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Global burden of thyroid cancer from 1990 to 2021: a systematic analysis from the Global Burden of Disease Study 2021

Tianjiao Zhou^{1,2,3†}, Xiaoting Wang^{1,2,3†}, Jingyu Zhang^{1,2,3†}, Enhui Zhou^{1,2,3†}, Chen Xu^{1,2,3}, Ying Shen⁴, Jianyin Zou^{1,2,3}, Wen Lu^{1,2,3}, Kaiming Su^{1,2,3}, Weijun Huang^{1,2,3*}, Hongliang Yi^{1,2,3*} and Shankai Yin^{1,2,3*}

Abstract

Thyroid cancer (TC) is a significant global healthcare burden. However, the lack of comprehensive data has impeded our understanding of its global impact. We aimed to examine the burden of TC and its trends at the global, regional, and national levels using data stratified by sociodemographic index (SDI), sex, and age. Data on TC, including incidence, mortality, and disability-adjusted life-years (DALYs) from 1990 to 2021, were obtained from the Global Burden of Disease Study 2021. Estimated annual percentage changes (EAPCs) were calculated to assess the incidence rate, mortality, and DALYs trends. The incidence, mortality, and DALYs of TC in 2021 were 249,538 (95% uncertainty interval: 223,290–274,638), 44,799 (39,925–48,541), and 646,741 (599,119–717,357), respectively. The age-standardized incidence rate (ASIR) in 2021 was 2.914 (2.607–3.213), with an EAPC of 1.25 (1.14–1.37) compared to 1990. In 2021, the age-standardized death rate (ASDR) was 0.53 (0.47–0.575) and age-standardized DALYs rate was 14.571 (12.783–16.115). Compared with 1990, the EAPCs of ASDR and age-standardized DALYs rate showed decreasing trends, at -0.24 (-0.27 to -0.21) and -0.14 (-0.17 to -0.11), respectively. Low SDI regions showed the highest ASDR and age-standardized DALYs rate, at 0.642 (0.516–0.799) and 17.976 (14.18–23.06), respectively. Low-middle SDI regions had the highest EAPCs for ASDR and age-standardized DALYs rate, at 0.74 (0.71–0.78) and 0.67 (0.63–0.7), respectively. Females exhibited decreasing trend in ASDR and age-standardized DALYs rate, with EAPCs of -0.58 (-0.61 to -0.55) and -0.45 (-0.47 to -0.42), respectively. In contrast, males showed an increasing trend in ASDR and age-standardized DALYs rate, with EAPCs of 0.41 (0.35–0.46) for both. In high-income regions, most countries with decreased annual changes in deaths experience increasing age-related deaths. Over the past few decades, a notable increase in TC incidence and decreased mortality has been observed globally. Regions characterized by lower SDI, male sex, and an aging population exhibited no improvement in TC mortality. Effective resource allocation, meticulous control of risk factors, and tailored interventions are crucial for addressing these issues.

Keywords Global burden of disease study, Thyroid cancer, Incidence, Death, Disability-adjusted life-years, Trend

[†]Tianjiao Zhou, Xiaoting Wang, Jingyu Zhang and Enhui Zhou have contributed equally to this work.

*Correspondence:

Weijun Huang

hellohuangwj@126.com

Hongliang Yi

yihongl@126.com

Shankai Yin

skyyin@sjtu.edu.cn

Full list of author information is available at the end of the article



To the editor

Thyroid cancer (TC) is a common endocrine malignancy with high incidence of lymph node metastasis [1]. The availability of medical resources within regions often dictates the standardization of postoperative follow-up and adjuvant therapies, which consequently affects TC recurrence and metastasis rates [2]. Therefore, holistic understanding of recent TC disease burden and trends requires a global perspective. The Global Burden of Disease (GBD) database provides valuable TC data [3]. We used the latest GBD data (1990–2021) to evaluate TC burden, to provide insight on personalized approaches to alleviate its global impact.

We initially investigated the global TC burden and trends. The incidence, mortality, and DALYs of TC in 2021 were 249,538 (95% uncertainty interval: 223,290–274,638), 44,799 (39,925–48,541), and 646,741 (599,119–717,357), respectively (Table 1). The age-standardized incidence rate (ASIR) in 2021 was 2.914 (2.607–3.213), with an estimated annual percentage change (EAPC) of 1.25 (1.14–1.37). In 2021, the ASDR was 0.53 (0.47–0.575) and age-standardized DALYs rate was 14.571 (12.783–16.115). Both EAPCs for ASDR (–0.24; –0.27 to –0.21) and age-standardized DALYs rate (–0.14; –0.17 to –0.11) showed decreasing trends. High-income North America had the highest ASIR (5.303; 5.075–5.526), whereas Saudi Arabia had the highest overall ASIR (7.131; 5.395–9.331) (Fig. 1A, Table 1 and Table S1). In summary, the 1990–2021 period witnessed a global increase in TC incidence coupled with decreased mortality rates, although this trend exhibited regional differences.

