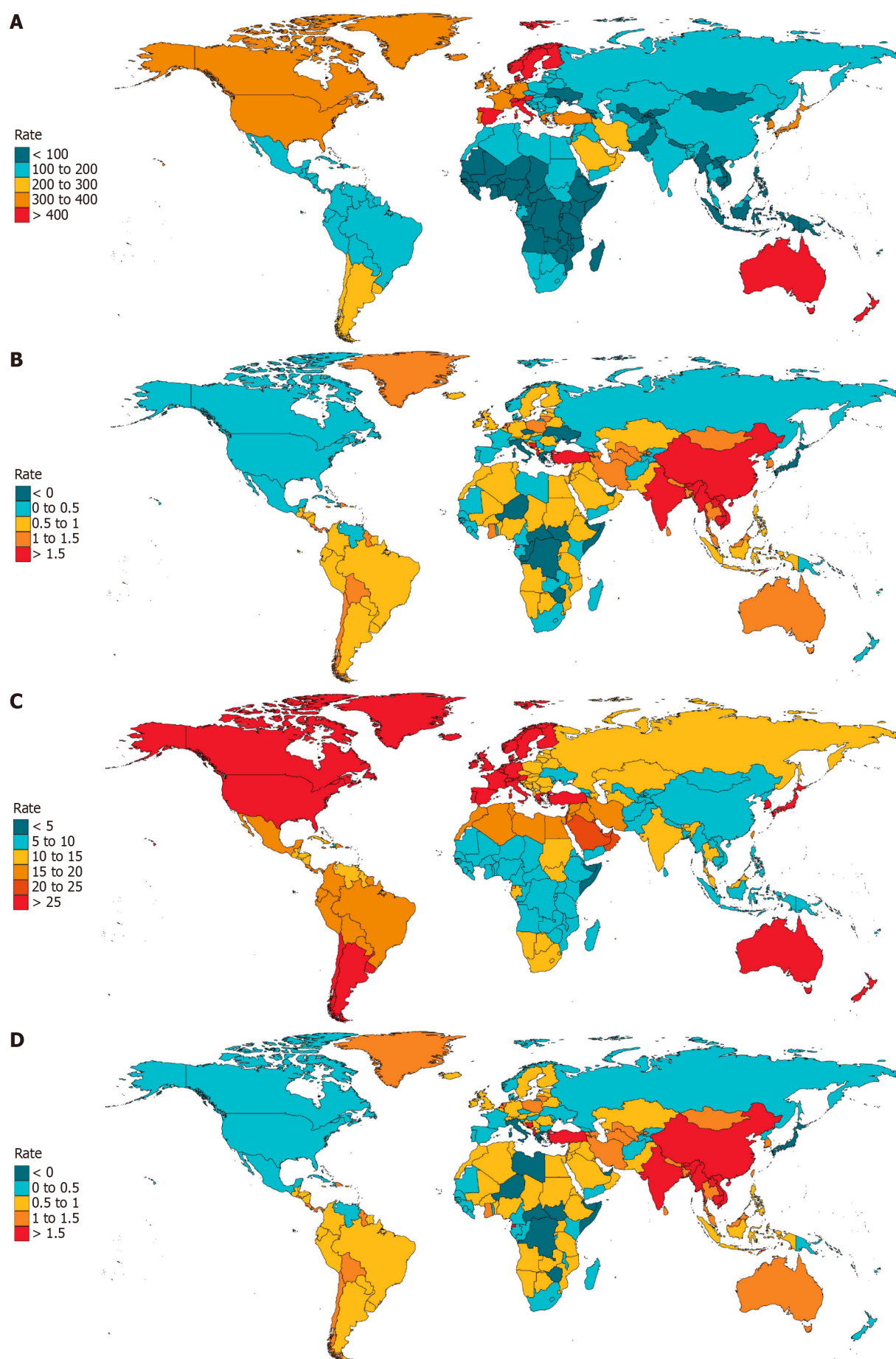
As shown in Figure 5, there was a negative association between the rates and the EAPCs in the DALY ( $\rho = -0.141$ ,  $P = 0.045$ ) and prevalence ( $\rho = -0.133$ ,  $P = 0.057$ ) rates. A positive correlation was detected between the human development indices in 2019 and the EAPCs in the DALY ( $\rho = 0.199$ ,  $P = 0.012$ ) and prevalence ( $\rho = 0.200$ ,  $P = 0.012$ ) rates of EDs when HDIs  $< 0.7$ , whereas a negative association was detected when HDIs  $> 0.7$ .

