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Burden of digestive congenital anomalies among children aged 0–14 years in 204 countries and territories, 1990–2021: results from the Global Burden of Disease Study 2021

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ABSTRACT

Objectives We aim to delineate the digestive congenital abnormalities burden in children under 14 years old between 1990 and 2021.

Design We implemented data from the Global Burden of Disease (GBD) 2021 database to evaluate digestive congenital abnormalities burden with different measures in 204 countries and territories from 1990 to 2021. We present precise estimations with 95% uncertainty intervals. In addition, we computed the estimated annual percentage change (EAPC) to examine the temporal patterns of these indicators.

Setting It uses prevalence, deaths and disability-adjusted life years (DALYs) data from the GBD study to analyse this issue.

Participants Patients with digestive congenital abnormalities diagnosis.

Outcomes Total numbers, age-standardised rates (ASRs) of prevalence, mortality and DALYs and their EAPCs were the main outcomes among children aged 0–14 years.

Results In 2021, 2206.79 thousand prevalent cases were reported worldwide, with digestive congenital anomalies accounting for 47.16 thousand deaths and 4324.56 thousand DALYs among children aged 0–14 years. Digestive congenital anomalies prevalence was mitigated by 8.15% between 1990 and 2021, with the global ASR of prevalence declining to 40.09 per 100 000. Digestive congenital anomalies mortality was mitigated by 35.35% between 1990 and 2021, with an ASR of deaths declining to 0.77 per 100 000. The worldwide burden of digestive congenital anomalies decreased by 34.96% in terms of DALYs from 1990 to 2021, with an ASR of 70.44 DALYs per 100 000 population. There was a significant hindrance in the prevalence, particularly among older children. The likelihood of digestive congenital abnormalities peaked during infancy (2–4 years) in all regions.

Conclusion We highlight promising global declines in the digestive congenital anomalies burden among children over the past 32 years. Prevalence, deaths and DALYs associated with these anomalies have shown consistent decreases, although regional variations persist. These findings offer crucial insights for shaping effective prevention and management strategies for paediatric digestive congenital anomalies.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study uses comprehensive data from the Global Burden of Disease (GBD) Study 2021.
⇒ The analysis covers a period of 32 years of digestive congenital anomalies, providing long-term trends.
⇒ One of the limitations is that, within the GBD database, the availability and quality of data varied by location and time.
⇒ Another limitation is the significant heterogeneity among countries in terms of disease definitions, diagnoses, healthcare services, coding practices and cultural factors, which may affect disease estimates.
⇒ The third limitation is that broad exposure measures like the sociodemographic index may not fully capture the social complexities within countries.

INTRODUCTION

Based on prior research on the Global Burden of Disease (GBD) data, congenital birth abnormalities are the fourth prevailing cause of mortality among children under the age of 5, encompassing around 10% of all deaths within this age group.[1] According to the WHO, the estimated worldwide occurrence of congenital abnormalities varies between 1% and 5%, based on the region and the particular population under investigation.[2] While the overall death rate linked to congenital defects is declining, congenital malformations account for roughly 17%–42% of newborn mortalities.[3] Digestive congenital anomalies are a common group of serious conditions that significantly impact the health of children. These abnormalities can occur at any point along the digestive tract, from the oesophagus to the anus. The types of diseases are diverse, including oesophageal atresia, duodenal atresia or stenosis and anorectal atresia and stenosis, among others.[4] Congenital malformations in the digestive system might result in death if not promptly

treated with surgery. Therefore, a multidisciplinary approach is necessary to ensure appropriate therapy for these disorders.[5] Typically, children who have congenital defects affecting their digestive system are prone to have delays in their development, issues with eating and other concerns. Feeding difficulties in newborns may result from challenges in swallowing or digesting food, while delayed or mitigated gastrointestinal digestive function could cause problems, including constipation, diarrhoea and different digestive concerns. Consequently, these problems might lead to malnutrition and an inability to thrive. Moreover, surgical intervention for congenital defects affecting the digestive system might also have an influence on a child's growth and development.[6]

An analysis of very underweight newborns found that the most common forms of congenital defects were associated with the digestive system (31.7%) and the heart (27.7%).[7] Between 2008 and 2012, the European Surveillance of Congenital Anomalies reported a rate of 2.1 instances per 10 000 live births for significant congenital gastrointestinal abnormalities. Anorectal abnormalities, such as anal atresia and/or stenosis, were the most prevalent subgroup. This was followed by oesophageal atresia with or without tracheoesophageal fistula, diaphragmatic hernia, Hirschsprung disease and duodenal atresia or stenosis.[8] Gastroschisis (GS) and omphalocele (OC) are the two most often congenital abnormalities of the abdominal wall. The prevalence of GS is around 4.5 per 10 000 live births, whereas the OC incidence ranges from 0.6 to 4.8 per 10 000 live births. In contrast to other congenital anomalies, there has been an increasing occurrence of GS in recent years.[9] GS is often an isolated abnormality, and the prognosis is influenced by the overall condition of the prolapsed bowel loops. On the contrary, OC is often linked to different abnormalities encompassing chromosomal or cardiac anomalies, as well as syndromes encompassing pentalogy of Cantrell and Beckwith–Wiedemann syndrome.[10] There is a potential link between the occurrence of abdominal wall abnormalities and maternal smoking, with a positive correlation. Conversely, there is a negative correlation between the occurrence of these defects and maternal age and socioeconomic position.[11]

Currently, there are studies focusing specifically on digestive congenital anomalies in certain countries, including one from South Korea[12] and another from Malaysia.[13] So, there is a lack of additional relevant research that provides information on the worldwide status of this disease. The GBD study is an accessible database that offers a systematic scientific evaluation of the global occurrence and implication on the life quality of 369 conditions measured in disability-adjusted life years (DALYs).[14] We aim to use the latest GBD dataset from 1990 to 2021 to understand the global disease burden of digestive congenital anomalies. These findings will support and strengthen the theoretical basis for personalised intervention strategies tailored to the needs of national healthcare systems and individual patients. The outcomes of our investigation will improve our comprehension of the burden and aid in the creation of efficient approaches for the prevention and management of this condition.