We first analyzed these regional differences using the sociodemographic index (SDI). From 1990 to 2021, the incidence, mortality, and DALYs of TC increased across all SDI regions, similar to the 2019 findings (Fig. 1B) [4]. High and high-middle SDI regions showed higher ASIR than other regions, and the ASIR of 204 countries were positively correlated with the SDI ($r=0.57$, $p<0.05$) (Fig. 1C, Figure S1, S2). Low SDI regions showed the highest ASDR (0.642; 0.516–0.799) and age-standardized DALYs rate (17.976; 14.18–23.06). Low-middle SDI regions had the highest EAPCs for ASDR (0.74; 0.71–0.78) and age-standardized DALYs rate (0.67; 0.63–0.7) (Table 1). Therefore, healthcare departments in low and middle SDI countries need to

be prepared for the potential increase in TC burden as their SDI improves [5].

For sex-based analysis, the incidence, mortality, and DALYs ratio between females and males was 2.03, 1.49, and 1.47 in 2021, respectively (Table S2). From 1990 to 2021, only males showed increasing trends in ASDR and age-standardized DALYs rate, with EAPCs of 0.41 (0.35–0.46) (Table S2, Figure S3). The median male-to-female burden rate ratios of TC for ages 5–70 years increased significantly ($p<0.05$) every 10 years across 204 countries (Figure S4). Although TC incidence was lower in males, mortality rates did not improve. Therefore, increased emphasis should be placed on monitoring male patients with TC in the future.

From an age-specific viewpoint, the highest TC incidence was observed in 55–59-years-old, with 19,600.77 (17,266.17–22,578.22) in females and 11,440.96 (9759.37–13,132.14) in males (Fig. 1D). Elderly patients with TC face unique challenges, including declining immunity, comorbidities, and changes in cancer pathology, necessitating further investigation into age-related trends in TC burden [6]. We defined the ratio of disease burden in those aged ≥ 65 years to that in those aged < 15 years as the aging-related disease burden [7]. In 2021, the countries with the lowest rates of age-related incidence, deaths, and DALYs ratio were all from Sub-Saharan Africa (Fig. 1E). Most countries experiencing decreased annual change are located in high-income regions (Fig. 1E, Figure S5). The rising TC incidence and death rates due to aging highlight the need for targeted strategies to manage the increasing burden in older patients, especially in regions with high SDI [8]. The present study is limited by its reliance on global disease data sources, which vary in quality control standards across different regions and statistical agencies [9]. Moreover, the increase in the global population also influenced the number of TC reported in 2021.

In summary, the 1990–2021 period witnessed increased TC incidence coupled with decreased mortality rates. In particular, regions characterized by lower SDI, male sex, and an aging population have emerged as significant contributors to the currently rising TC burden. Thus, targeted international collaborative research is essential to identify the relevant influencing factors and effectively manage the global disease burden of TC.