## DISCUSSION

To our knowledge, the present study is the first to explore trends in and the prevalence of EDs in children and adolescents in the past three decades based on the GBD 2019. We examined the burden of EDs in terms of DALY and prevalence rates at the regional, national, and global levels. In our study, an increasing trend was observed in the burden of EDs globally, but the rate of increase varied by gender, location, and age. Moreover, regardless of the SDI, there was an increasing trend in the burden of EDs in almost all regions, and it increased with increasing SDI. Among 204 countries and territories, an increasing trend was also detected, and the three countries with the greatest increase were Equatorial Guinea, Turkey, and China.

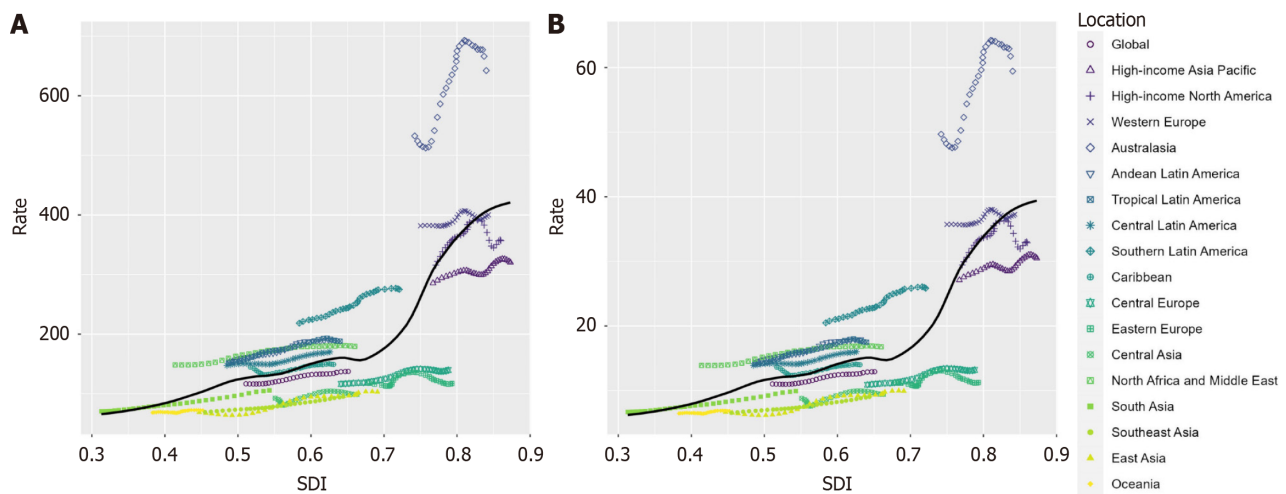
The burden of EDs has increased globally and peaks at 15-19 years among children and adolescents[9,10]. This trend is consistent with the change in the DSM-5, which includes broadened diagnostic criteria to promote inclusion[11]. Ornstein revealed that the proposed DSM-5 criteria substantially increased the prevalences of AN and BN among young patients [12]. In accordance with this increasing trend in EDs, there was a rapid increase in the overall burden of mental illness.

Economic growth may be another important factor. For example, China's rapidly developing economy and urbanization could be significant contributing factors in the development of EDs[13]. During the psychosocial developmental phase of adolescence, the incidence of EDs reaches its highest point. Several studies have demonstrated that the highest incidence rates are found in individuals aged 15-19 years, and there has been an increase in this age group over the past decades[1,14]; this may be attributed to puberty, a time of increased vulnerability to developing an EDs due to normal weight gain, which is associated with sexual maturation[15].