METHODS

Study data

The statistics on congenital malformations of the digestive system from 1990 to 2021 were acquired from the Global Health Data website (https://vizhub.healthdata.org/gbd-results/). All statistics as values coupled with 95% uncertainty intervals (UI) derived from 100 000 simulations were presented with the GBD 2021 research. The data for analysis were selected based on the following selection criteria. The research period was initially established as 1990–2021. Furthermore, the location name was established to incorporate 'Global', 'the 21 geographic locations', 'sociodemographic index (SDI) areas' and 'the 204 countries or territories'.[15] Furthermore, the reason was determined to be 'digestive congenital anomalies'. The assessment index for measuring the burden of digestive congenital abnormalities was determined to be the 'prevalence', 'deaths' and 'DALYs'. Ultimately, the age variable was divided into five distinct categories: less than 1 year, 2–4 years, 5–9 years, 10–14 years and 0–14 years (online supplemental file 1).

Definitions

Age-standardised rate

ASR used the GBD 2021 global age-standardised population as its foundation. The ASR of this research primarily encompassed ASR of prevalence and DALYs.[16]

Disability-adjusted life years

In the GBD 2021 project, the worldwide syphilis burden was assessed with DALYs, which is a metric that integrates the number of years lived with a disability and the number of years lost.[16]

Sociodemographic index

The SDI is a composite measure that indicates the level of economic and social advancement. It is derived from factors, such as education, average income and overall fertility rate under the age of 25.[17] In the GBD 2021, countries and territories were categorised into five quintiles based on their SDI: low, low-middle, middle, high-middle and high.[18]

Estimated annual percentage change (EAPC)

The EAPC and 95% CIs were determined by calculating the average annual percentage change in ASR from 1990 to 2021. An increasing trend in the ASR was determined if both the EAPC and the lower 95% CI limit were positive. On the other hand, if both the EAPC and the upper 95% CI limit were negative, the ASR was deemed to have a declining trend. However, ASR was considered to be consistently stable throughout time.

Statistical analysis

The data were obtained from the GBD database and analysed with R software version 4.3.3 (https://www.R-project.

Table 1 Prevalent cases for digestive congenital anomalies among aged 0–14 years in 2021, the percentage change in ASRs per 100 000 and EAPC by GBD region, from 1990 to 2021 (generated from the data available at https://vizhub.healthdata.org/gbd-results/)

	Prevalence (95% UI)			
	No, in thousands (95% UI)	ASRs per 100 000 (95% UI)	Percentage change in ASRs from 1990 to 2021	EAPC (1990–2021) (95% UI)
Global	2206.79 (1734.74 to 2735.1)	45.09 (36.64 to 54.19)	−8.15 (−14.04 to −1.8)	−0.27 (−0.32 to −0.23)
High-income Asia Pacific	24.06 (19.02 to 29.12)	48.56 (39.22 to 57.38)	−3.48 (−8.82 to 2.6)	−0.06 (−0.21 to 0.09)
High-income North America	68.6 (55.33 to 83.42)	47.04 (39.49 to 54.44)	−6.4 (−13.89 to 1.88)	−0.07 (−0.15 to 0.01)
Western Europe	78.19 (63.87 to 94.89)	51.54 (42.75 to 61.21)	−8.17 (−13.16 to −3.71)	−0.32 (−0.34 to −0.3)
Australasia	3.98 (3.11 to 4.89)	28.28 (22.96 to 33.56)	−5.94 (−15.04 to 3.87)	−0.53 (−0.63 to −0.43)
Andean Latin America	29.54 (23.13 to 37.63)	68.49 (54.93 to 83.79)	10.19 (−0.71 to 23.29)	0.27 (0.18 to 0.36)
Tropical Latin America	107.38 (86.11 to 132.64)	86.52 (70.56 to 103.38)	−7.68 (−16.5 to 2.16)	−0.25 (−0.28 to −0.21)
Central Latin America	81.46 (65.23 to 98.93)	54.26 (44.66 to 64.09)	11.16 (3.07 to 20.64)	0.32 (0.22 to 0.43)
Southern Latin America	18.27 (14.28 to 22.31)	52.54 (42.72 to 62.11)	38.05 (22.34 to 56.25)	0.92 (0.76 to 1.08)
Caribbean	19.3 (15.23 to 24.06)	67.86 (55.53 to 81.41)	−11.15 (−18.02 to −4.66)	−0.41 (−0.48 to −0.33)
Central Europe	15.63 (12.26 to 19.01)	36.23 (29.74 to 42.78)	−16.3 (−21.91 to −9.85)	−0.56 (−0.6 to −0.53)
Eastern Europe	37.63 (29.96 to 46.25)	47.5 (38.41 to 56.18)	−7.63 (−12.38 to −2.63)	−0.29 (−0.38 to −0.21)
Central Asia	39.57 (31.18 to 49.68)	58.77 (47.54 to 70.44)	9.98 (1.59 to 18.99)	0.39 (0.34 to 0.44)
North Africa and Middle East	212.13 (167.12 to 262.39)	50.57 (40.88 to 59.51)	−10.55 (−18.88 to −2.04)	−0.41 (−0.46 to −0.37)
South Asia	470.43 (364.27 to 595.31)	39.49 (31.32 to 48.78)	−11.43 (−20.06 to −1.83)	−0.32 (−0.4 to −0.25)
Southeast Asia	169.27 (133.05 to 209.26)	40.47 (32.89 to 48.29)	−2.48 (−11.28 to 7.3)	−0.14 (−0.18 to −0.09)
East Asia	277.1 (209.16 to 345.5)	40.06 (31.76 to 48.82)	−10.47 (−20.82 to 3.17)	−0.2 (−0.29 to −0.12)
Oceania	5.3 (4.08 to 6.75)	41.59 (33.21 to 51.15)	7.53 (−1.71 to 19.49)	0.18 (0.08 to 0.27)
Western sub-Saharan Africa	269.66 (207.96 to 334.32)	48.18 (38.88 to 57.8)	−4.58 (−11.78 to 3.72)	−0.26 (−0.35 to −0.17)
Eastern sub-Saharan Africa	194.24 (152.15 to 242.44)	43.2 (35.14 to 52.54)	−17.39 (−24.99 to −8.04)	−0.6 (−0.66 to −0.53)
Central sub-Saharan Africa	61.89 (48.28 to 78.81)	42.45 (34.53 to 51.86)	−18.82 (−29.16 to −6.85)	−0.76 (−0.85 to −0.67)
Southern sub-Saharan Africa	23.17 (18.29 to 28.69)	41.74 (33.86 to 49.87)	2.48 (−4.34 to 11.58)	0.14 (0 to 0.27)