Table 1 Global burden and trends of thyroid cancer from 1990 to 2021 by regions

Characteristics	1990			2021			1990			2021		
	Incidence cases (95%UI)	ASIR per 100,000(95%UI)	ASIR (95%CI)	Incidence cases (95%UI)	ASIR per 100,000(95%UI)	EAPC (95%CI)	Death cases (95%UI)	ASDR per 100,000(95%UI)	ASDR (95%CI)	Death cases (95%UI)	ASDR per 100,000(95%UI)	EAPC (95%CI)
Global	89,885(84,681–96,999)	2.062(1.951–2.224)	1.25(1.14–1.37)	249,538(223,290–274,638)	2.914(2.607–3.213)	1.25(1.14–1.37)	21,893(20,437–24,108)	0.57(0.53–0.628)	0.53(0.47–0.575)	44,799(39,925–48,541)	0.53(0.47–0.575)	–0.24(–0.27 to –0.21)
Gender												
Female	64,579(59,813–71,524)	2.859(2.656–3.157)	1.03(0.92–1.14)	167,237(147,083–195,647)	3.826(3.363–4.486)	1.03(0.92–1.14)	14,531(13,201–16,693)	0.687(0.624–0.785)	0.584(0.501–0.676)	26,768(23,015–30,905)	0.584(0.501–0.676)	–0.58(–0.61 to –0.55)
Male	25,306(24,146–27,282)	1.222(1.168–1.313)	1.78(1.64–1.92)	82,301(71,575–91,093)	1.98(1.721–2.188)	1.78(1.64–1.92)	7362(6917–8197)	0.425(0.399–0.474)	0.469(0.397–0.516)	18,031(15,238–19,895)	0.469(0.397–0.516)	0.41(0.35–0.46)
SDI regions												
Low SDI	3431(2759–4296)	1.131(0.912–1.422)	1.23(1.12–1.34)	12,358(9599–16,515)	1.689(1.328–2.2)	1.23(1.12–1.34)	1455(1199–1778)	0.599(0.491–0.735)	0.642(0.516–0.799)	3392(2688–4329)	0.642(0.516–0.799)	0.19(0.11–0.28)
Low-middle SDI	8234(7035–10,302)	1.047(0.907–1.309)	2.09(2.07–2.12)	33,464(27,896–40,293)	1.965(1.651–2.339)	2.09(2.07–2.12)	3015(2624–3757)	0.482(0.419–0.603)	0.598(0.522–0.679)	8531(7411–9772)	0.598(0.522–0.679)	0.74(0.71–0.78)
Middle SDI	17,155(15,283–19,997)	1.351(1.212–1.597)	2.37(2.28–2.46)	75,357(62,756–84,675)	2.711(2.259–3.047)	2.37(2.28–2.46)	5276(4815–6145)	0.535(0.49–0.63)	0.568(0.484–0.626)	14,667(12,467–16,171)	0.568(0.484–0.626)	0.21(0.16–0.26)
High-middle SDI	24,411(22,753–25,920)	2.347(2.189–2.491)	1.05(0.89–1.21)	55,158(49,518–62,489)	3.068(2.754–3.489)	1.05(0.89–1.21)	5609(5201–5935)	0.587(0.544–0.621)	0.434(0.388–0.479)	8437(7553–9304)	0.587(0.544–0.621)	–1.03(–1.09 to –0.97)
High SDI	36,533(35,292–37,708)	3.546(3.434–3.659)	1.01(0.75–1.28)	72,996(68,514–76,747)	4.493(4.252–4.746)	1.01(0.75–1.28)	6505(6098–6798)	0.586(0.549–0.612)	0.438(0.391–0.467)	9730(8466–10,437)	0.586(0.549–0.612)	–0.91(–0.96 to –0.86)
GBD regions												
