Original Article

Temporal trends of bladder cancer incidence and mortality from 1990 to 2016 and projections to 2030

Qiliang Cai[1,2#], Yegang Chen[1#], Shuhui Xin[3], Dingrong Zhang[1], Jiancheng Pan[1], Zunke Xie[1], Chenjie Xu[2], Shu Li[2], Xinyu Zhang[2], Ying Gao[4], Jie Hou[5], Xuemei Guo[6], Xiaodong Zhou[1], Baoshuai Zhang[7], Fei Ma[8], Wei Zhang[1], Guiting Lin[9], Zhongcheng Xin[1,10], Yuanjie Niu[1], Yaogang Wang[2]

[1]Department of Urology, the Second Hospital of Tianjin Medical University, Tianjin Institute of Urology, Tianjin 300211, China; [2]School of Public Health, Tianjin Medical University, Tianjin 300070, China; [3]The Second Hospital of Tianjin Medical University, Tianjin 300211, China; [4]Department of Health Management, Tianjin Medical University General Hospital, Tianjin 300052, China; [5]School of Basic Medical Sciences, [6]Library of Tianjin Medical University, Tianjin Medical University, Tianjin 300070, China; [7]Scientific Research Department, the Second Hospital of Tianjin Medical University, Tianjin 300070, China; [8]Department of Epidemiology and Biostatistics, School of Public Health, Tianjin Medical University, Tianjin 300070, China; [9]Knuppe Molecular Urology Laboratory, Department of Urology, School of Medicine, University of California, San Francisco, CA, USA; [10]Andrology Center, Peking University First Hospital, Peking University, Beijing 100034, China

Contributions: (I) Conception and design: Q Cai, Y Chen, Z Xin, Y Niu, Y Wang; (II) Administrative support: X Zhou, B Zhang, F Ma, W Zhang, G Lin; (III) Provision of study materials or patients: Q Cai, Y Chen, S Xin, D Zhang, J Pan; (IV) Collection and assembly of data: S Xin, D Zhang, J Pan, Z Xie, C Xu, S Li, X Zhang, Y Gao, J Hou, X Guo; (V) Data analysis and interpretation: Q Cai, Y Chen, S Xin, D Zhang, J Pan; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

[#]These authors contributed equally to this work.

Correspondence to: Prof. Yuanjie Niu. Department of Urology, the Second Hospital of Tianjin Medical University, Tianjin Institute of Urology, Tianjin 300211, China. Email: qlcwwwtg@gmail.com; Prof. Yaogang Wang. School of Public Health, Tianjin Medical University, Tianjin 300070, China. Email: wyg@tmu.edu.cn.

Background: Bladder cancer is a leading cause of cancer-related deaths all over the world. Epidemiological studies of bladder cancer are therefore crucial for policy making. This study was carried out to describe the characteristics of changes in the incidence and mortality of bladder cancer from 1990 to 2016 by age group, gender, geographical region, and sociodemographic index (SDI) and to simultaneously project future trends up to 2030.

Methods: Incidence and mortality trends in bladder cancer from 1990 to 2016 were described based on data and methodologies from the Global Burden of Disease (GBD) Study. The data also allowed the future trends of bladder cancer incidence and mortality to be predicted by ARIMA model. Trends were analyzed by age group, gender, and SDI. Projections to 2030 were sub-analyzed by SDI countries. R software (x64 version 3.5.1), SAS (version 9.3), and SPSS (version 22.0) were used throughout the process.

Results: Globally, in 2016, there were 437,442 [95% uncertainty interval (UI), 426,709–447,912] new bladder cancer cases and 186,199 (95% UI, 180,453–191,686) bladder cancer-associated deaths. Between 1990 and 2016, changes in the age-standardized incidence rate (ASIR) of bladder cancer decreased by 5.91% from 7.11 (95% UI, 6.93–7.27) in 1990 to 6.69 (95% UI, 6.52–6.85) in 2016. The age-standardized death rate (ASDR) decreased from 3.58 (95% UI, 3.49–3.68) to 2.94 (95% UI, 2.85–3.03) over the same period of time. In future, the greatest occurrence of bladder cancer will be in high SDI countries, followed by high-middle SDI countries. Moreover, bladder cancer incidence rates may increase substantially in middle SDI countries, while the incidence rates will remain relatively stable for men and women in other SDI countries. From 2017 to 2030, bladder cancer deaths will continue to increase in low SDI countries, while deaths in other SDI countries will continue to decrease.

Conclusions: There was a regional difference in the incidence and mortality trends of bladder cancer between 1990 and 2016. Overall, the situation is not optimistic. From 2017 to 2030, the incidence of bladder cancer will continue to rise, especially in high and high-middle SDI countries, where decision-makers should propose appropriate policies on the screening and prevention of bladder cancer.

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Keywords: Bladder cancer; incidence; mortality; over-time trends; projections

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Introduction

Bladder cancer is one of the most common types of cancer and is a prominent cause of cancer-related deaths all over the world (1). Bladder cancer is more likely to affect older people and men (2), and along with the growing and ageing global population, the number of cancer-related deaths has dramatically increased, which in part can be attributed to its recurrence rate of up to 75% (1,3).

Due to international differences in the incidence and mortality of bladder cancer, the burden of bladder cancer is becoming more noticeable (4,5). Necessary data to inform health policies with respect to urologic cancer at a global level, including cancer control and implementation plans, are not widely available. This study therefore aims to describe the global burden of urologic cancer from 1990 to 2016 according to age, sex, region, and sociodemographic index (SDI) (a summary indicator of income per capita, educational attainment, and fertility), and then forecast worldwide bladder cancer incidence and mortality rates for the next 15 years. Understanding these factors is critical for providing detailed information on bladder cancer etiologies and their trends over time, without which targeted prevention strategies are impossible to design and evaluate, and for promoting strategic investments into research and clinical resources.

Methods

Methodology and research processes for the Global Burden of Disease (GBD) Study have been reported previously in many publications (6-11). Herein, we present methods for the incidence, mortality, trends, and 15-year prediction of bladder cancer from 1990 to 2030 based on the data collected from the GBD study. Our study complies with the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) and the detailed methodology also complies with the GATHER guidelines (12). Tables, which can be found in the Supplementary materials (*Tables S1-S9*), record the estimation steps and other detailed information about the methodology (7,13-15). The International Classification of Diseases 10 (ICD-10) codes corresponding to bladder cancer incidence and mortality are C67-C67.9, Z12.6-Z12.79, Z80.52, Z85.51 and C67-C67.9, D09.0, D30.3, D41.4-D41.8, D49.4, respectively.

The GBD estimation process starts with cancer mortality. Data sources for bladder cancer mortality include vital registration systems and cancer registries. Cancer incidence data are used to model mortality in places where without cancer mortality data by multiplying incidence by a separately modelled mortality-to incidence ratio. These mortality estimates are used in a cause of death ensemble model (CODEm) (7,11). Each cancer type is estimated separately using covariates with a causal connection. Cancer incidence is estimated by dividing final cancer-specific mortality estimates by the mortality-to-incidence ratio. We also estimated the contributions of population ageing, population growth, and the change in age-specific rates on the change of incident cases between 2006 and 2016, which are available in the Supplementary materials (6).

Results

Trends in bladder cancer incidence in the period from 1990 to 2016

Globally, new bladder cancer diagnoses rose 1.8-fold between 1990 and 2016 {238,617 [95% uncertainty interval (UI), 232,159–244,362] to 437,442 (95% UI, 426,709–447,912)}. In 2016, in relation to SDI countries, the highest bladder cancer incidence in both men and women occurred in high SDI countries (213,500, 95% UI, 206,159–220,038), followed by high-middle SDI countries (96,865; 95% UI, 93,605–100,135), middle SDI countries (85,371; 95% UI, 80,381–87,836), low-middle SDI countries (34,771; 95% UI, 32,913–36,384), and low SDI countries (8,223; 95% UI, 7,850–8,585). In the same year, 334,373 (95% UI, 325,085–342,168) and 103,069 (95% UI, 98,687–107,068) incident cases were estimated for males and females, respectively. In terms of SDI countries, the largest increase (162.60%) was in middle SDI countries [from 32,510 (95% UI, 31,501–34,224) in 1990 to 85,371 (95% UI, 80,381–87,836)

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in 2016]. Among the regions, the largest increase in bladder cancer incident cases from 1990 to 2016 was in Oceania, with a rise of 259.52% [from 42 (95% UI, 37–55) in 1990 to 151 (95% UI, 133–185) in 2016]. In 2016, bladder cancer was more common in men, with 334,373 incident cases compared to women, with 103,069 cases (*Table 1*).

Trends in bladder cancer-related deaths in the period from 1990 to 2016

Globally, there were 186,199 (95% UI, 180,453–191,686) deaths from bladder cancer in 2016, and the number of deaths was 137,883 (95% UI, 133,054–142,437) in males and 48,315 (95% UI, 46,028–50,487) in females. Between 1990 and 2016, deaths from bladder cancer rose 1.6-fold [113,414 (95% UI, 110,361–117,066) to 186,199 (95% UI, 180,453–191,686)]. In terms of SDI countries, the highest burden of bladder cancer deaths for both men and women occurred in high SDI countries (75,336; 95% UI, 72,679–77,841), followed by middle SDI countries (41,248; 95% UI, 38,787–42,863), high-middle SDI countries (38,889; 95% UI, 36,379–41,379), low-middle SDI countries (22,311; 95% UI, 20,831–23,545), and low SDI countries (8,320; 95% UI, 7,757–8,853). However, there was a decrease (18.65%) in bladder cancer deaths observed across all SDI countries from 1990 to 2016, especially in high-middle SDI countries. Among the regions, Oceania experienced the largest increase in bladder cancer-related deaths from 1990 to 2016, with a rise of 14.92% [from 29 (95% UI, 24–38) in 1990 to 78 (95% UI, 64–103) in 2016]. In 2016, bladder cancer mortality was much higher in men compared to women, with the number of death cases standing at 137,883 and 48,315, respectively (*Table 1*).