**Figure 3** Burden of eating disorders at the national level. A and B: Prevalence rates in 2019 (A) and the estimated annual percentage change of

prevalence rates from 1990 to 2019 (B) of eating disorders in 204 countries or territories; C and D: Disability-adjusted life years (DALY) rates in 2019 (C) and the estimated annual percentage change of DALY rates from 1990 to 2019 (D) of eating disorders in 204 countries or territories.



**Figure 4 Rates of prevalence A and disability-adjusted life years B of eating disorders by sociodemographic index from 1990 to 2019, and expected value-based sociodemographic index.** A and B: The black line represents the average expected relationship between sociodemographic index and prevalence (A) or disability-adjusted life years (B) of eating disorders based on values from all regions from 1990 to 2019. SDI: Sociodemographic index.

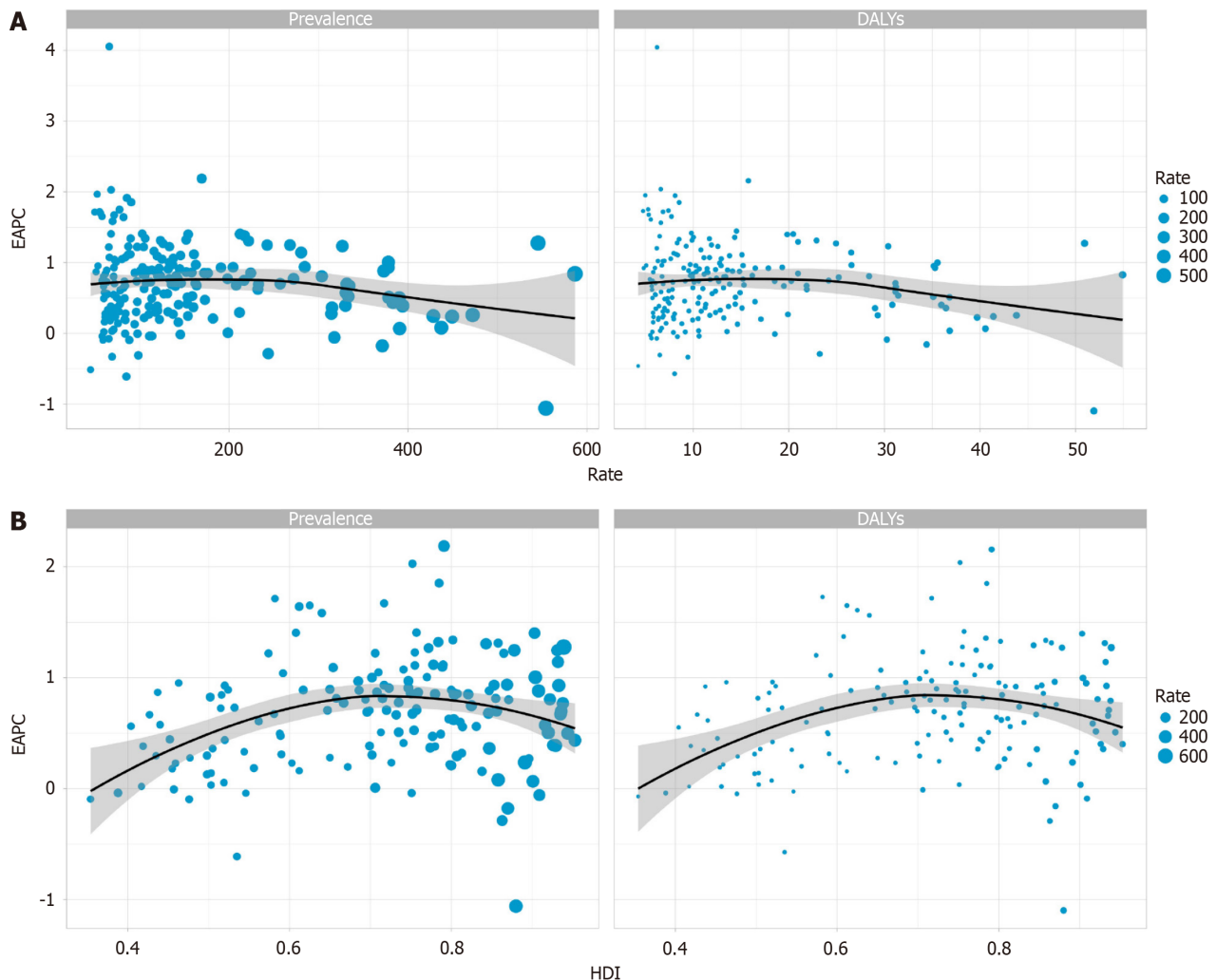
In line with previous consensus, we found that the burden of EDs was gender-related and that the DALY and prevalence rates of EDs were greater for women than men in all age groups[16-18]. Given the emphasis on attractiveness in female gender role stereotypes and the correlations between thinness, femininity, and beauty, girls may be particularly susceptible to engaging in unhealthy weight-control behaviors. Moreover, as semiclosed environments, campuses can exacerbate sociocultural pressures to maintain a thin body shape, and females are more significantly affected by these conditions[19]. Furthermore, there is ongoing debate regarding whether there is a correlation with Western culture or the contemporary influence of the media[18]. EDs were historically considered the most common gender-related mental illnesses, with females experiencing the majority of cases. However, according to recent evidence, approximately 25% of individuals with AN and BN are male, which indicates that this disease burden in male patients is a health problem that warrants attention[20].