North Africa and Middle East	3792(3151–5143)	1.694(1.407–2.299)	2.89(2.77–3.01)	21,222(17,602–24,975)	3.653(3.053–4.269)	2.89(2.77–3.01)	658(546–937)	0.405(0.334–0.576)	0.446(0.388–0.523)	1935(1676–2236)	0.446(0.388–0.523)	0.64(0.54–0.75)
South Asia	7853(6476–10,285)	1.013(0.842–1.316)	2.54(2.49–2.59)	37,336(30,263–44,931)	2.136(1.737–2.557)	2.54(2.49–2.59)	2915(2454–3700)	0.483(0.405–0.611)	0.632(0.529–0.726)	9324(7794–10,741)	0.632(0.529–0.726)	0.92(0.89–0.96)
Central Asia	914(841–996)	1.735(1.602–1.894)	0.01(–0.73–0.75)	1631(1432–1845)	1.748(1.54–1.97)	0.01(–0.73–0.75)	253(236–274)	0.533(0.496–0.578)	0.428(0.381–0.475)	339(302–379)	0.533(0.496–0.578)	–0.81(–1.43 to –0.18)
Central Europe	4655(4429–4884)	3.198(3.043–3.356)	–0.65(–0.86 to –0.45)	4876(4407–5323)	2.708(2.443–2.949)	–0.65(–0.86 to –0.45)	1266(1213–1317)	0.864(0.826–0.899)	0.44(0.401–0.475)	986(898–1065)	0.864(0.826–0.899)	–2.37(–2.65 to –2.1)
Eastern Europe	6468(6164–6831)	2.426(2.314–2.562)	1.27(0.8–1.75)	9617(8698–10,650)	3.202(2.899–3.548)	1.27(0.8–1.75)	1349(1274–1423)	0.496(0.468–0.523)	0.472(0.432–0.517)	1651(1508–1807)	0.496(0.468–0.523)	–0.25(–0.6–0.09)
Australasia	586(522–660)	2.605(2.32–2.936)	2.61(2.06–3.16)	1949(1570–2343)	4.566(3.702–5.543)	2.61(2.06–3.16)	98(87–109)	0.417(0.373–0.466)	0.364(0.296–0.433)	199(161–237)	0.417(0.373–0.466)	0.14(–0.13 to 0.41)
High-income Asia Pacific	6950(6496–7654)	3.419(3.185–3.768)	1.15(0.68–1.61)	14,278(12,630–16,477)	4.396(3.942–5.153)	1.15(0.68–1.61)	1236(1126–1404)	0.642(0.58–0.729)	0.504(0.427–0.561)	2844(2309–3186)	0.642(0.58–0.729)	–0.82(–0.98 to –0.65)
High-income North America	12,130(11,695–12,450)	3.812(3.683–3.913)	1.15(0.97–1.33)	28,289(26,783–29,536)	5.303(5.075–5.526)	1.15(0.97–1.33)	1392(1285–1450)	0.393(0.364–0.409)	0.414(0.375–0.44)	2766(2473–2949)	0.393(0.364–0.409)	0.15(0.06–0.23)
Southern Latin America	1000(896–1119)	2.133(1.91–2.383)	0.7(0.48–0.92)	2047(1787–2334)	2.541(2.22–2.901)	0.7(0.48–0.92)	359(325–395)	0.786(0.706–0.864)	0.552(0.484–0.63)	485(426–554)	0.786(0.706–0.864)	–1.01(–1.26 to –0.77)
Western Europe	19,206(18,292–20,159)	3.881(3.692–4.082)	0.28(–0.1 to 0.67)	26,005(23,788–28,201)	3.84(3.512–4.176)	0.28(–0.1 to 0.67)	3951(3667–4174)	0.677(0.631–0.714)	0.387(0.344–0.42)	3829(3319–4191)	0.677(0.631–0.714)	–1.7(–1.77 to –1.64)
Andean Latin America	422(354–495)	1.76(1.472–2.05)	2.6(2.44–2.77)	2424(1907–3044)	3.868(3.052–4.847)	2.6(2.44–2.77)	182(153–211)	0.899(0.759–1.043)	1.101(0.871–1.363)	641(508–794)	0.899(0.759–1.043)	0.66(0.54–0.77)