Trends in the age-standardized incidence rate (ASIR) of bladder cancer in the period from 1990 to 2016

Globally, between 1990 and 2016, changes in the ASIR for bladder cancer decreased by 5.91% from 7.11 (95% UI, 6.93–7.27) in 1990 to 6.69 (95% UI, 6.52–6.85) in 2016. In 2016, the highest ASIR was in high SDI countries (11.92; 95% UI, 11.53–12.28). However, the ASIR of bladder cancer in both sexes decreased in high SDI, high-middle SDI, and low SDI countries while it increased in middle SDI and low-middle SDI countries from 1990 to 2016. Between 1990 and 2016, ASIRs of bladder cancers remained highest in Western Europe, where the ASIR decreased by 7.97% from 15.93 (95% UI, 15.57–16.30) to 14.66 (95% UI, 13.93–15.24), followed by Central Europe, where it rose from 9.23 (95% UI, 9.03–9.45) to 12.05 (95% UI, 11.62–12.51). Globally, the age-standard bladder cancer incidence rate (per 100,000 people) in 2016 among men [11.54 (11.21–11.81)] was 4 times higher than among women [2.86 (2.75–2.98)] (*Table 2*, *Figures 1*,*2*).

Trends in the age-standardized death rate (ASDR) of bladder cancer in the period from 1990 to 2016

Globally, the ASDR of bladder cancer decreased from 3.58 (95% UI, 3.49–3.68) in 1990 to 2.94 (95% UI, 2.85–3.03) in 2016. Between 1990 and 2016, changes in ASDRs was highest among men in low-middle SDI countries, where the ASDRs increased by 4.58% from 2.84 (95% UI, 2.45–3.14) to 2.97 (95% UI, 2.71–3.21). Between 1990 and 2016, in terms of region, the highest changes in ASDR occurred in Oceania, followed by Central Europe. Simultaneously, ASDR decreased substantially in East Asia and Southern Latin America. Globally, the mortality rates of bladder cancer were higher among males than females, with male-to-female ratios of 3.7:1, which indicated that the age-standard bladder cancer death rate (per 100,000 people) among men [5.10 (4.93–5.27)] was approximately 3.7-fold higher than among women [1.35 (1.28–1.41)] (*Table 2*, *Figures 2*,*3*).

Projections of bladder cancer incidence and mortality from 2017 to 2030

This study also forecast the trends in the incidence and mortality rates of bladder cancer from 2017 to 2030. Bladder cancer will occur most frequently in high SDI countries, followed by high-middle SDI countries. Bladder cancer incidence rates may increase substantially in middle SDI countries, while incidence rates for both men and women should remain relatively stable in other SDI countries. Deaths due to bladder cancer will continue to increase in low SDI countries, while in other SDI countries the decrease from 1990 will continue to 2030. Globally, the probability of developing bladder cancer for men between the ages of 30 and 70 is around 1.32%, compared to 0.32% for women. In other words, the estimated risk of suffering from bladder cancer is higher among men than women. Similar results can be seen in other age intervals and SDI countries (*Table 3*, *Figure 4*).

Discussion

The estimates presented in this study reveal remarkable

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Table 1 Global and regional bladder cancer incident and death cases by geography, gender, and SDI, 1990 and 2016

Location	Incident cases, global and regional						Death cases, global and regional					
	1990			2016			1990			2016		
	Male	Female	Both	Male	Female	Both	Male	Female	Both	Male	Female	Both
Global	179,438 [174,049–184,282]	59,179 [57,539–60,890]	238,617 [232,159–244,362]	334,373 [325,085–342,168]	103,069 [98,687–107,068]	437,442 [426,709–447,912]	81,981 [79,064–85,004]	31,433 [30,267–32,783]	113,414 [110,361–117,066]	137,883 [133,054–142,437]	48,315 [46,028–50,487]	186,199 [180,453–191,686]
High SDI	101,014 [99,063–103,041]	32,979 [32,367–33,606]	133,992 [131,968–136,064]	161,396 [154,512–166,577]	52,104 [49,679–54,630]	213,500 [206,159–220,038]	35,703 [35,030–36,370]	14,346 [14,031–14,669]	50,049 [49,298–50,885]	54,949 [52,530–57,085]	20,387 [19,284–21,390]	75,336 [72,679–77,841]
High-middle SDI	43,298 [39,889–45,673]	11,490 [10,833–12,202]	54,788 [51,061–57,281]	77,144 [74,433–79,912]	19,721 [18,543–20,826]	96,865 [93,605–100,135]	20,432 [18,799–21,725]	5,790 [5,482–6,115]	26,223 [24,462–27,545]	30,484 [28,212–32,743]	8,404 [7,598–9,352]	38,889 [36,379–41,379]
Low SDI	2,512 [2,361–2,905]	1,513 [1,303–1,797]	4,025 [3,709–4,547]	5,193 [4,866–5,488]	3,030 [2,848–3,239]	8,223 [7,850–8,585]	2,489 [2,236–2,930]	1,510 [1,286–1,809]	3,999 [3,631–4,545]	5,274 [4,773–5,712]	3,046 [2,723–3,346]	8,320 [7,757–8,853]
Low-middle SDI	9,893 [8,765–10,706]	4,498 [4,029–5,279]	14,391 [12,928–15,622]	25,581 [23,840–27,099]	9,190 [8,856–9,530]	34,771 [32,913–36,384]	7,189 [6,256–7,946]	3,662 [3,082–4,402]	10,851 [9,872–11,959]	15,795 [14,474–17,080]	6,516 [5,972–7,038]	22,311 [20,831–23,545]
Middle SDI	23,751 [23,023–25,145]	8,759 [8,342–9,217]	32,510 [31,501–34,224]	66,277 [62,215–68,205]	19,094 [17,794–20,156]	85,371 [80,381–87,836]	16,144 [15,408–17,259]	6,111 [5,744–6,443]	22,254 [21,368–23,483]	31,314 [29,333–32,668]	9,934 [9,182–10,567]	41,248 [38,787–42,863]
High-income Asia Pacific	8,994 [8,746–9,250]	3,114 [3,027–3,197]	12,108 [11,837–12,374]	21,513 [19,918–22,754]	7,581 [7,129–8,098]	29,094 [27,312–30,653]	2,875 [2,781–2,978]	1,308 [1,266–1,355]	4,183 [4,080–4,303]	7,038 [6,440–7,622]	3,030 [2,793–3,291]	10,067 [9,365–10,749]
Western Europe	64,281 [62,445–66,177]	18,395 [17,896–18,909]	82,676 [80,720–84,679]	91,848 [86,389–96,142]	25,886 [24,239–27,686]	117,734 [111,908–122,735]	23,439 [22,820–24,061]	8,642 [8,365–8,915]	32,081 [31,398–32,778]	32,283 [30,396–34,059]	10,672 [9,930–11,416]	42,955 [40,983–44,950]
Andean Latin	269 [253–289]	142 [126–160]	411 [385–443]	622 [581–667]	356 [331–381]	978 [935–1,023]	189 [172–206]	100 [87–116]	288 [266–315]	391 [337–452]	225 [189–265]	616 [550–687]
America	1,221 [1,184–1,260]	644 [624–666]	1,865 [1,818–1,910]	3,644 [3,539–3,759]	1,995 [1,871–2,072]	5,639 [5,494–5,778]	785 [758–814]	420 [404–437]	1,205 [1,172–1,239]	1,769 [1,673–1,873]	977 [904–1,038]	2,747 [2,624–2,870]
Central Latin America	2,412 [2,274–2,557]	624 [581–669]	3,036 [2,887–3,192]	3,901 [3,619–4,187]	1,466 [1,346–1,596]	5,367 [5,050–5,682]	1,370 [1,272–1,467]	397 [364–431]	1,766 [1,664–1,869]	1,781 [1,577–1,992]	762 [662–874]	2,543 [2,317–2,792]
Southern Latin America	2,131 [2,058–2,204]	820 [786–855]	2,952 [2,869–3,038]	6,311 [6,047–6,574]	2,942 [2,776–3,100]	9,253 [8,945–9,559]	1,334 [1,273–1,399]	519 [493–546]	1,853 [1,786–1,924]	3,234 [3,034–3,427]	1,482 [1,375–1,594]	4,715 [4,490–4,947]
Tropical Latin America	7,453 [6,903–8,204]	1,864 [1,661–2,086]	9,316 [8,680–10,212]	22,984 [21,176–24,621]	5,142 [4,743–5,619]	28,126 [26,065–30,002]	5,002 [4,479–5,615]	1,268 [1,106–1,454]	6,270 [5,624–6,986]	10,655 [9,643–11,721]	2,496 [2,278–2,775]	13,152 [12,143–14,214]
North Africa and Middle	27,248 [26,618–27,875]	10,465 [10,158–10,789]	37,712 [36,932–38,481]	46,158 [44,662–47,633]	15,905 [15,200–16,620]	62,062 [60,383–63,707]	8,929 [8,698–9,161]	4,046 [3,921–4,175]	12,975 [12,688–13,262]	15,028 [14,427–15,637]	5,891 [5,605–6,216]	20,919 [20,235–21,653]
East	27 [25–36]	15 [12–20]	42 [37–55]	97 [88–119]	54 [42–70]	151 [133–185]	18 [15–24]	11 [8–16]	29 [24–38]	47 [40–63]	32 [23–44]	78 [64–103]
High-income North America	375 [324–464]	238 [197–290]	613 [533–718]	744 [676–815]	432 [381–490]	1,176 [1,100–1,256]	340 [271–428]	219 [179–273]	559 [465–662]	705 [605–820]	424 [363–487]	1,130 [1,009–1,264]
Oceania	1,050 [975–1,146]	809 [699–942]	1,859 [1,725–1,999]	2,335 [2,060–2,538]	1,758 [1,479–2,089]	4,094 [3,567–4,514]	1,069 [954–1,203]	835 [692–1,002]	1,904 [1,722–2,108]	2,375 [2,036–2,656]	1,739 [1,411–2,077]	4,115 [3,529–4,533]
Central sub-Saharan	1,572 [1,303–1,742]	400 [350–460]	1,972 [1,659–2,166]	2,500 [2,328–2,647]	552 [511–597]	3,052 [2,860–3,217]	789 [656–889]	219 [190–257]	1,008 [851–1,118]	1,090 [985–1,197]	250 [225–277]	1,339 [1,232–1,457]
Africa	844 [718–954]	574 [518–617]	1,418 [1,247–1,547]	1,623 [1,458–1,771]	988 [930–1,047]	2,611 [2,410–2,789]	490 [373–590]	334 [278–383]	824 [657–954]	879 [773–977]	528 [461–598]	1,407 [1,275–1,540]
Eastern sub-Saharan	1,199 [1,140–1,280]	558 [513–604]	1,757 [1,670–1,872]	2,163 [2,060–2,256]	967 [869–1,052]	3,129 [2,959–3,268]	1,206 [1,082–1,343]	583 [516–662]	1,789 [1,630–1,961]	2,120 [1,922–2,362]	941 [811–1,081]	3,061 [2,794–3,363]
Africa	18,715 [17,988–19,829]	6,821 [6,436–7,230]	25,536 [24,567–26,906]	51,759 [48,743–53,797]	12,867 [11,731–14,081]	64,626 [60,665–67,499]	12,258 [11,642–13,087]	4,756 [4,386–5,105]	17,014 [16,205–17,924]	21,531 [20,229–22,538]	6,070 [5,517–6,665]	27,601 [25,919–28,929]
Central Asia	8,119 [7,279–8,781]	3,215 [2,891–3,748]	11,334 [10,216–12,246]	22,160 [20,533–23,458]	7,281 [6,918–7,677]	29,440 [27,591–30,984]	5,561 [4,829–6,166]	2,375 [1,996–2,844]	7,936 [7,126–8,737]	13,054 [11,845–14,181]	4,820 [4,303–5,287]	17,874 [16,426–19,107]
Southern sub-Saharan	3,862 [3,634–4,317]	1,802 [1,501–2,162]	5,664 [5,185–6,330]	11,956 [11,335–12,490]	4,117 [3,818–4,503]	16,073 [15,403–16,759]	2,619 [2,394–2,964]	1,463 [1,178–1,830]	4,082 [3,661–4,598]	5,869 [5,460–6,291]	2,571 [2,336–2,885]	8,440 [7,944–9,008]
Africa	1,881 [1,774–1,996]	638 [591–684]	2,519 [2,402–2,642]	3,008 [2,754–3,289]	1,018 [916–1,127]	4,026 [3,755–4,333]	617 [579–657]	267 [248–287]	884 [845–927]	1,050 [937–1,170]	432 [380–495]	1,482 [1,361–1,618]
Western sub-Saharan	845 [803–892]	342 [314–376]	1,186 [1,131–1,253]	1,742 [1,643–1,845]	718 [664–775]	2,460 [2,346–2,576]	477 [446–513]	203 [183–230]	681 [638–732]	833 [758–908]	365 [325–410]	1,198 [1,117–1,285]
Africa	9,479 [9,189–9,769]	2,796 [2,688–2,906]	12,276 [11,983–12,579]	17,011 [16,318–17,768]	5,495 [5,135–5,878]	22,506 [21,692–23,381]	4,709 [4,517–4,881]	1,391 [1,334–1,452]	6,100 [5,898–6,277]	7,202 [6,774–7,709]	2,295 [2,114–2,488]	9,496 [9,033–10,048]
East Asia	17,461 [14,748–19,251]	4,904 [4,373–5,519]	22,365 [19,368–24,346]	20,295 [18,847–21,796]	5,549 [5,091–6,053]	25,844 [24,301–27,409]	7,882 [6,603–8,865]	2,063 [1,794–2,366]	9,945 [8,562–11,004]	8,885 [6,996–10,985]	2,285 [1,680–3,046]	11,169 [9,211–13,423]