ASRs, age-standardised rates; EAPC, estimated annual percentage change; GBD, Global Burden of Disease; 95% UI, 95% uncertainty interval.

org/). Subgroup analysis was conducted based on sex, age, SDI, 21 geographic locations and 204 countries.

RESULTS

Global level

In 2021, 2206.79 thousand recorded instances of digestive congenital abnormalities worldwide, as shown in table 1. The age-standardised point prevalence was 45.09 per 100 000, which is a drop of 8.15% compared with 1990. In 2021, there were 47.16 thousand fatalities caused by digestive congenital abnormalities, with an ASR of 0.77. This is a reduction of 35.35% compared with 1990 (table 2). The worldwide number of DALYs for digestive congenital abnormalities in 2021 was 4324.56 thousand, with an ASR of 70.44 DALYs per 100 000. This represents a 34.96% reduction compared with 1990 (table 3).

Regional level

In 2021, Tropical Latin America (86.52), Andean Latin America (68.49) and Caribbean (67.86) possessed the greatest age-standardised point prevalence for digestive congenital anomalies (per 100 000), whereas Australasia (28.28) , Central Europe (36.23) and South Asia (39.49) had the lowest (table 1). Western sub-Saharan Africa (1.58), Caribbean (1.27) and Central Latin America (1.03) experienced the greatest age-standardised death rates from digestive congenital anomalies in 2021, with

Table 2 Deaths for digestive congenital anomalies among aged 0–14 years in 2021, the percentage change in ASRs per 100 000 and EAPC by GBD region, from 1990 to 2021 (generated from the data available at https://vizhub.healthdata.org/gbd-results/)