In fact, although females still accounted for more ED cases, males had a greater increase in DALY and prevalence rates than females did. Gorrell explained why the burden of EDs has been underestimated among males[20]. First, EDs have been regarded as female phenomena, leading to the neglect of males over the past several decades of research efforts. Second, a lack of insight, denial, secrecy, and shame related to having a “female disorder” could contribute to male patients’ refusal to seek treatment. Third, the diagnostic criteria are biased toward females, resulting in low diagnostic efficiency in males. To address this gap, it is important to eliminate amenorrhea as a diagnostic criterion for AN in the DSM-5, improving the accuracy of the prevalence estimates among males[11]. Early research findings demonstrated that up to 42% of men who were diagnosed with an ED were identified as homosexual or bisexual[21,22]. Notably, given that adolescence is a crucial period in the development of gender identity and sexual orientation as well as body image disturbances, EDs may disproportionately impact vulnerable youth. Lesbian, gay, bisexual, and transgender (LGBT) youth, as indicated by the extant literature, are especially vulnerable to body dissatisfaction and EDs[23,24]. Therefore, more concern and support should be provided to male patients and LGBT youth.

The highest burdens of EDs and its subtypes were observed in the high-SDI region. This result was consistent with those of Castaldelli-Maia, who demonstrated that countries with higher SDI levels had a greater prevalence of mental and substance use disorders, indicating a greater recognition of mental disorders in developed countries as a sign of relatively greater allocation of resources toward mental health and higher education levels[25]. Another reason for the higher prevalence of these disorders in high-income Western countries, such as America, could be the development of psychiatric diagnostic criteria, which are largely impacted by local schools of psychiatry. Moreover, the validity of these psychiatric diagnostic manuals (*e.g.*, DSM-5 and ICD-10) is weak in some areas, leading to systematic differences.

Although more ED cases can be found in the industrialized Western world, a greater increase in the burden of EDs was observed in Asian countries, including China and India. Moreover, the greatest increasing trend among the five SDI regions was observed in middle-SDI regions. With almost one-fifth of the world’s population, China, which is classified as part of the middle-SDI region, is the third fastest-growing country in terms of the burden of EDs. According to Huang, China has undergone economic development and social changes at an unprecedented rate in the past 30 years, leading to tremendous changes in its urbanization, education, population structure, culture, social concept, and so on[13]. These changes may increase psychological pressure, resulting in mood, cognitive, and behavioral disorders, along with related problems[13,26]. In addition to the economic growth and urbanization in these areas, globalization could also increase the risk of exposure to risk factors. For example, another study conducted in India showed that increasing exposure to global