Data in the parentheses indicates 95% uncertainty interval (95% UI). SDI, Sociodemographic index (a summary indicator of income per capita, educational attainment, and fertility).

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Table 2 Global and regional age-standardized bladder cancer incidence and death rates with 95% uncertainty interval and percent change by geography, gender, and SDI between 1990 and 2016

Location	Sex	Age-standardized incidence rates per 100,000			Age-standardized death rates per 100,000		
		1990	2016	Change (%)	1990	2016	Change (%)
Global	Both	7.11 (6.93–7.27)	6.69 (6.52–6.85)	−5.91	3.58 (3.49–3.68)	2.94 (2.85–3.03)	−17.88
	Male	12.47 (12.713–12.79)	11.54 (11.21–11.81)	−7.46	6.29 (6.09–6.50)	5.10 (4.93–5.27)	−18.92
	Female	3.18 (3.10–3.27)	2.86 (2.75–2.98)	−10.06	1.74 (1.68–1.81)	1.35 (1.28–1.41)	−22.41
High SDI	Both	12.68 (12.49–12.87)	11.92 (11.53–12.28)	−6	4.65 (4.58–4.72)	3.84 (3.71–3.96)	−17.42
	Male	23.45 (23.01–23.91)	20.76 (19.91–21.42)	−11.47	8.74 (8.58–8.91)	6.89 (6.60–7.16)	−21.17
	Female	5.25 (5.15–5.35)	5.07 (4.84–5.30)	−1.52	2.14 (2.10–2.19)	1.70 (1.62–1.79)	−20.56
High-middle SDI	Both	7.65 (7.16–7.99)	7.62 (7.36–7.88)	−0.39	3.86 (3.61–4.04)	3.14 (2.94–3.33)	−18.65
	Male	14.94 (13.91–15.68)	14.18 (13.68–14.67)	−5.09	7.84 (7.29–8.28)	6.05 (5.63–6.47)	−22.83
	Female	2.79 (2.63–2.95)	2.75 (2.58–2.90)	−1.43	1.44 (1.36–1.51)	1.15 (1.04–1.28)	−20.14
Middle SDI	Both	3.44 (3.33–3.61)	4.10 (3.86–4.21)	19.19	2.63 (2.53–2.77)	2.17 (2.05–2.25)	−17.49
	Male	5.46 (5.29–5.78)	6.78 (6.40–6.97)	24.18	4.24 (4.06–4.53)	3.62 (3.41–3.77)	−14.62
	Female	1.74 (1.70–1.82)	1.76 (1.64–1.85)	11.49	1.35 (1.27–1.42)	0.98 (0.91–1.05)	−27.41
Low-middle SDI	Both	2.48 (2.22–2.68)	2.75 (2.60–2.88)	10.89	2.01 (1.82–2.21)	1.94 (2.05–1.80)	−3.48
	Male	3.60 (3.19–3.88)	4.29 (4.00–4.56)	19.17	2.84 (2.45–3.14)	2.97 (2.71–3.21)	4.58
	Female	1.48 (1.33–1.72)	1.39 (1.34–1.44)	−6.08	1.28 (1.07–1.53)	1.06 (0.97–1.15)	−17.19
Low SDI	Both	3.00 (2.79–3.35)	2.88 (2.74–3.01)	−4	3.23 (2.97–3.63)	3.21 (2.99–3.42)	−0.62
	Male	4.04 (3.80–4.62)	3.89 (3.62–4.13)	−3.71	4.32 (3.89–5.02)	4.33 (3.93–4.70)	0.23
	Female	2.09 (1.82–2.44)	1.99 (1.87–2.13)	−4.78	2.29 (2.70–1.97)	2.23 (1.99–2.44)	−2.62
High-income Asia Pacific	Both	7.12 (6.96–7.27)	7.33 (6.85–7.74)	2.95	2.59 (2.53–2.66)	2.22 (2.06–2.39)	−14.29
	Male	12.84 (12.49–13.21)	13.14 (12.18–13.9)	2.34	4.57 (4.42–4.73)	4.09 (3.75–4.44)	−10.5
	Female	3.18 (3.10–3.27)	3.00 (2.81–3.23)	−5.66	1.36 (1.32–1.40)	1.01 (0.93–1.11)	−25.74
Western Europe	Both	15.93 (15.57–16.30)	14.66 (13.93–15.24)	−7.97	5.93 (5.81–6.06)	4.77 (4.54–4.98)	−19.56
	Male	30.58 (29.75–31.43)	26.32 (24.83–27.48)	−13.93	11.54 (11.25–11.85)	8.81 (8.30–9.28)	−23.66
	Female	5.86 (5.70–6.01)	5.53 (5.18–5.90)	−5.63	2.53 (2.45–2.60)	1.92 (1.79–2.05)	−24.11
Andean Latin America	Both	2.41 (2.26–2.60)	2.27 (2.17–2.38)	−5.81	1.87 (1.73–2.04)	1.49 (1.33–1.66)	−20.32
	Male	3.48 (3.28–3.74)	3.20 (2.99–3.43)	−8.05	2.74 (2.51–3.00)	2.15 (1.86–2.47)	−21.53
	Female	1.53 (1.36–1.71)	1.52 (1.41–1.63)	−0.65	1.17 (1.02–1.35)	0.98 (0.82–1.15)	−16.24
Central Latin America	Both	2.48 (2.41–2.53)	3.01 (2.93–3.09)	21.37	1.73 (1.68–1.78)	1.55 (1.48–1.62)	−10.4
	Male	3.64 (3.53–3.75)	4.34 (4.21–4.48)	19.23	2.56 (2.47–2.65)	2.28 (2.16–2.41)	−10.94
	Female	1.54 (1.50–1.60)	1.93 (1.81–2.00)	25.32	1.09 (1.04–1.13)	0.98 (0.91–1.04)	−10.09
Southern Latin America	Both	7.31 (6.96–7.67)	7.32 (6.90–7.76)	0.14	4.38 (4.14–4.63)	3.35 (3.05–3.69)	−23.52
	Male	13.57 (12.8–14.36)	12.86 (11.95–13.80)	−5.23	8.21 (7.64–8.78)	6.07 (5.39–6.79)	−26.07
	Female	2.67 (2.49–2.85)	3.37 (3.08–3.67)	26.22	1.71 (1.57–1.85)	1.6 (1.40–1.84)	−6.43