Table 1 (continued)

Characteristics	1990			2021			1990			2021		
	Incidence cases (95%UI)	ASIR per 100,000(95%UI)	ASIR (95%CI)	Incidence cases (95%UI)	ASIR per 100,000(95%UI)	EAPC (95%CI)	Death cases (95%UI)	ASDR per 100,000(95%UI)	ASDR (95%CI)	Death cases (95%UI)	ASDR per 100,000(95%UI)	EAPC (95%CI)
Caribbean	443(411–479)	1.563(1.451–1.691)	1.5(1.32–1.69)	1245(1086–1427)	2.358(2.055–2.704)	1.5(1.32–1.69)	143(132–156)	0.551(0.511–0.602)	0.551(0.511–0.602)	321(281–368)	0.597(0.521–0.683)	0.42(0.2–0.65)
Central Latin America	1712(1651–1775)	1.714(1.651–1.775)	1.66(1.52–1.8)	7753(6907–8701)	2.963(2.64–3.32)	1.66(1.52–1.8)	636(614–658)	0.787(0.755–0.815)	0.787(0.755–0.815)	1965(1749–2165)	0.798(0.71–0.879)	–0.07(–0.26 to 0.11)
Tropical Latin America	1372(1299–1443)	1.285(1.217–1.349)	0.76(0.6–0.91)	4491(4198–4758)	1.728(1.613–1.831)	0.76(0.6–0.91)	509(480–537)	0.58(0.54–0.614)	0.58(0.54–0.614)	1253(1142–1332)	0.497(0.451–0.528)	–0.6(–0.69 to –0.5)
East Asia	13,203(10,809–15,461)	1.301(1.075–1.517)	2.43(2.26–2.6)	50,885(41,562–63,162)	2.53(2.07–3.145)	2.43(2.26–2.6)	3781(3212–4380)	0.478(0.411–0.552)	0.478(0.411–0.552)	8064(6456–9800)	0.391(0.314–0.474)	–0.65(–0.74 to –0.55)
Oceania	45(30–60)	1.192(0.834–1.59)	0.33(0.24–0.42)	131(80–185)	1.363(0.854–1.872)	0.33(0.24–0.42)	15(10–19)	0.557(0.41–0.732)	0.557(0.41–0.732)	37(23–50)	0.536(0.354–0.727)	–0.13(–0.16 to –0.1)
Southeast Asia	6441(5206–7277)	2.021(1.678–2.321)	1.82(1.74–1.9)	26,559(20,899–31,184)	3.615(2.856–4.239)	1.82(1.74–1.9)	2008(1698–2303)	0.809(0.692–0.957)	0.809(0.692–0.957)	5643(4565–6451)	0.898(0.737–1.023)	0.32(0.24–0.4)
Central Sub-Saharan Africa	154(112–226)	0.568(0.412–0.822)	0.63(0.42–0.83)	496(319–771)	0.691(0.446–1.086)	0.63(0.42–0.83)	78(58–113)	0.362(0.266–0.524)	0.362(0.266–0.524)	183(118–284)	0.35(0.226–0.556)	–0.11(–0.23 to 0.01)
Eastern Sub-Saharan Africa	1908(1517–2388)	1.806(1.46–2.241)	0.76(0.6–0.92)	6384(4630–9479)	2.408(1.767–3.452)	0.76(0.6–0.92)	839(686–1015)	1.009(0.824–1.215)	1.009(0.824–1.215)	1801(1338–2486)	0.991(0.742–1.32)	–0.18(–0.29 to –0.07)
Southern Sub-Saharan Africa	377(318–448)	1.091(0.912–1.3)	1.54(1.3–1.79)	1117(935–1316)	1.612(1.34–1.884)	1.54(1.3–1.79)	124(102–148)	0.454(0.374–0.552)	0.454(0.374–0.552)	324(264–372)	0.574(0.461–0.653)	0.92(0.65–1.18)
Western Sub-Saharan Africa	254(186–312)	0.218(0.161–0.264)	0.52(0.45–0.58)	804(598–1069)	0.262(0.201–0.342)	0.52(0.45–0.58)	103(78–123)	0.111(0.084–0.131)	0.111(0.084–0.131)	210(165–264)	0.097(0.079–0.122)	–0.51(–0.59 to –0.43)
Characteristics	1990			2021			2021			2021		
	DALYs cases (95%UI)	Age_standardised DALYs Rate per 100,000(95%UI)	DALYs cases (95%UI)	Age_standardised DALYs Rate per 100,000(95%UI)	DALYs cases (95%UI)	Age_standardised DALYs Rate per 100,000(95%UI)	DALYs cases (95%UI)	Age_standardised DALYs Rate per 100,000(95%UI)	DALYs cases (95%UI)	Age_standardised DALYs Rate per 100,000(95%UI)	EAPC (95%CI)	
Global	646,741(599,119–717,357)	15.206(14.184–16.83)	1,246,485(1,094,416–1,375,853)	14.571(12.783–16.115)	1,246,485(1,094,416–1,375,853)	14.571(12.783–16.115)	14,571(12,783–16,115)	14.571(12.783–16.115)	14,571(12,783–16,115)	14.571(12.783–16.115)	–0.14(–0.17 to –0.11)	
Gender												
Female	421,139(375,418–489,860)	18.824(16.867–21.844)	742,044(627,065–865,021)	18.824(16.867–21.844)	742,044(627,065–865,021)	18.824(16.867–21.844)	16,695(14,087–19,586)	16.695(14.087–19.586)	16,695(14,087–19,586)	16.695(14,087–19,586)	–0.45(–0.47 to –0.42)	
Male	225,602(210,319–250,806)	11.185(10.453–12.465)	504,440(421,688–563,175)	11.185(10.453–12.465)	504,440(421,688–563,175)	11.185(10.453–12.465)	12,344(10,335–13,777)	12.344(10,335–13,777)	12,344(10,335–13,777)	12.344(10,335–13,777)	0.41(0.35–0.46)	
SDI_regions												
Low SDI	52,662(43,472–63,948)	17.751(14.57–21.62)	120,143(93,673–157,131)	17.751(14.57–21.62)	120,143(93,673–157,131)	17.751(14.57–21.62)	17,976(14,18–23,06)	17.976(14,18–23,06)	17,976(14,18–23,06)	17.976(14,18–23,06)	–0.05(–0.12 to 0.02)	
Low-middle SDI	103,648(90,343–129,887)	13.755(11.989–17.15)	269,914(229,089–316,826)	13.755(11.989–17.15)	269,914(229,089–316,826)	13.755(11.989–17.15)	16,755(14,349–19,425)	16.755(14,349–19,425)	16,755(14,349–19,425)	16.755(14,349–19,425)	0.67(0.63–0.7)	
Middle SDI	166,177(149,966–190,691)	14.017(12.761–16.178)	416,218(350,751–460,889)	14.017(12.761–16.178)	416,218(350,751–460,889)	14.017(12.761–16.178)	15,218(12,811–16,807)	15.218(12,811–16,807)	15,218(12,811–16,807)	15.218(12,811–16,807)	0.28(0.22–0.34)	
High-middle SDI	158,942(146,717–170,153)	15.569(14.397–16.646)	218,961(196,635–244,418)	15.569(14.397–16.646)	218,961(196,635–244,418)	15.569(14.397–16.646)	11,628(10,442–13,018)	11.628(10,442–13,018)	11,628(10,442–13,018)	11.628(10,442–13,018)	–0.99(–1.05 to –0.92)	
High SDI	164,382(155,871–173,718)	15.381(14.592–16.281)	220,136(201,450–237,835)	15.381(14.592–16.281)	220,136(201,450–237,835)	15.381(14.592–16.281)	11,757(10,791–12,773)	11.757(10,791–12,773)	11,757(10,791–12,773)	11.757(10,791–12,773)	–0.77(–0.86 to –0.68)	

Table 1 (continued)