	Deaths (95% UI)			
	No, in thousands (95% UI)	ASRs per 100 000 (95% UI)	Percentage change in ASRs from 1990 to 2021	EAPC (1990–2021) (95% UI)
Global	47.16 (35.18 to 59.03)	0.77 (0.58 to 0.96)	−35.35 (−57.49 to 16.74)	−1.26 (−1.31 to −1.2)
High-income Asia Pacific	0.08 (0.06 to 0.11)	0.15 (0.11 to 0.2)	−68.46 (−79.51 to −53.29)	−3.4 (−3.65 to −3.15)
High-income North America	0.41 (0.32 to 0.49)	0.22 (0.17 to 0.26)	−33.36 (−53.44 to −20.95)	−0.79 (−0.97 to −0.6)
Western Europe	0.34 (0.28 to 0.42)	0.18 (0.15 to 0.22)	−63.49 (−73.63 to −53.63)	−2.99 (−3.13 to −2.86)
Australasia	0.02 (0.02 to 0.04)	0.15 (0.11 to 0.23)	−71.45 (−78.39 to −59.18)	−3.67 (−3.96 to −3.39)
Andean Latin America	0.59 (0.41 to 0.78)	1.01 (0.71 to 1.34)	−48.04 (−71.69 to 7.32)	−1.57 (−1.73 to −1.41)
Tropical Latin America	1.29 (1.02 to 1.64)	0.81 (0.64 to 1.01)	−21.46 (−44.19 to 8.6)	−0.16 (−0.59 to 0.27)
Central Latin America	1.89 (1.4 to 2.46)	1.03 (0.77 to 1.33)	−8.57 (−39.06 to 27.09)	0 (−0.14 to 0.14)
Southern Latin America	0.24 (0.18 to 0.3)	0.64 (0.48 to 0.8)	−33.82 (−52.08 to −12.47)	−1.15 (−1.35 to −0.95)
Caribbean	0.48 (0.28 to 0.77)	1.27 (0.75 to 2.03)	−31.65 (−54.14 to 11.32)	−1.02 (−1.2 to −0.83)
Central Europe	0.14 (0.11 to 0.18)	0.28 (0.22 to 0.35)	−74.11 (−83.17 to −61.55)	−4.24 (−4.41 to −4.08)
Eastern Europe	0.29 (0.21 to 0.38)	0.34 (0.25 to 0.45)	−72.05 (−81.14 to −58.57)	−4.65 (−5.04 to −4.26)
Central Asia	0.6 (0.48 to 0.77)	0.62 (0.49 to 0.8)	−21.41 (−40.02 to 6.22)	−0.67 (−0.99 to −0.35)
North Africa and Middle East	4.2 (2.87 to 5.52)	0.74 (0.5 to 0.97)	−62.97 (−78.95 to −10.76)	−2.96 (−3.04 to −2.88)
South Asia	9.51 (5.32 to 15.99)	0.64 (0.37 to 1.08)	−34.19 (−63.5 to 49.35)	−1.11 (−1.22 to −1)
Southeast Asia	3.3 (2.19 to 4.52)	0.62 (0.41 to 0.85)	−31.27 (−59.27 to 61)	−1.25 (−1.33 to −1.17)
East Asia	2.45 (1.53 to 3.64)	0.43 (0.27 to 0.64)	−65.73 (−84.05 to −19.77)	−3.9 (−4.08 to −3.72)
Oceania	0.06 (0.02 to 0.14)	0.29 (0.11 to 0.71)	−4.73 (−43.78 to 55.25)	−0.15 (−0.34 to 0.04)
Western sub-Saharan Africa	12.74 (7.89 to 17.46)	1.58 (1.01 to 2.17)	−20.1 (−44.56 to 76.76)	−0.39 (−0.5 to −0.27)
Eastern sub-Saharan Africa	6.52 (3.51 to 10.59)	1.02 (0.59 to 1.66)	−39.48 (−65.46 to 59.58)	−1.3 (−1.43 to −1.18)
Central sub-Saharan Africa	1.62 (0.86 to 2.83)	0.78 (0.43 to 1.36)	−50.4 (−71.5 to 25.5)	−2.07 (−2.21 to −1.93)
Southern sub-Saharan Africa	0.39 (0.21 to 0.62)	0.52 (0.29 to 0.83)	−18.18 (−47.53 to 15.54)	−0.61 (−0.75 to −0.48)

ASRs, age-standardised rates; EAPC, estimated annual percentage change; GBD, Global Burden of Disease; 95% UI, 95% uncertainty interval.

the lowest rates in high-income Asia Pacific (0.15), Australasia (0.15) and Western Europe (0.18) (table 2). In 2021, Western sub-Saharan Africa (140.99), Caribbean (116.09) and Central Latin America (93.06) experienced the greatest age-standardised DALYs per 100 000. On the other hand, Australasia (14.24), high-income Asia Pacific (14.75) and Western Europe (18.35) had the lowest rate (table 3). Online supplemental tables 1–3 show the age-standardised point prevalence, mortality and DALY rates of digestive congenital abnormalities, respectively, categorised by gender in the year 2021. These tables include data from all regions and countries that comprise the GBD research. The prevalence, deaths and DALY rates due to digestive congenital anomalies have shown a decreasing trend across all regions and countries worldwide.

The largest decreases in the age-standardised point prevalence of digestive congenital anomalies from 1990 to 2021 were found in Central sub-Saharan Africa (−18.82%), Eastern sub-Saharan Africa (−17.39%) and Central Europe (−16.3%), with the greatest increases in Southern Latin America (38.05%), Central Latin America (11.16%) and Andean Latin America (10.09%) (table 1). In the same period, all regions showed a decrease in the age-standardised death rates from digestive congenital

Table 3 DALYs for digestive congenital anomalies among aged 0–14 years in 2021, the percentage change in ASRs per 100 000 and EAPC by GBD region, from 1990 to 2021 (generated from the data available at https://vizhub.healthdata.org/gbd-results/)