Table 2 (*continued*)

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Table 2 (*continued*)

Location	Sex	Age-standardized incidence rates per 100,000			Age-standardized death rates per 100,000		
		1990	2016	Change (%)	1990	2016	Change (%)
Tropical Latin America	Both	4.34 (4.21–4.46)	5.04 (4.87–5.22)	16.13	3.08 (2.97–3.19)	2.74 (2.60–2.88)	−11.04
	Male	7.47 (7.21–7.72)	8.21 (7.82–8.57)	9.91	5.44 (5.18–5.70)	4.66 (4.35–4.94)	−14.34
	Female	2.13 (2.04–2.22)	2.80 (2.64–2.96)	31.46	1.51 (1.43–1.59)	1.46 (1.36–1.58)	−3.31
North Africa and Middle East	Both	6.03 (5.55–6.58)	7.85 (7.31–8.35)	30.18	4.42 (3.95–4.89)	4.09 (3.78–4.40)	−7.47
	Male	10.27 (9.38–11.25)	13.39 (12.44–14.31)	30.38	7.64 (6.78–8.48)	7.10 (6.49–7.73)	−7.07
	Female	2.32 (2.05–2.58)	2.81 (2.60–3.07)	21.12	1.71 (1.48–1.96)	1.49 (1.36–1.64)	−12.87
High-income North America	Both	11.90 (11.66–12.15)	11.67 (11.34–11.97)	−1.93	3.95 (3.86–4.04)	3.73 (3.61–3.86)	−5.57
	Male	20.84 (20.37–21.32)	19.48 (18.85–20.11)	−6.53	7.12 (6.94–7.30)	6.39 (6.13–6.65)	−10.25
	Female	5.60 (5.43–5.77)	5.41 (5.18–5.65)	−3.39	1.98 (1.92–2.04)	1.80 (1.71–1.89)	−9.09
Oceania	Both	1.81 (1.58–2.30)	2.73 (2.44–3.30)	50.83	1.81 (1.59–2.43)	2.08 (1.81–2.71)	14.92
	Male	2.43 (2.20–3.15)	3.79 (3.46–4.59)	55.97	1.03 (0.79–1.40)	1.19 (0.91–1.60)	15.53
	Female	1.27 (0.98–1.66)	1.85 (1.49–2.35)	45.67	0.28 (0.23–0.33)	0.23 (0.19–0.28)	−17.86
Central sub-Saharan Africa	Both	3.44 (3.12–3.88)	3.12 (2.85–3.37)	−9.3	3.44 (2.94–3.94)	3.29 (2.93–3.69)	−4.36
	Male	4.97 (4.44–5.87)	4.46 (3.92–4.97)	−10.26	4.98 (3.95–6.05)	4.67 (3.97–5.49)	−6.22
	Female	2.35 (2.05–2.75)	2.08 (1.89–2.30)	−11.49	2.36 (2.02–2.82)	2.23 (1.93–2.54)	−5.51
Eastern sub-Saharan Africa	Both	2.90 (2.70–3.10)	2.94 (2.58–3.23)	1.38	3.25 (2.97–3.59)	3.29 (2.84–3.60)	1.23
	Male	3.61 (3.34–3.93)	3.72 (3.30–4.06)	3.05	4.02 (3.60–4.48)	4.19 (3.62–4.66)	4.23
	Female	2.30 (2.00–2.65)	2.31 (1.97–2.71)	0.43	2.61 (2.17–3.12)	2.56 (2.10–3.02)	−1.92
Central Asia	Both	4.58 (3.90–5.02)	4.69 (4.41–4.94)	2.4	2.50 (2.14–2.77)	2.24 (2.07–2.43)	−10.4
	Male	9.26 (7.84–10.22)	9.14 (8.53–9.65)	−1.3	5.20 (4.42–5.82)	4.52 (4.11–4.93)	−13.08
	Female	1.59 (1.39–1.83)	1.50 (1.39–1.61)	−5.66	0.91 (0.79–1.07)	0.72 (0.65–0.80)	−20.88
Southern sub-Saharan Africa	Both	5.58 (4.86–6.13)	5.85 (5.38–6.27)	4.84	3.60 (2.88–4.15)	3.5 (3.18–3.83)	−2.78
	Male	8.01 (6.75–9.10)	9.27 (8.34–10.13)	15.73	5.27 (4.04–6.32)	5.85 (5.18–6.48)	11.01
	Female	3.86 (3.46–4.16)	3.67 (3.45–3.91)	−4.92	2.47 (2.06–2.82)	2.12 (1.86–2.4)	−14.17
Western sub-Saharan Africa	Both	2.41 (2.30–2.55)	2.23 (2.13–2.32)	−7.47	2.77 (2.54–3.02)	2.53 (2.33–2.79)	−8.66
	Male	3.57 (3.39–3.80)	3.28 (3.14–3.40)	−8.12	4.05 (3.63–4.50)	3.75 (3.41–4.17)	−7.41
	Female	1.43 (1.32–1.53)	1.31 (1.20–1.44)	−8.39	1.70 (1.52–1.92)	1.5 (1.31–1.73)	−11.76
East Asia	Both	3.65 (3.52–3.85)	4.20 (3.95–4.38)	15.07	2.72 (2.59–2.85)	1.96 (1.85–2.05)	−27.94
	Male	5.91 (5.69–6.27)	7.10 (6.70–7.36)	20.14	4.49 (4.28–4.79)	3.34 (3.15–3.49)	−25.61
	Female	1.84 (1.74–1.94)	1.63 (1.49–1.78)	−11.41	1.40 (1.30–1.50)	0.82 (0.74–0.90)	−41.43
South Asia	Both	2.32 (2.08–2.50)	2.69 (2.52–2.83)	15.95	2.08 (1.87–2.33)	1.97 (1.86–2.11)	−5.29
	Male	3.35 (3.00–3.62)	4.18 (3.86–4.43)	24.78	3.10 (2.83–3.52)	3.20 (2.97–3.43)	3.23
	Female	1.29 (1.16–1.49)	1.29 (1.24–1.36)	0	1.33 (1.09–1.64)	1.08 (0.98–1.20)	−18.8

Table 2 (*continued*)

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Table 2 (*continued*)

Location	Sex	Age-standardized incidence rates per 100,000			Age-standardized death rates per 100,000		
		1990	2016	Change (%)	1990	2016	Change (%)
Southeast Asia	Both	2.63 (2.42–2.93)	3.34 (3.21–3.48)	27	2.08 (1.87–2.33)	1.97 (1.86–2.11)	−5.29
	Male	4.07 (3.83–4.56)	5.59 (5.31–5.84)	37.35	3.10 (2.83–3.52)	3.20 (2.97–3.43)	3.23
	Female	1.52 (1.29–1.80)	1.58 (1.47–1.72)	3.95	1.33 (1.09–1.64)	1.08 (0.98–1.20)	−18.8
Australasia	Both	11.72 (11.20–12.28)	9.44 (8.81–10.14)	−19.45	4.15 (3.97–4.34)	3.24 (2.97–3.54)	−21.93
	Male	20.58 (19.50–21.78)	15.54 (14.23–16.95)	−24.49	7.31 (6.88–7.76)	5.33 (4.78–5.92)	−27.09
	Female	5.27 (4.90–5.65)	4.35 (3.92–4.80)	−17.46	2.13 (1.97–2.28)	1.64 (1.44–1.88)	−23
Caribbean	Both	5.08 (4.84–5.37)	5.61 (5.35–5.89)	10.43	3.00 (2.82–3.22)	2.74 (2.56–2.94)	−8.67
	Male	7.76 (7.37–8.19)	8.76 (8.26–9.27)	12.89	4.58 (4.29–4.90)	4.32 (3.93–4.71)	−5.68
	Female	2.75 (2.53–3.01)	3.00 (2.77–3.25)	9.09	1.67 (1.50–1.88)	1.50 (1.33–1.69)	−10.18
Central Europe	Both	9.23 (9.03–9.45)	12.05 (11.62–12.51)	30.55	4.70 (4.55–4.84)	4.89 (4.66–5.17)	6.82
	Male	17.08 (16.59–17.55)	21.60 (20.72–22.52)	26.46	9.05 (8.70–9.36)	9.37 (8.81–10.01)	6.94
	Female	3.68 (3.55–3.81)	5.16 (4.82–5.51)	40.22	1.83 (1.76–1.91)	1.94 (1.79–2.1)	9.95
Eastern Europe	Both	8.84 (7.70–9.60)	8.31 (7.84–8.80)	−6	4.02 (3.49–4.42)	3.53 (2.90–4.25)	−12.19
	Male	20.46 (17.59–22.39)	18.04 (16.84–19.34)	−11.83	10.34 (8.86–11.50)	8.37 (6.68–10.22)	−19.05
	Female	3.06 (2.73–3.45)	2.85 (2.62–3.09)	−6.86	1.26 (1.09–1.43)	1.08 (0.79–1.44)	−14.29

Data in the parentheses indicates 95% uncertainty interval (95% UI). SDI, Sociodemographic index (a summary indicator of income per capita, educational attainment, and fertility).

differences in trends in the incidence and death rates of bladder cancer from 1990 to 2016. New bladder cancer diagnoses and related deaths increased while the ASIR and ASDR decreased over the same time period. At a global level, between 1990 and 2016, the decreasing incidence rate of bladder cancer was particularly noticeable. Cancer outcomes depend on health care expenditures as well as adequate diagnosis and treatment services (11). Trends in the incidence and death rates of bladder cancer were evaluated for both sexes, and these rates were observed to be greater in males than females across all SDI countries and most regions. A large proportion of the increase in bladder cancer incidence can be attributed to improving life expectancy and population growth (16). Tobacco smoking is the dominant risk factor for bladder cancer and is associated with 50–65% of male cases and 20–30% of female cases (17-19). Furthermore, genetic predisposition, occupational exposure to aromatic amines, polycyclic aromatic hydrocarbons, chlorinated hydrocarbons, cyclophosphamide, pioglitazone, exposure to ionising radiation, and chlorination of drinking water and subsequent levels of trihalomethanes have all been suggested as contributing to the development of bladder cancer (20). Clinically, early symptoms of bladder cancer include bloody urine or pain during urination. In its early stages, the disease can be treated cystoscopically plus immunotherapy with Bacillus Calmette-Guérin (BCG) (21); however, up to 70% of tumors recur (22,23). Early detection of bladder cancer and a high recurrence rate of bladder cancer may be two of the reasons for the sharp increase in the incidence and deaths of bladder cancer seen in recent years.