Characteristics	1990		2021		EAPC (95%CI)
	DALYs cases (95%UI)	Age-standardised DALYs Rate per 100,000(95%UI)	DALYs cases (95%UI)	Age-standardised DALYs Rate per 100,000(95%UI)	
GBD regions					
North Africa and Middle East	21,944(18,189–30,746)	10.992(9.069–15.492)	65,316(55,454–76,496)	12.682(10.87–14.795)	0.76(0.66–0.86)
South Asia	105,303(88,400–135,793)	14.205(11.978–18.175)	302,257(249,828–356,789)	18.217(15.089–21.353)	0.85(0.82–0.87)
Central Asia	8145(7568–8817)	15.865(14.737–17.217)	10,273(9056–11,543)	11.663(10.329–13.029)	-1.19(-1.81 to -0.57)
Central Europe	34,786(33,224–36,474)	23.489(22.423–24.619)	23,434(21,250–25,475)	11.604(10.503–12.654)	-2.47(-2.76 to -2.17)
Eastern Europe	37,930(35,923–40,329)	13.857(13.108–14.727)	42,086(38,218–46,388)	12.867(11.664–14.145)	-0.29(-0.68–0.11)
Australasia	2544(2273–2868)	11.046(9.867–12.461)	5041(4104–6033)	10.615(8.673–12.782)	0.51(0.21–0.82)
High-income Asia Pacific	30,856(28,505–35,131)	15.357(14.147–17.485)	50,783(43,704–57,571)	11.815(10.45–13.68)	-0.75(-0.99 to -0.5)
High-income North America	37,316(34,968–39,721)	11.231(10.512–11.973)	70,642(65,004–76,457)	11.964(11.039–13.029)	0.21(0.11–0.31)
Southern Latin America	9492(8618–10,470)	20.253(18.382–22.338)	11,960(10,465–13,594)	14.264(12.484–16.208)	-1.02(-1.28 to -0.75)
Western Europe	94,707(89,027–100,543)	17.602(16.6–18.756)	84,465(75,823–92,550)	10.464(9.444–11.538)	-1.5(-1.64 to -1.36)
Andean Latin America	5274(4419–6186)	23.024(19.325–26.969)	16,690(13,208–20,767)	27.535(21.722–34.253)	0.54(0.43–0.65)
Caribbean	4117(3769–4556)	14.915(13.667–16.462)	8690(7533–10,099)	16.344(14.15–18.983)	0.46(0.25–0.68)
Central Latin America	18,293(17,666–18,921)	19.538(18.869–20.227)	52,187(47,013–58,083)	20.391(18.359–22.673)	0(-0.2 to 0.2)
Tropical Latin America	15,021(14,259–15,823)	14.784(14.015–15.58)	32,680(30,547–34,741)	12.678(11.831–13.486)	-0.65(-0.75 to -0.55)
East Asia	116,582(98,062–136,721)	12.247(10.382–14.197)	213,609(173,066–262,362)	10.253(8.34–12.519)	-0.56(-0.67 to -0.46)
Oceania	480(325–641)	13.903(9.845–18.463)	1174(725–1642)	13.548(8.609–18.629)	-0.1(-0.14 to -0.06)
Southeast Asia	62,695(51,465–70,375)	21.408(17.908–24.29)	164,547(130,333–189,174)	23.604(18.798–27.013)	0.27(0.21–0.34)
Central Sub-Saharan Africa	2545(1889–3610)	9.444(6.945–13.656)	5956(3863–9188)	8.915(5.752–13.928)	-0.19(-0.31 to -0.06)
Eastern Sub-Saharan Africa	31,046(25,044–38,047)	30.052(24.542–36.695)	66,491(48,520–94,804)	27.756(20.555–38.358)	-0.43(-0.55 to -0.32)
Southern Sub-Saharan Africa	4035(3399–4776)	12.405(10.313–14.788)	10,253(8481–11,926)	15.667(12.84–18.144)	1(0.72–1.27)
Western Sub-Saharan Africa	3629(2762–4379)	3.184(2.411–3.818)	7951(6109–10,289)	2.816(2.214–3.549)	-0.49(-0.56 to -0.42)