	DALYs (95% UI)			
	No, in thousands (95% UI)	ASRs per 100 000 (95% UI)	Percentage change in ASRs from 1990 to 2021	EAPC (1990–2021) (95% UI)
Global	4324.56 (3246.58 to 5390.46)	70.44 (53.14 to 87.6)	−34.96 (−57.06 to 15.48)	−1.24 (−1.29 to −1.19)
High-income Asia Pacific	8.16 (6.28 to 10.85)	14.75 (11.46 to 19.35)	−65.6 (−77.02 to −50.89)	−3.14 (−3.36 to −2.91)
High-income North America	40.1 (31.73 to 47.45)	21.68 (17.25 to 25.44)	−31.79 (−51.19 to −20.16)	−0.74 (−0.92 to −0.57)
Western Europe	34.49 (28.94 to 42.73)	18.35 (15.45 to 22.59)	−60.66 (−71.23 to −51.22)	−2.78 (−2.92 to −2.65)
Australasia	2.35 (1.83 to 3.51)	14.24 (11.25 to 21.14)	−69.76 (−76.79 to −57.84)	−3.53 (−3.79 to −3.26)
Andean Latin America	53.93 (38.13 to 71.83)	92.32 (65.51 to 122.41)	−47.44 (−71.19 to 7.27)	−1.54 (−1.7 to −1.38)
Tropical Latin America	120.66 (95.77 to 151.6)	74.54 (59.73 to 92.91)	−21.61 (−43.62 to 6.67)	−0.19 (−0.61 to 0.23)
Central Latin America	172.87 (128.91 to 224.32)	93.06 (69.56 to 120.37)	−8.58 (−38.73 to 26.53)	−0.01 (−0.14 to 0.13)
Southern Latin America	22.12 (16.98 to 27.67)	59.39 (45.76 to 74.21)	−32.51 (−50.78 to −11.39)	−1.1 (−1.3 to −0.9)
Caribbean	43.69 (26.14 to 69.73)	116.09 (70.06 to 184.27)	−31.12 (−53.54 to 11.44)	−0.99 (−1.17 to −0.82)
Central Europe	13.28 (10.44 to 16.54)	26.49 (20.89 to 32.86)	−72.99 (−82.12 to −60.39)	−4.12 (−4.27 to −3.96)
Eastern Europe	27.42 (20.62 to 36.02)	31.88 (24.29 to 41.44)	−71.04 (−80.14 to −57.73)	−4.54 (−4.91 to −4.16)
Central Asia	55.81 (44.31 to 71.01)	57.85 (46.1 to 73.44)	−20.36 (−38.8 to 6.4)	−0.63 (−0.93 to −0.33)
North Africa and Middle East	385.82 (268.91 to 506.2)	67.85 (47.56 to 88.75)	−62.35 (−78.36 to −10.86)	−2.91 (−2.99 to −2.83)
South Asia	875.77 (498.39 to 1459.05)	58.84 (33.86 to 97.43)	−33.89 (−63.13 to 47.19)	−1.1 (−1.21 to −0.99)
Southeast Asia	303.11 (203.61 to 413.26)	56.7 (38.26 to 77.26)	−30.64 (−58.62 to 58.94)	−1.22 (−1.3 to −1.14)
East Asia	232.39 (148.76 to 340.92)	40.15 (25.59 to 59.03)	−64.86 (−83.36 to −19.65)	−3.81 (−3.98 to −3.63)
Oceania	5.44 (2.14 to 13.12)	28.02 (11.77 to 65.82)	−4.07 (−41.76 to 51.97)	−0.13 (−0.31 to 0.05)
Western sub-Saharan Africa	1151.28 (718.89 to 1575.46)	140.99 (88.96 to 192.78)	−20.05 (−44.28 to 76.91)	−0.38 (−0.5 to −0.27)
Eastern sub-Saharan Africa	592 (325.22 to 955.78)	92.69 (52.8 to 148.72)	−39.22 (−64.98 to 56.04)	−1.29 (−1.41 to −1.17)
Central sub-Saharan Africa	148.02 (79.98 to 256.28)	71.28 (39.19 to 122.63)	−50.1 (−70.99 to 21.87)	−2.06 (−2.2 to −1.92)
Southern sub-Saharan Africa	35.85 (20.28 to 56.53)	47.51 (27.27 to 74.32)	−18.12 (−46.68 to 14.53)	−0.61 (−0.74 to −0.48)

ASRs, age-standardised rates; DALYs, disability-adjusted life years; EAPC, estimated annual percentage change; GBD, Global Burden of Disease; 95% UI, 95% uncertainty interval.

anomalies, with the largest decreases in Central Europe (−74.11%), Eastern Europe (−72.05%) and Australasia (−71.45%) (table 2). The age-standardised DALYs decreased in all regions from 1990 to 2021, with the largest decreases in Central Europe (−72.99%), Eastern Europe (−71.04%) and Australasia (−69.76%) (table 3).

National level

In 2021, the national age-standardised point prevalence of digestive congenital anomalies spanned from 36.6 to 54.2 instances per 100 000. Brazil (86.7), Plurinational State of Bolivia (86.2) and the Cuba (83.4) possessed the greatest age-standardised point prevalences of digestive congenital anomalies, with Australia (24.6), Czechia (27.8) and Montenegro (29.1) having the lowest estimates (figure 1 and online supplemental table S1). In 2021, the national age-standardised mortality rates for digestive congenital abnormalities ranged from 0.6 to 1 death per 100 000 people. The highest rates were seen in Burkina Faso (2.0), Haiti (1.9), Bolivia (1.8), Mali (1.8), Nigeria (1.8), Sierra Leone (1.8) and South Sudan (1.8), whereas the lowest rates were found in Northern Mariana Islands (0.05), Estonia (0.1), Andorra (0.1) and Luxembourg (0.1) (figure 2 and online supplemental table S2). In 2021, the national age-standardised DALYs of digestive congenital anomalies ranged from 53.1 to 87.6 patients per 100 000. The highest rates were seen in Burkina Faso (174.5), Haiti (169.4) and Bolivia (166.3), whereas the lowest rates were in American Samoa (9.0), Latvia (9.2) and Slovenia (9.2) (online supplemental table S3). The age-standardised point prevalence had significant