For chronic diseases such as bladder cancer, it is especially important to develop appropriate and reasonable strategies for prevention and control. Epidemiology references are absolutely imperative in bladder cancer prevention, screening, and treatment. In our study, data of bladder cancer were analyzed by age group, gender, geographical region, and SDI. We found that there are differences in the incidence and mortality of bladder cancer regardless of age group, gender, region, or SDI. Additionally, we also forecast the trends in the incidence and mortality rates of bladder cancer from 2017 to 2030. What we did has considerable significance in terms of the proposal of bladder cancer

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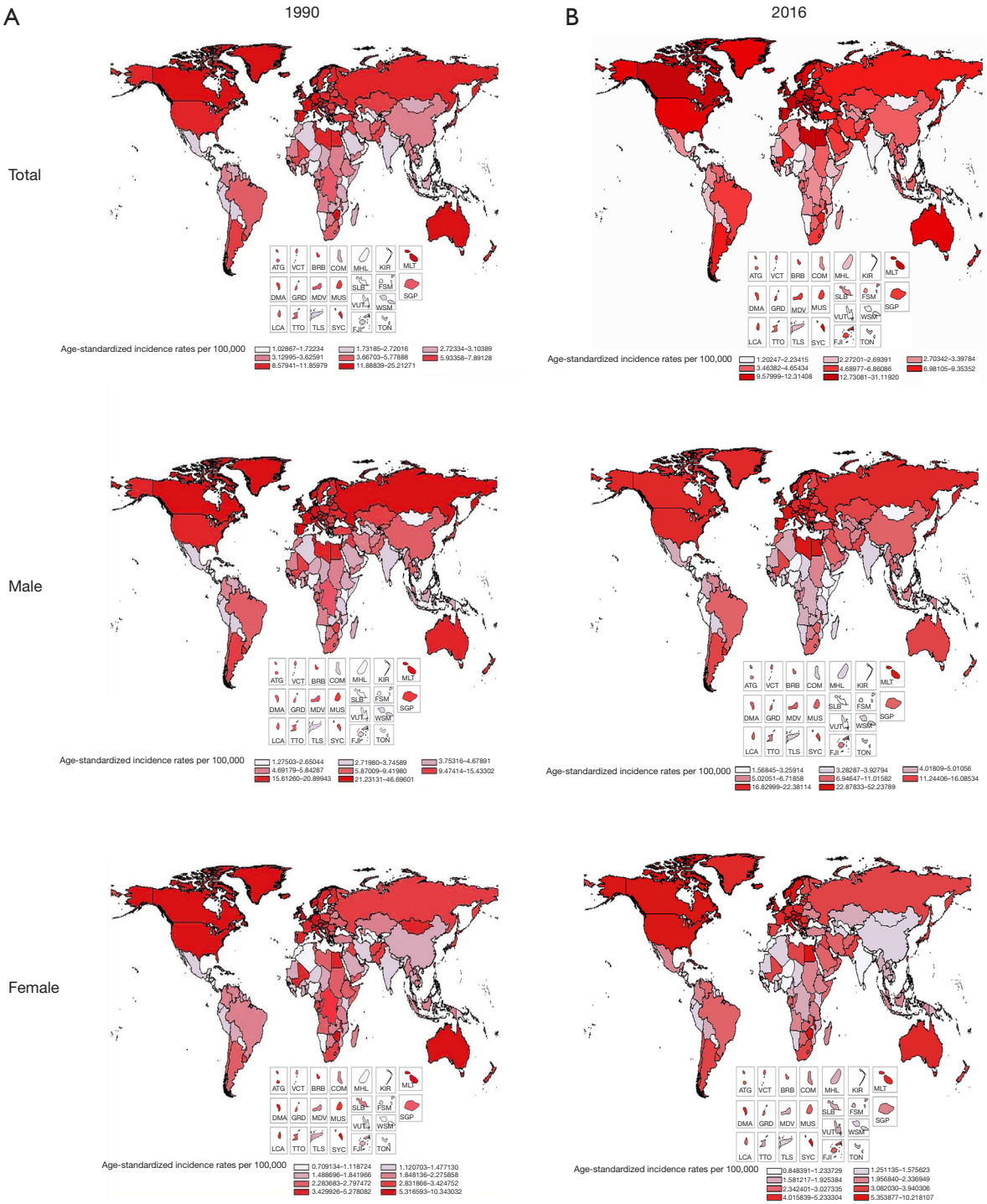

Figure 1 Global and regional bladder cancer ASIR by geography and gender, 1990 and 2016. ASIR, age-standardized incidence rate; ATG, Antigua and Barbuda; VCT, Saint Vincent and the Grenadines; BRB, Barbados; COM, Comoros; MHL, Marshall Islands; KIR, Kiribati; MLT, Malta; DMA, Dominica; GRD, Grenada; MDV, Maldives; MUS, Mauritius; SLB, Solomon Islands; FSM, Federated States of Micronesia; VUT, Vanuatu; WSM, Samoa. SGP, Singapore; LCA, Saint Lucia; TTO, Trinidad and Tobago; TLS, Timor-Leste; SYC, Seychelles; FJI, Fiji; TON, Tonga.

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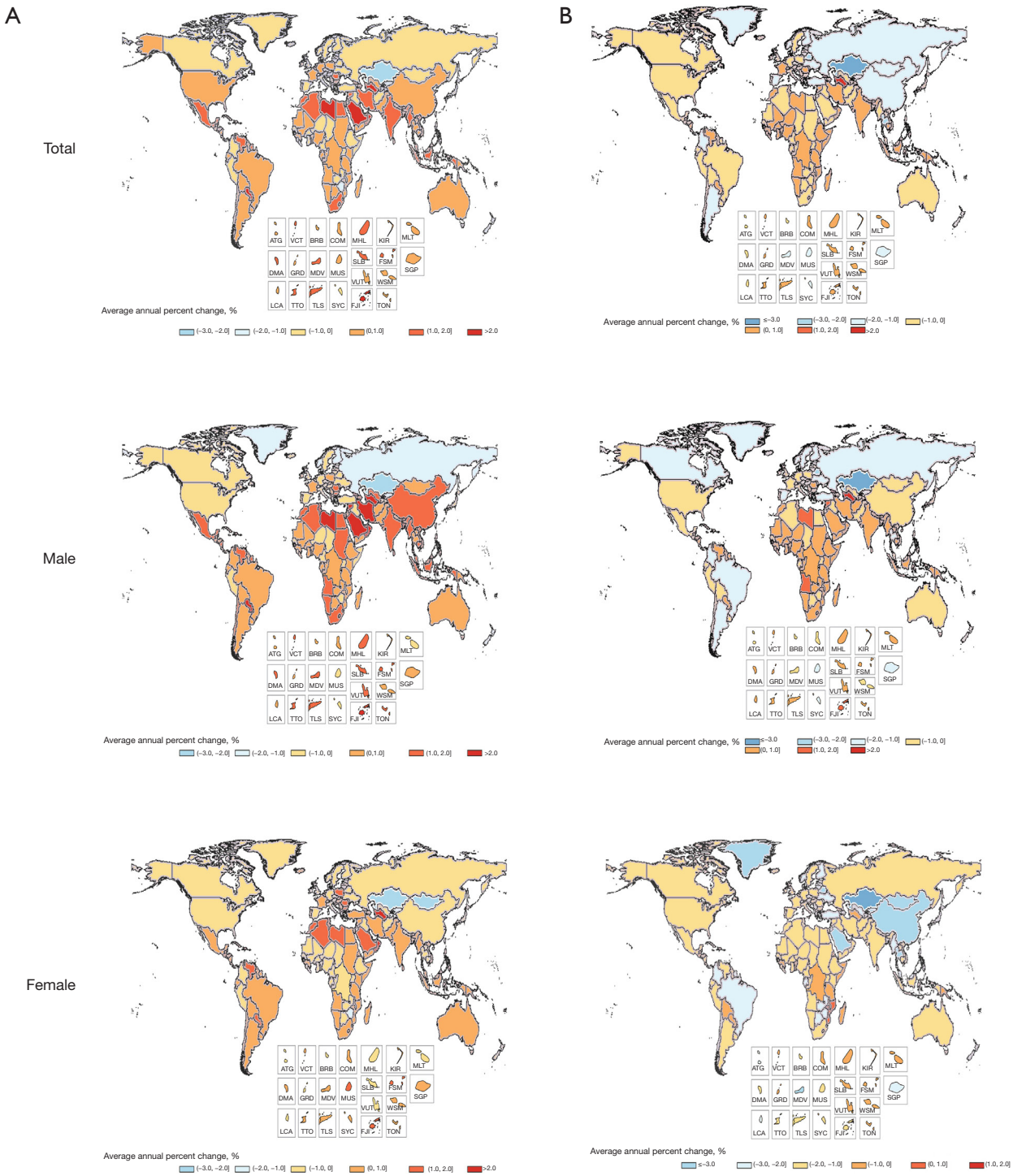

Figure 2 Global and regional average annual percent change in age-standardized incidence and death rates for bladder cancer by geography and gender, 1990–2016. (A) Average annual percent change in age-standardized incidence rates for bladder cancer by geography and gender, 1990–2016; (B) average annual percent change in age-standardized death rates for bladder cancer by geography and gender, 1990–2016. ATG, Antigua and Barbuda; VCT, Saint Vincent and the Grenadines; BRB, Barbados; COM, Comoros; MHL, Marshall Islands; KIR, Kiribati; MLT, Malta; DMA, Dominica; GRD, Grenada; MDV, Maldives; MUS, Mauritius; SLB, Solomon Islands; FSM, Federated States of Micronesia; VUT, Vanuatu; WSM, Samoa. SGP, Singapore; LCA, Saint Lucia; TTO, Trinidad and Tobago; TLS, Timor-Leste; SYC, Seychelles; FJI, Fiji; TON, Tonga.