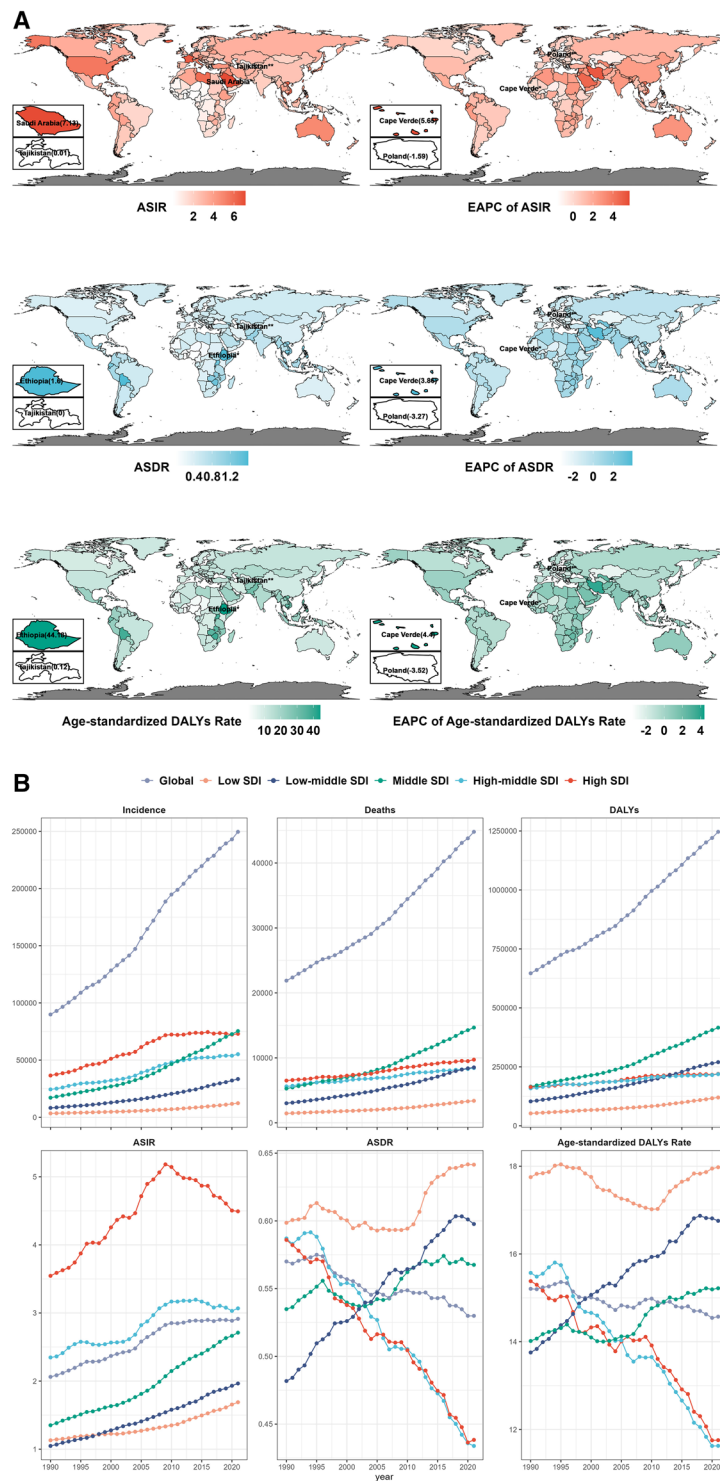


Fig. 1 Burden and trends of thyroid cancer at the global, regional, and national levels by sociodemographic index (SDI), sex and age from 1990 to 2021. **A** Age-standardized disease burden and EAPCs of thyroid cancer across 204 countries and territories from 1990 to 2021. **B** Trends in the incidence, deaths, DALYs, ASIR, ASDR and age-standardized DALYs rate of thyroid cancer from 1990 to 2021 by different SDI level regions. **C** The correlation between SDI and thyroid cancer burden across 204 countries in 2021. (Different colors indicate GBD super-regions. Point size represents the numbers of incidence, deaths, and DALYs. "R" represents the Pearson correlation coefficient). **D** Thyroid cancer burden across different age groups (5 year intervals) by sex in 2021. **E** Age-related thyroid cancer burden ratio between 2000 and 2021 in 7 GBD super-regions.(Point size represents the absolute annual change of age-related thyroid cancer burden rate from 2000 to 2021. Points filled by grey color represent an annual change less than zero.The values in parentheses represent ratios of the age-related thyroid cancer burden rate between 2000 and 2021). ASIR, age-standardized incidence rate; ASDR, age-standardized death rate; DALYs, disability-adjusted life years.EAPC, estimated annual percentage change.SDI, socio-demographic index.Data are represented as mean ± SEM.