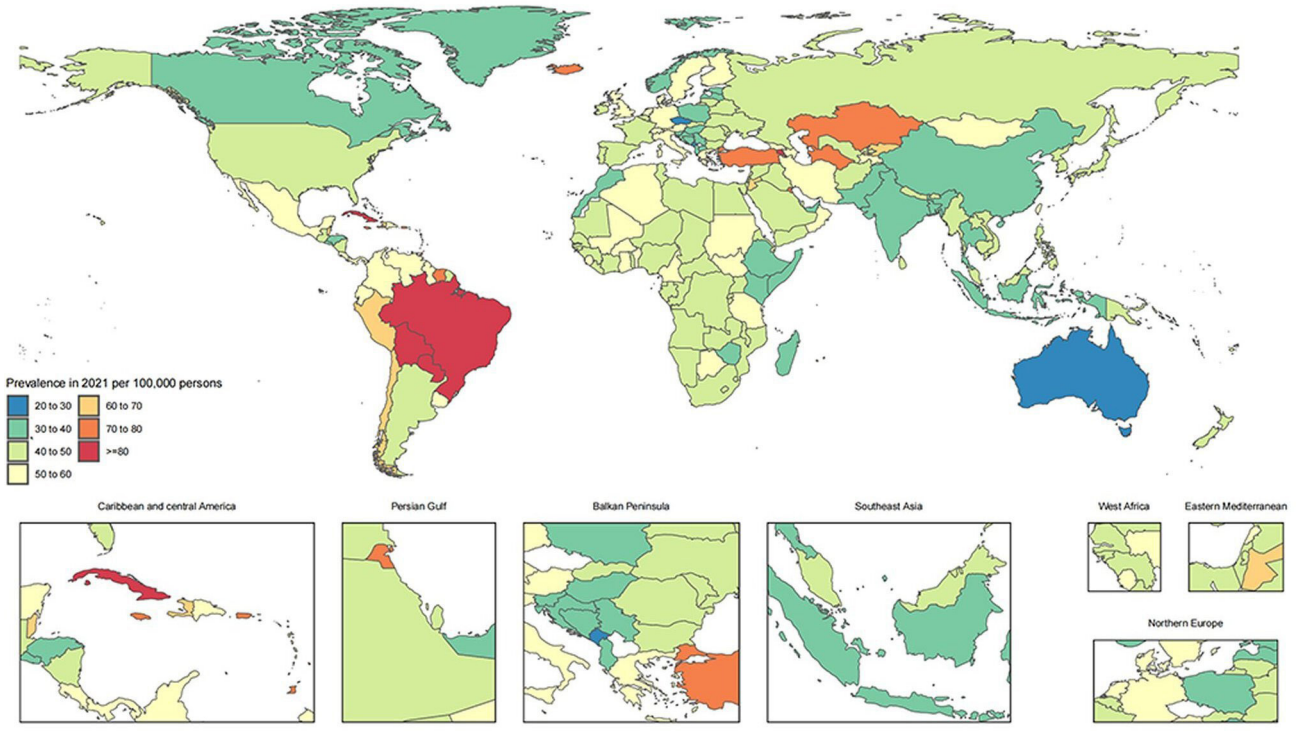

Figure 1 Age-standardised point prevalence of digestive congenital anomalies per 100 000 population in 2021 by country (generated from the data available at https://vizhub.healthdata.org/gbd-results/).

variations in percentage change from 1990 to 2021 across different countries. Notably, Turkmenistan, Seychelles and Chile had the highest increases, with percentages of 48.1%, 44.2% and 40.9%, respectively. On the other hand, the Norway, Czechia and Slovenia experienced the largest hindrances, with percentages of −40%, −35.7% and −32.5%, respectively (online supplemental table S1). Tokelau, Niue and Guatemala exhibited the most increases in the age-standardised death rate over the same time, with percentages of 226.3%, 182.5% and 103.8%,