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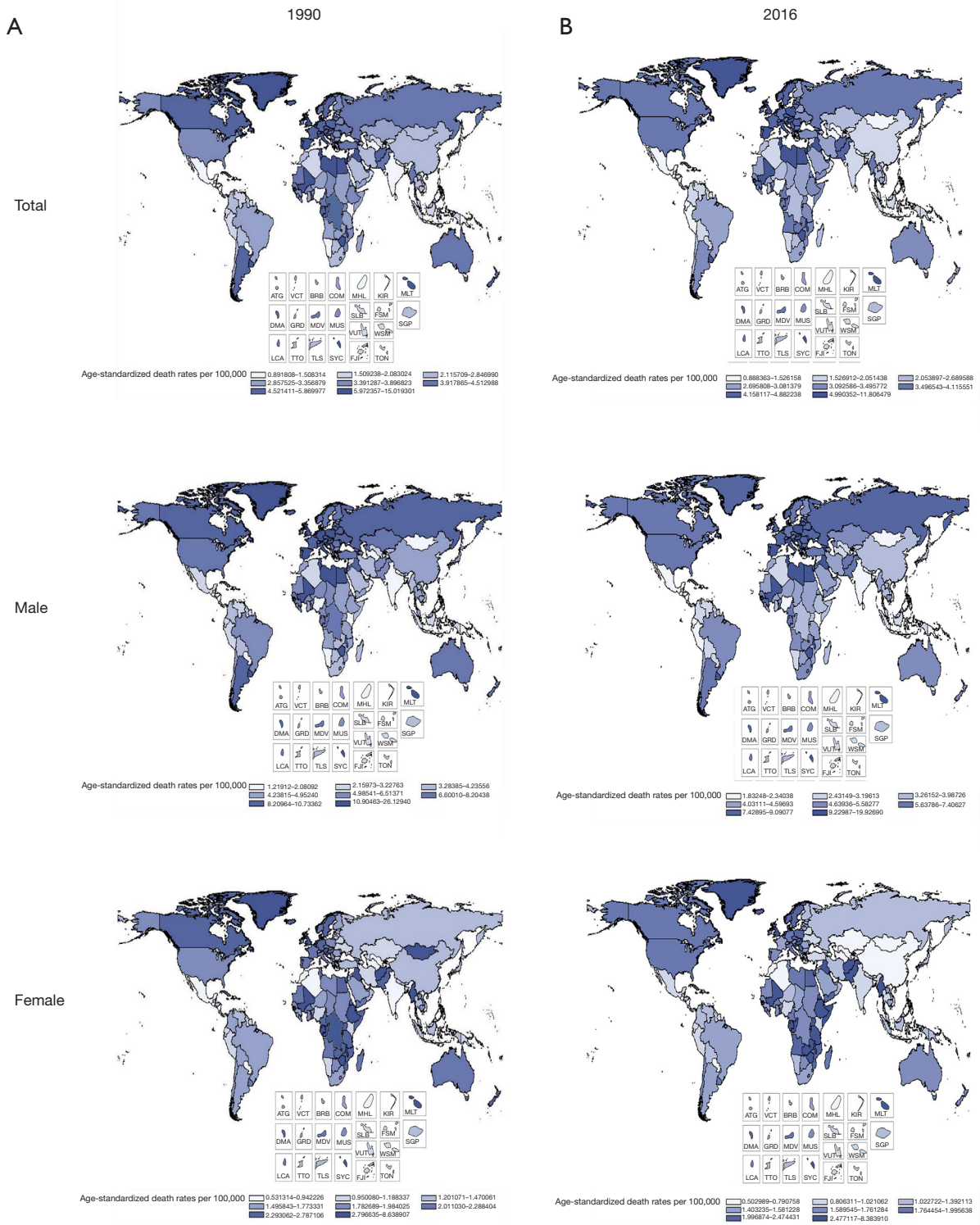

Figure 3 Global and regional bladder cancer ASDR by geography and gender, 1990 and 2016. ASDR, age-standardized death rate; ATG indicates Antigua and Barbuda; VCT, Saint Vincent and the Grenadines; BRB, Barbados; COM, Comoros; MHL, Marshall Islands; KIR, Kiribati; MLT, Malta; DMA, Dominica; GRD, Grenada; MDV, Maldives; MUS, Mauritius; SLB, Solomon Islands; FSM, Federated States of Micronesia; VUT, Vanuatu; WSM, Samoa. SGP, Singapore; LCA, Saint Lucia; TTO, Trinidad and Tobago; TLS, Timor-Leste; SYC, Seychelles; FJI, Fiji; TON, Tonga.

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Table 3 Probability of developing bladder cancer within selected age intervals, globally, and by SDI quintile, by sex, 2006–2016 in % (odds)

Location/ SDI quintile	Birth to age 49		Age 50 to 59		Age 60 to 69		Age 70 to 79		Age 30 to 70		Birth to age 79	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Global	0.05 (1 in 1,961)	0.02 (1 in 5,319)	0.14 (1 in 740)	0.04 (1 in 2,679)	0.38 (1 in 266)	0.09 (1 in 1,169)	0.77 (1 in 130)	0.18 (1 in 561)	1.32 (1 in 76)	0.32 (1 in 315)	1.33 (1 in 75)	0.32 (1 in 313)
High-middle SDI	0.06 (1 in 1,588)	0.02 (1 in 4,868)	0.18 (1 in 542)	0.04 (1 in 2,558)	0.52 (1 in 193)	0.09 (1 in 1,135)	0.98 (1 in 103)	0.18 (1 in 568)	1.73 (1 in 58)	0.32 (1 in 311)	1.73 (1 in 58)	0.32 (1 in 309)
High SDI	0.08 (1 in 1,227)	0.04 (1 in 2,800)	0.27 (1 in 375)	0.07 (1 in 1,388)	0.71 (1 in 140)	0.16 (1 in 618)	1.39 (1 in 72)	0.32 (1 in 316)	2.43 (1 in 41)	0.58 (1 in 172)	2.44 (1 in 41)	0.58 (1 in 171)
Low-middle SDI	0.03 (1 in 3,478)	0.01 (1 in 8,843)	0.06 (1 in 1,621)	0.02 (1 in 4,529)	0.15 (1 in 646)	0.05 (1 in 2,066)	0.26 (1 in 377)	0.08 (1 in 1,206)	0.51 (1 in 197)	0.16 (1 in 611)	0.51 (1 in 196)	0.16 (1 in 608)
Low SDI	0.03 (1 in 3,864)	0.02 (1 in 6,406)	0.05 (1 in 2,020)	0.03 (1 in 3,135)	0.13 (1 in 787)	0.07 (1 in 1,453)	0.26 (1 in 385)	0.10 (1 in 964)	0.46 (1 in 217)	0.22 (1 in 457)	0.46 (1 in 217)	0.22 (1 in 455)
Middle SDI	0.05 (1 in 1,885)	0.02 (1 in 5,801)	0.10 (1 in 1,034)	0.03 (1 in 3,640)	0.24 (1 in 422)	0.05 (1 in 1,855)	0.43 (1 in 232)	0.11 (1 in 927)	0.81 (1 in 123)	0.20 (1 in 490)	0.82 (1 in 122)	0.21 (1 in 485)

Data in the parentheses indicates 95% uncertainty interval (95% UI). SDI, sociodemographic index (a summary indicator of income per capita, educational attainment, and fertility).