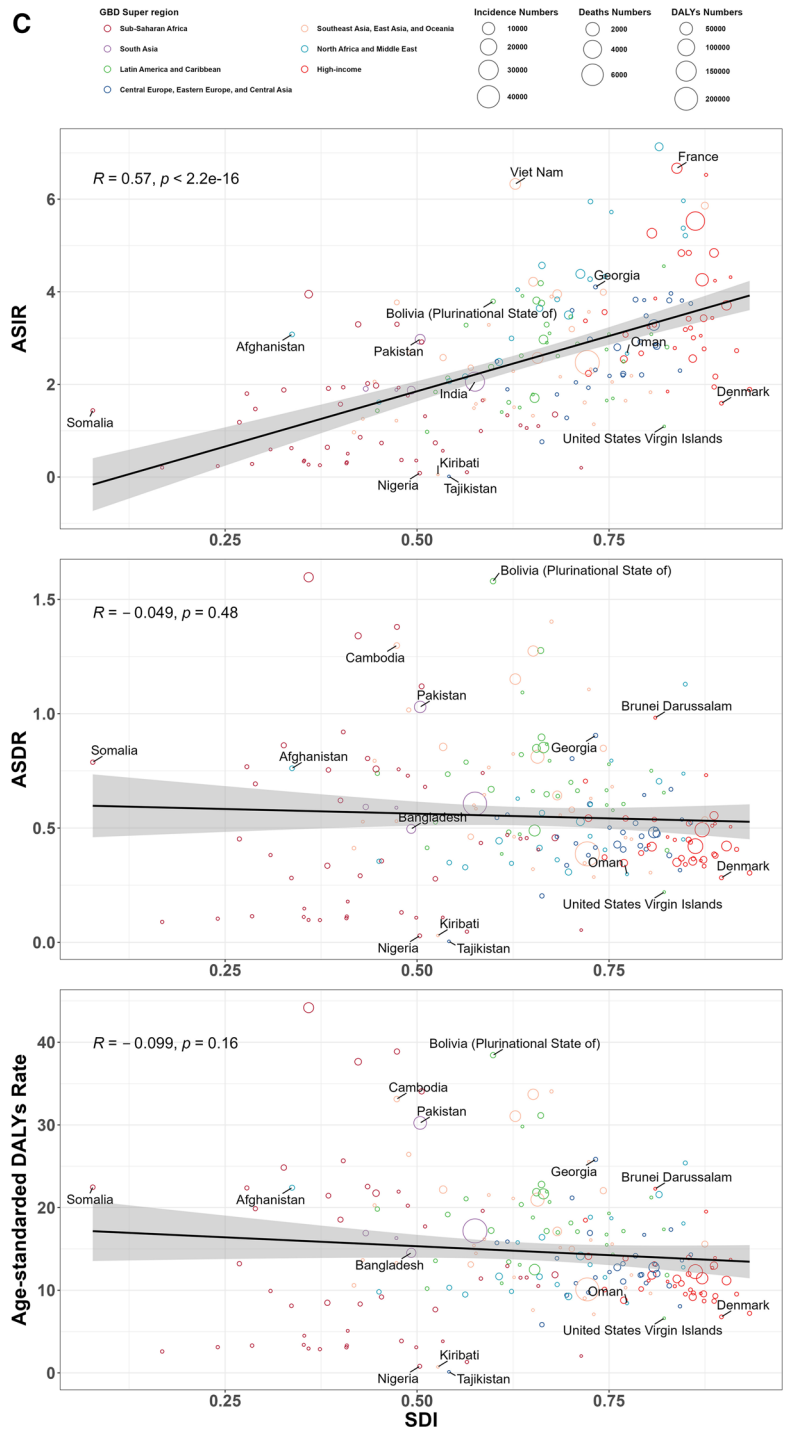


Fig. 1 continued

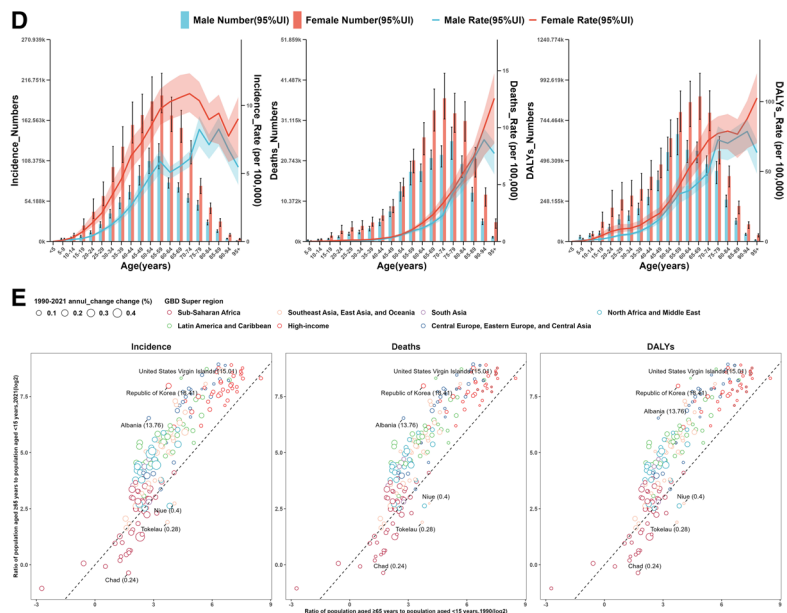


Fig. 1 continued

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s13045-024-01593-y>.

- Supplementary Material 1.
- Supplementary Material 2.
- Supplementary Material 3.
- Supplementary Material 4.
- Supplementary Material 5.

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Author contributions

The corresponding authors are responsible for the authenticity of the data. All authors made a significant contribution to the work reported (i.e., in the conception design or execution of the study, acquisition, analysis, or interpretation of the data, or in all of these areas). All authors contributed to the drafting of the work or revised the article critically for important intellectual content. All authors approved the final version of the manuscript to be published. TJZ and EHZ confirmed the accuracy of the data sources. TJZ and JYZ processed the raw data using software, and TJZ and XTW visualized the data. TJZ and WJH reviewed and edited the manuscript. KMS, HLY and SKY contributed to managing the overall research enterprise.

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Availability of data and materials

The data used for these analyses are all publicly available at <http://ghdx.healthdata.org/gbd-2021>.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

¹Department of Otorhinolaryngology Head and Neck Surgery, Shanghai Sixth People’s Hospital Affiliated to Shanghai Jiao Tong University School of Medicine, Shanghai, China. ²Shanghai Key Laboratory of Sleep Disordered Breathing, Shanghai, China. ³Otolaryngology Institute of Shanghai Jiao Tong University, Shanghai, China. ⁴Department of Otolaryngology, Shanghai Tenth People’s Hospital, School of Medicine, Tongji University, Shanghai, China.

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