**Figure 5 Correlation.** A: Correlation between the estimated annual percentage change (EAPC) of prevalence rates and the prevalence rates in 1990, and the EAPC of disability-adjusted life year rates and the disability-adjusted life year rates in 1990; B: Correlation between the EAPC of prevalence rates and the human development indexes (HDI) in 2019, the EAPC of disability-adjusted life year rates and the HDIs in 2019. EAPC: Estimated annual percentage change; HDIs: Human development indexes.

body image trends may contribute to an increase in EDs[27]. Furthermore, the lack of awareness, insufficient coverage of mental health services, and stigma attached to these disorders in these areas could pose great challenges to the diagnosis, prevention, and treatment of EDs.

The burden of EDs varies across regions and countries. Although AN has historically been regarded as a possible “culture-bound syndrome” rooted in Western culture, which emphasizes body dissatisfaction and EDs, they are widespread and associated with the specific culture in which they develop. There is significant heterogeneity concerning attitudes toward body image and food across countries and ethnic groups. Traditional cultures in these countries can act as protective factors against the increasing prevalence of EDs. However, increased utilization of mass media and peer exposure can be a catalyst for the dissemination of Western-oriented values, resulting in the ineffectiveness of the protective factors mentioned above[28,29]. On the other hand, the emergence of EDs in certain regions of Asia predated Western influences, challenging such theories and underscoring the distinct phenotypic expressions of EDs that may develop without societal factors emphasizing concerns about shape and weight. For example, a study in Japan revealed that restrictive EDs were observed as early as the 18<sup>th</sup> century and that EDs symptoms can persist independently of Western influence, with sociocultural factors, such as family dynamics and gender-specific stressors, contributing to the prevalence of EDs in Japanese people[30]. In addition to culture, environmental factors can differ across countries.

It was found that the burden of EDs increases with increasing SDI, and a positive correlation was detected between HDIs and the burden of EDs. This may be due to more social pressure and greater use of electronic media in these high socioeconomic countries[25]; it could also be due to the insufficient coverage of mental health services in developing countries, leading to a relatively lower diagnosis rate[27].

This study investigated the trends and prevalences of EDs in children and adolescents and the associations with SDI over the past 30 years and HDIs in 2019. Our study revealed the increasing burden of EDs among males and LGBT youth. However, there are several limitations of our study. First, this research shared the limitations of the GBD 2019 database that which have been detailed in previous studies[31]. Whereas GBD 2019 employed several techniques to mitigate bias and inaccuracy, completely eliminating bias remains a challenge[32]. Second, only AN and BN were included in GBD



2019, whereas BED, which is one of the most prevalent EDs, was not included. The potential inclusion of BED when quantifying the burden of EDs, as the GBD is designed for continual updates, offers an opportunity to increase the accuracy of estimating the burden. Third, considering the diversity of cultures, different results may be obtained when the same diagnostic tools are used across cultures. Therefore, the development of diagnostic criteria needs to consider cultural factors[33].

## CONCLUSION

Although the greatest burden of EDs remains in high-income Western countries, a global increase was observed across all SDI regions, particularly in Asia. These results are helpful for resource planning and medical policy prioritization.

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## FOOTNOTES

**Author contributions:** Tang XW and Chen Q contributed to study conception and design; Chen Q, Huang S, Peng JY, Xu H, Wang P and contributed to drafting of manuscript; Shi XM, Li SQ, Luo R, Zhang W, Shi L, Peng Y, and Wang XH contributed to acquisition of data and critical revision; Tang XW and Chen Q contributed to revision of manuscript and final approval of manuscript; and all authors have read and approved the final manuscript. Chen Q and Huang S contributed equally to this work as co-first authors; Wang XH and Tang XW contributed equally to this work as co-corresponding authors. The reasons for designating Wang XH and Tang XW as co-corresponding authors are their significant contributions to the study's design and methodology, their active involvement in data interpretation.

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