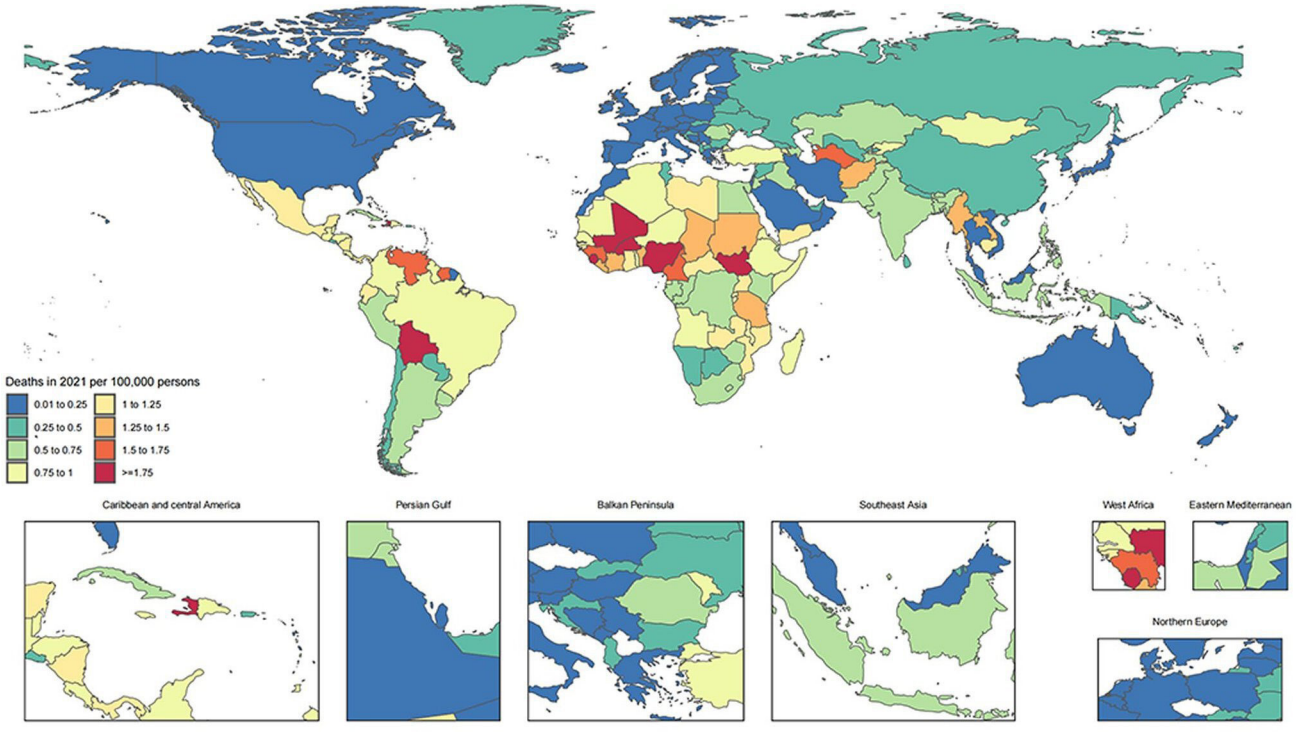

Figure 2 Age-standardised death rate of digestive congenital anomalies per 100 000 population in 2021 by country (generated from the data available at https://vizhub.healthdata.org/gbd-results/).

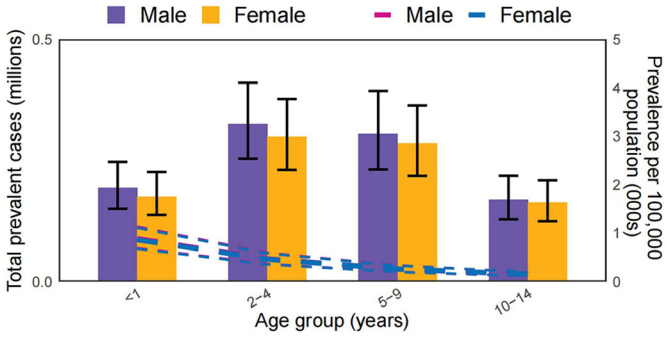

Figure 3 Number of prevalent cases globally and prevalence of digestive congenital anomalies per 100 000 population by age and sex in 2021. The lines represent the most common instance, along with a 95% range of uncertainty, for both male and female (generated from the data available at https://vizhub.healthdata.org/gbd-results/).

respectively. Conversely, Iran, Estonia and Czechia had the biggest declines in the death rate, with percentages of −88.3%, −87.8% and −87.2%, respectively (online supplemental table S2). Tokelau (209.4%), Niue (169.9%) and Guatemala (103.4%) had the largest increases in age-standardised DALY rate of digestive congenital anomalies' (DCAs) from 1990 to 2021. In contrast, the greatest decreases during the study period were found in Iran (−87.3%), Czechia (−85.8%) and Estonia (−85.6%) (online supplemental table S3).

Age and sex patterns

In 2021, the point occurrence of digestive congenital abnormalities started to rise in the <1 year group worldwide, with the highest incidence observed in children aged 2–4 years. Likewise, the number of existing instances was most abundant in the 2–4 years age group but thereafter declined as age increased. The prevalence was greater in males across all age groups (figure 3).

Association with the SDI

We observed a horizontal S-shaped connection between the SDI and the age-standardised DALYs of digestive congenital abnormalities at the regional level, spanning from 1990 to 2021. The age-standardised DALYs exhibited exponential growth as the SDI climbed, reaching a peak at around 0.4, before which they declined. From 1990 to 2021, Western sub-Saharan Africa, North Africa, the Middle East and Eastern sub-Saharan Africa experienced a larger number of DALYs than what was anticipated based on their SDI. Conversely, Australasia, high-income North America, high-income Asia Pacific and Western Europe had lower-than-anticipated burdens from 1990 to 2021 (figure 4).

In 2021, the digestive congenital abnormalities burdens declined as socioeconomic development increased at the country level until reaching an SDI of around 0.25. However, after that point, the prevalence started to fall again until reaching an SDI of about 0.6 (online supplemental figure S1). Several countries and territories, including Burkina Faso, Mali, South Sudan and Chad, had much larger burdens than anticipated. Conversely, the Northern Mariana Islands, Estonia and Andorra had considerably lower burdens than projected (online supplemental figure S1).