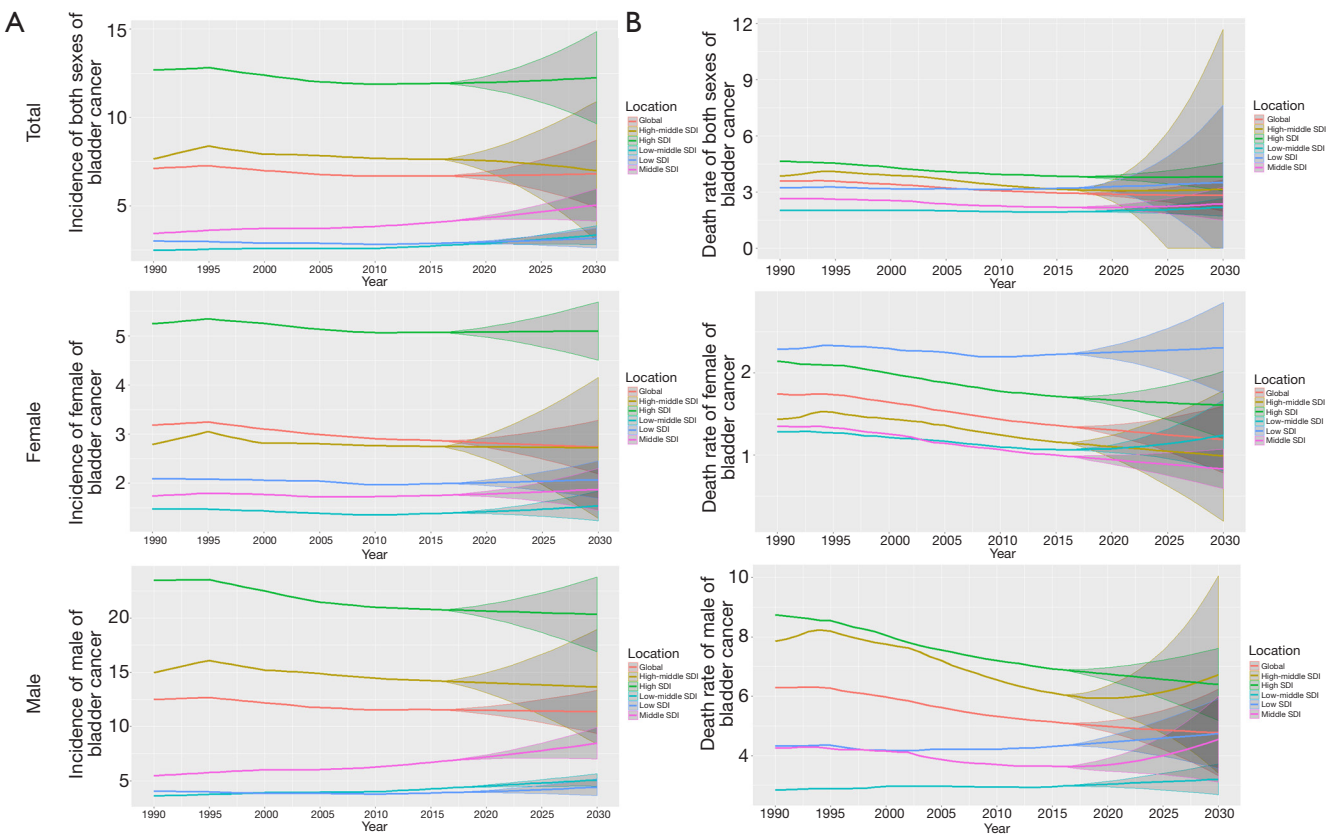

Figure 4 Global and regional trends and predictions in age-standardized incidence and death rates for bladder cancer by SDI quintile, 1990–2030. (A) Trends and predictions in age-standardized incidence rates for bladder cancer by SDI quintile, 1990–2030; (B) trends and predictions in age-standardized death rates for bladder cancer by SDI quintile, 1990–2030. SDI, Sociodemographic index (a summary indicator of income per capita, educational attainment, and fertility).

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prevention and control strategies. However, although we extracted the data accurately, there is likely a small amount of bias in the prediction results. However, future trends in bladder cancer are worthy of attention.

Conclusions

Globally, between 1990 and 2016, the incidence and death cases of bladder cancer increased substantially, while the ASIR and ASDR of bladder cancer decreased. The incidence and mortality rates of bladder cancer will continue to increase among some SDI countries and regions in the next 15 years. Policy makers in different regions should devise improved strategies for bladder cancer prevention and control.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Supplementary

Table S1 Sources for cancer incidence and mortality-to-incidence (MI) ratio data by country, year, and registry