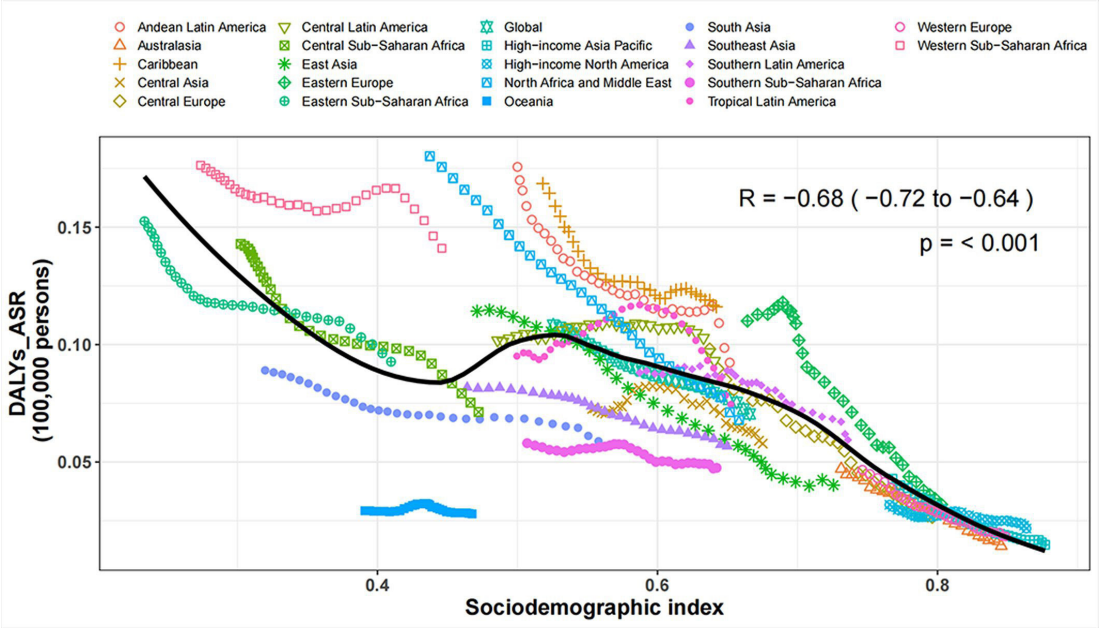

Figure 4 Age-standardised DALYs of digestive congenital anomalies for the 21 GBD regions by SDI, 1990–2021. Each region is represented by 32 data points, which display the age-standardised DALYs recorded from 1990 to 2021 for that specific region. The solid line represents the expected values, which are determined by considering the SDI and disorder rates in all areas (generated from the data available at https://vizhub.healthdata.org/gbd-results/). ASR, age-standardised rate; DALYs, disability-adjusted life years; GBD, Global Burden of Disease; SDI, sociodemographic index.

DISCUSSION

Digestive congenital anomalies worldwide constitute a broad topic involving medical, public health and societal issues. These malformations refer to structural abnormalities in the digestive system present at birth, which can affect the development and function of organs, such as the oesophagus, stomach, small intestine, large intestine, anus and other related organs,[19] including conditions like oesophageal atresia,[20] biliary atresia[21] and Hirschsprung disease.[22]

The incidence of digestive congenital anomalies in children varies significantly worldwide, attributed in part to interactions among genetic, environmental and nutritional factors. Regarding genetic factors, chromosomal abnormalities, such as Down syndrome, are associated with higher rates of upper gastrointestinal tract malformations.[23] Gene mutations are also associated with Hirschsprung disease.[24] Environmental factors such as exposure to drugs and toxins, such as certain medications and chemicals, can increase the risk of malformations. Research has shown that maternal exposure to drugs during pregnancy,[25] such as antidepressants, can lead to digestive congenital anomalies.[26] Maternal exposure to pesticides or active/passive smoking during pregnancy can also increase the risk of birth defects.[27] Some studies indicate that pesticide exposure throughout pregnancy is a risk factor for neuroblastoma in infants.[28 29] Infections during pregnancy, particularly viral infections like cytomegalovirus, rubella virus, Zika virus and others in early pregnancy, can potentially cause fetal malformations.[30] Research has shown that maternal infections during pregnancy can increase the risk of biliary atresia.[31] Nutritional factors also play a crucial role, with maternal malnutrition, such as folate deficiency, being linked to neural tube defects and congenital heart diseases.[32] A prospective investigation in Norway demonstrated that prenatal supplementation with folic acid and multivitamins can reduce the incidence of infant abdominal wall defects.[33]

In developed countries, advancements in preventive measures and medical technology have significantly improved the ability to diagnose and treat congenital malformations, leading to higher survival rates among affected children.[34] However, in some developing countries, these medical conditions are poorer, leading to significant global disparities between North and South. These differences are evident not only in incidence and mortality rates but also in patient prognosis and quality of life. Treating congenital digestive tract malformations is typically a complex process requiring multidisciplinary collaboration, including paediatrics, surgery, nutrition and rehabilitation medicine. Even within the same country, there are differences across various regions.[13] Early diagnosis and treatment are crucial for improving the life quality and increasing survival rates of impacted children,[35] whereas delayed treatment may result in long-term malnutrition, developmental delays and other complications. With advancements in technology and increased global health awareness, there has been growing attention and research focused on digestive congenital anomalies. Driven by global health agendas, many countries and organisations are committed to improving child health, particularly in the early detection and treatment of congenital diseases.

Limitations

Our study, however, has its limitations. First, within the GBD framework, the availability and quality of data vary by location and time. Incomplete vital registration systems, erroneous cause-of-death coding and missing data can introduce potential biases. Despite extensive corrections, these issues may still affect statistical outcomes. Second, there is significant heterogeneity among countries regarding disease definitions, diagnoses, healthcare services, coding practices and cultural factors, which may impact disease estimates. Furthermore, generalised exposure measures like the SDI may not fully capture the social complexities within countries. In conclusion, while this study provides valuable insights into the global burden of digestive congenital anomalies using GBD database, caution is warranted when interpreting its findings due to the aforementioned limitations. Therefore, further research is necessary to address these gaps and to achieve a more comprehensive understanding of global disease burden trends and determinants.

Conclusion

In summary, according to our study of the GBD 2021 database, the prevalence, deaths and DALYs of digestive congenital anomalies in the global population aged 0–14 years are generally declining, reflecting ongoing progress worldwide. Digestive congenital anomalies worldwide represent a complex and diverse issue that requires attention and support from society as a whole. With the technological advancements and the formulation of public health policies via international collaboration, we can provide better treatment and management for patients, thereby improving their quality of life.

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