Location	Registry	Years available from registry	Years used for incidence	Years available for MI ratio	Years used for MI ratio
Algeria	Algiers	1993–1997	5	1993–1997	0
Algeria	Batna	2000–2006	7	2000–2006	0
Algeria	Oran	2005–2006	2	2005–2006	0
Algeria	Setif	1986–2007	18	1986–2007	0
Antilles except Aruba	Antilles except Aruba	1973–1982	0	NA	NA
Argentina	Bahia Blanca	1993–2007	15	1993–2007	0
Argentina	Concordia	1990–1997	10	1990–1997	0
Argentina	Cordoba	2003–2007	4	2004–2007	0
Argentina	Mendoza	2003–2007	5	2003–2007	0
Argentina	Tierra del Fuego	2003–2007	5	2003–2007	0
Australia	Capital Territory	1978–2007	25	1983–2007	0
Australia	National Registry	1982–2007	26	1968–2007	26
Australia	New South Wales	1973–2007	25	1983–2007	0
Australia	Northern Territory	1993–2007	10	1998–2007	0
Australia	Queensland	1982–2007	15	1993–2007	0
Australia	South Australia	1977–2007	31	1977–2007	0
Australia	Tasmania	1978–2007	30	1978–2007	0
Australia	Victoria	1982–2007	25	1983–2007	0
Australia	Western Australia	1982–2007	25	1983–2007	0
Austria	National Registry	1983–2010	31	1983–2010	7
Austria	Salzburg	NA	NA	1999–2006	0
Austria	Tyrol	1988–2007	0	1988–2007	0
Austria	Vorarlberg	1993–2007	0	1993–2007	0
Bahrain	National Registry	1998–2007	10	1998–2007	0
Belarus	National Registry	1983–2007	25	1983–2007	0
Belgium	Antwerp	1998–2002	5	1998–2002	0
Belgium	Flanders	1998–2001	4	1998–2001	0
Belgium	Flanders except Limburg	1997–1998	2	1997–1998	0
Belgium	Limburg	1997–1998	2	1997–1998	0
Belgium	National Registry	2003–2010	7	2003–2010	0
Bermuda	Bermuda	1983–1987	5	1983–1987	0
Brazil	Aracaju	1996–2012	17	1996–2012	0
Brazil	Barretos	2008–2013	6	2008–2013	0
Brazil	Belem	1989–2009	17	1989–2009	0
Brazil	Belo Horizonte	2000–2008	9	2000–2008	0
Brazil	Brasilia	1998–2001	4	1998–2001	0
Brazil	Campinas	1991–2005	15	1991–2005	0
Brazil	Campo Grande	2000–2009	6	2000–2009	0
Brazil	Cuiaba	2000–2007	8	2000–2007	0
Brazil	Curitiba	1998–2010	13	1998–2010	0
Brazil	Distrito Federal	1999–2002	4	1999–2002	0
Brazil	Espirito Santo	1997–2012	16	1997–2012	0
Brazil	Florianopolis	2008–2012	5	2008–2012	0
Brazil	Fortaleza	1978–2006	25	1978–2006	0
Brazil	Goiania	1988–2009	22	1988–2009	0
Brazil	Jahu	1996–2013	18	1996–2013	0
Brazil	Joao Pessoa	1999–2010	12	1999–2010	0
Brazil	Manaus	1999–2006	8	1999–2006	0
Brazil	MatoGrosso Interior	2001–2005	5	2001–2005	0
Brazil	Natal	1999–2005	7	1999–2005	0
Brazil	Palmas	2000–2012	13	2000–2012	0
Brazil	Pocos de Caldas	2007–2011	5	2007–2011	0
Brazil	Porto Alegre	1979–2006	22	1979–2006	0
Brazil	Recife	1968–2010	17	1968–2010	0
Brazil	Roraima	2003–2010	8	2003–2010	0
Brazil	Salvador	1996–2005	10	1996–2005	0
Brazil	Santos	2008–2009	2	2008–2009	0
Brazil	Sao Paulo	1969–2011	17	1969–2011	0
Brazil	Teresina	2000–2006	7	2000–2006	0
Bulgaria	National Registry	1993–2010	12	1993–2010	12
Canada	Alberta	1960–2007	32	1960–2007	0
Canada	British Columbia	1969–2007	32	1969–2007	0
Canada	Manitoba	1958–2007	32	1958–2007	0
Canada	Maritime	1969–1987	9	1969–1987	0
Canada	National Registry	1978–2007	30	1978–2007	0
Canada	New Brunswick	1962–2007	25	1962–2007	0
Canada	Newfoundland	1969–2002	26	1969–2002	0
Canada	Newfoundland and Labrador	1960–2007	9	1960–2007	0
Canada	Northwest Territories	1983–2007	0	1983–2007	0
Canada	Northwest Territories and Yukon	1973–1987	5	1973–1987	0
Canada	Nova Scotia	1978–2007	20	1978–2007	0
Canada	Ontario	1969–2007	23	1969–2007	0
Canada	Prince Edward Island	1978–2007	16	1978–2007	0
Canada	Quebec	1963–2007	13	1963–2007	0
Canada	Saskatchewan	1960–2007	34	1960–2007	0
Canada	Yukon	1983–2007	0	1983–2007	0
Chile	Antofagasta	2003–2007	0	2003–2007	0
Chile	Bio Bio	2003–2007	5	2003–2007	0
Chile	Los Rios	2003–2007	5	2003–2007	0
Chile	National Registry	1959–1961	0	1959–1961	0
Chile	Valdivia	1998–2007	10	1998–2007	0
China	Anshan	1998–2011	11	1998–2011	13
China	Baoding	2009–2011	2	2009–2011	2
China	Beijing	1990–2011	22	1990–2011	21
China	Beijing Rural Areas	2011	0	2011	0
China	Beiliu	2011	1	2011	1
China	Bengbu	2011	1	2011	1
China	Benxi	2003–2011	8	2003–2011	8
China	Bijiang District, Tongren	2011	1	2011	1
China	Bincheng District, Binzhou	2011	1	2011	1
China	Binghai	2011	1	2011	1
China	Boli	2011	1	2011	1
China	Cangwu	2011	1	2011	1
China	Cangzhou	2011	1	2011	1
China	Changfeng	2011	1	2011	1
China	Changle	1990–2011	21	1990–2011	21
China	Changning	2011	1	2011	1
China	Changzhou	2011	1	2011	1
China	Chifeng	2009–2011	2	2009–2011	2
China	Chuzhou District, Huai'an	2004–2007	3	2004–2007	0
China	Ci County	1990–2009	23	1990–2009	12
China	Cili	2011	1	2011	1
China	Cixi	2011	1	2011	1
China	Cixian	2011	1	2011	1
China	Daan	2011	1	2011	1
China	Dafeng	2003–2011	6	2003–2011	8
China	Dalian City	1998–2011	12	1998–2011	13
China	Dancheng	2011	1	2011	1
China	Dandong	2008–2011	3	2008–2011	3
China	Daoli District, Harbin City	2005–2011	5	2005–2011	6
China	Dawukou	2011	1	2011	1
China	Dazhu	2011	1	2011	1
China	Decheng District, Dezhou	2011	1	2011	1
China	Dehui	2009–2011	2	2009–2011	2
China	Dingan	2011	1	2011	1
China	Donggang	2009–2011	2	2009–2011	2
China	Donghai County	2004–2011	3	2004–2011	2
China	Dunhuang	2011	1	2011	1
China	Faku	2011	1	2011	1
China	Feicheng	1998–2011	13	1998–2011	13
China	Feidong	2011	1	2011	1
China	Feixi County	2009–2011	2	2009–2011	2
China	Fusui County	1990–2011	14	1990–2011	8
China	Fuyuan	2011	1	2011	1
China	Ganyu	2004–2011	2	2004–2011	1
China	Ganzhou District, Zhangye	2011	1	2011	1
China	Gaomi	2011	1	2011	1
China	Gaotang	2011	1	2011	1
China	Gejiu	2004–2011	3	2004–2011	2
China	Gongan	2011	1	2011	1
China	Guangrao	2011	1	2011	1
China	Guangzhou City	2000–2011	9	2000–2011	11
China	Guannan	2011	1	2011	1
China	Guanyun County	2004–2011	3	2004–2011	3
China	Guilin	2011	1	2011	1
China	Guyuan	2011	1	2011	1
China	Hai'an County	2009–2011	2	2009–2011	2
China	Haimen	2003–2011	7	2003–2011	8
China	Hainan	2011	1	2011	1
China	Haining	1998–2011	11	1998–2011	13
China	Hangzhou City	2000–2011	9	2000–2011	11
China	Hanjiang District, Putian	2011	1	2011	1
China	Hefei	2011	1	2011	1
China	Hengdong County	2009–2011	2	2009–2011	2
China	Hepu	2011	1	2011	1
China	Hetian	2011	1	2011	1
China	Hong Kong Special Administrative Region of China	1974–2013	43	1974–2013	8
China	Hongta District, Yuxi	2011	1	2011	1
China	Hongtong	2011	1	2011	1
China	Hongze	2011	1	2011	1
China	Huai'an District, Huai'an	1998–2009	12	1998–2009	12
China	Huaiyin District, Huai'an	2009–2011	2	2009–2011	2
China	Huangdao District, Qingdao	2011	1	2011	1
China	Huian	2011	1	2011	1
China	Huichuan District, Zunyi	2011	1	2011	1
China	Huinong	2011	1	2011	1
China	Huixian	2011	1	2011	1
China	Huzhu	2011	1	2011	1
China	Jiangmen	2011	1	2011	1
China	Jianhu County	2003–2011	6	2003–2011	8
China	Jianou	2011	1	2011	1
China	Jianping	2011	1	2011	1
China	Jiashan County	1990–2011	22	1990–2011	21
China	Jiaxing	2000–2011	10	2000–2011	11
China	Jilin	2011	1	2011	1
China	Jinan	2011	1	2011	1
China	Jingan	2011	1	2011	1
China	Jingtai County	2009–2011	2	2009–2011	2
China	Jingxian	2011	1	2011	1
China	Jingyang	2011	1	2011	1
China	Jinhu County	2007–2011	3	2007–2011	4
China	Jintan District	2003–2011	6	2003–2011	7
China	Jinzhai	2011	1	2011	1
China	Jiulongpo District, Chongqing	2004–2011	3	2004–2011	4
China	Jiyuan	2011	1	2011	1
China	Junan	2011	1	2011	1
China	Kaihua	2011	1	2011	1
China	Kailu	2011	1	2011	1
China	Kaiyang	2011	1	2011	1
China	Kangping	2011	1	2011	1
China	Kunes County	2009	1	2009	1
China	Lanping	2011	1	2011	1
China	Lanzhou	2011	1	2011	1
China	Leishan	2011	1	2011	1
China	Leshan	2011	1	2011	1
China	Lhasa	2011	1	2011	1
China	Liangzhou District	2008–2011	3	2008–2011	3
China	Lianhu District, Xi'an	2011	1	2011	1
China	Lianshui	2011	1	2011	1
China	Lianyungang	2004–2011	4	2004–2011	4
China	Lingbi	2011	1	2011	1
China	Linhe District, Bayannaoer	2011	1	2011	1
China	Linqu County	1998–2011	11	1998–2011	13
China	Lintan	2011	1	2011	1
China	Linxian	2011	1	2011	1
China	Linzhou	1990–2011	19	1990–2011	21
China	Liuzhou	2009–2011	2	2009–2011	2
China	Liyang	2011	1	2011	1
China	Longnan	2011	1	2011	1
China	Longquanyi District, Chengdu	2011	1	2011	1
China	Lujiang	2011	1	2011	1
China	Luoshan	2011	1	2011	1
China	Luoyang	2011	1	2011	1
China	Lushan	2011	1	2011	1
China	Ma'anshan	2003–2011	6	2003–2011	8
China	Macao Special Administrative Region of China	2003–2007	5	2003–2007	0
China	Macheng	2011	1	2011	1
China	Maiji District, Tianshui	2011	1	2011	1
China	Mayang	2011	1	2011	1
China	Meixian	2011	1	2011	1
China	Minhe	2011	1	2011	1
China	Naidong	2011	1	2011	1
China	Nangang District, Harbin City	1992–2011	20	1992–2011	14
China	Nantong	2011	1	2011	1
China	Neixiang	2011	1	2011	1
China	Ningyang	2011	1	2011	1
China	Nongqishi	2011	1	2011	1
China	Pengzhou	2011	1	2011	1
China	Pingluo	2011	1	2011	1
China	Qianxi County	2009–2011	2	2009–2011	2
China	Qidong County	1983–2011	35	1983–2011	21
China	Qingdao	2011	1	2011	1
China	Qinghe	2011	1	2011	1
China	Qingpu	2011	1	2011	1
China	Qingyang District, Chengdu	2009–2011	2	2009–2011	2
China	Qinhuangdao	2011	1	2011	1
China	Qionghai	2011	1	2011	1
China	Renhe District, Panzhihua	2011	1	2011	1
China	Rushan	2011	1	2011	1
China	Sanmenxia	2011	1	2011	1
China	Sanya	2011	1	2011	1
China	Shangdong	1993–1997	0	NA	NA
China	Shanggao	2011	1	2011	1
China	Shanghai	1975–2011	31	1975–2011	21
China	Shangyu	2009–2011	2	2009–2011	2
China	Shangzhi	2009–2011	2	2009–2011	2
China	Shangzhou District, Shangluo	2011	1	2011	1
China	Shapingba District, Chongqing	2011	1	2011	1
China	Shenqiu	2011	1	2011	1
China	Shenyang City	2003–2011	7	2003–2011	8
China	Shenzen City	2004–2011	2	2004–2011	1
China	Shexian County	2003–2011	8	2003–2011	8
China	Sheyang County	2008–2011	3	2008–2011	3
China	Shifeng District, Zhuzhou	2011	1	2011	1
China	Shihezi	2011	1	2011	1
China	Shouxian	2011	1	2011	1
China	Shouyang	2011	1	2011	1
China	Sihui	1998–2011	11	1998–2011	13
China	Suzhou	2006–2011	4	2006–2011	5
China	Taixing	2004–2011	4	2004–2011	6
China	Tengchong	2011	1	2011	1
China	Tengzhou	2011	1	2011	1
China	Tianchang	2011	1	2011	1
China	Tianjin	1981–2011	22	1981–2011	16
China	Tianjin Rural Areas	2011	0	2011	0
China	Tianshan District, Urumqi	2011	1	2011	1
China	Tong'an District, Xiamen	2011	1	2011	1
China	Tongguan	2011	1	2011	1
China	Tonghua	2011	1	2011	1
China	Tongling	2008–2011	3	2008–2011	3
China	Wanzhouqu District, Chongqing	2011	1	2011	1
China	Wenshang County	2009–2011	2	2009–2011	2
China	Wuan	2011	1	2011	1
China	Wufeng	2011	1	2011	1
China	Wuhan City	1990–2011	22	1990–2011	18
China	Wuhu	2011	1	2011	1
China	Wuning	2011	1	2011	1
China	Wuwei	2004	1	2004	0
China	Wuxi	2006–2011	2	2006–2011	2
China	Xiamen City	2009–2011	2	2009–2011	2
China	Xiang'an District, Xiamen	2011	1	2011	1
China	Xiangfang District, Harbin	2011	1	2011	1
China	Xianju County	2009–2011	2	2009–2011	2
China	Xilinhaote	2011	1	2011	1
China	Xinghualing District, Taiyuan	2011	1	2011	1
China	Xining	2009–2011	2	2009–2011	2
China	Xinyuan	2011	1	2011	1
China	Xinzhou District, Shangrao	2011	1	2011	1
China	Xiping County	2009–2011	2	2009–2011	2
China	Xuanwei	2011	1	2011	1
China	Xuyi County	2009–2011	2	2009–2011	2
China	Xuzhou	2011	1	2011	1
China	Yakeshi	2011	1	2011	1
China	Yancheng	2011	1	2011	1
China	Yancheng District, Luohe	2011	1	2011	1
China	Yangcheng County	2003–2011	6	2003–2011	8
China	Yangquan	2009–2011	2	2009–2011	2
China	Yangshan	2011	1	2011	1
China	Yangzhong	1998–2011	12	1998–2011	13
China	Yanji	2009–2011	2	2009–2011	2
China	Yanshi	2009–2011	2	2009–2011	2
China	Yantai	2011	1	2011	1
China	Yanting County	1998–2011	10	1998–2011	13
China	Yinchuan	2011	1	2011	1
China	Yingdong District, Fuyang	2011	1	2011	1
China	Yingshan	2011	1	2011	1
China	Yiyuan	2011	1	2011	1
China	Yongding	2011	1	2011	1
China	Yongqiao District, Suzhou	2011	1	2011	1
China	Yuanhui District, Luohe	2011	1	2011	1
China	Yuanqu	2011	1	2011	1
China	Yucheng	2011	1	2011	1
China	Yuci District, Jinzhong	2011	1	2011	1
China	Yueyanglou	2011	1	2011	1
China	Yunmeng County	2009–2011	2	2009–2011	2
China	Yuzhong District, Chongqing	2011	1	2011	1
China	Yuzhou	2011	1	2011	1
China	Zanhuang	2011	1	2011	1
China	Zhanggong District	2009	1	2009	1
China	Zhanggong District, Ganzhou	2011	1	2011	1
China	Zhangqiu	2011	1	2011	1
China	Zhaoling District, Luohe	2011	1	2011	1
China	Zhaoyuan	2011	1	2011	1
China	Zhongshan	1998–2011	12	1998–2011	13
China	Zhongshan County	2004–2007	3	2004–2007	0
China	Zhongwei	2011	1	2011	1
China	Zhongxiang	2011	1	2011	1
China	Zhuanghe	2009–2011	2	2009–2011	2
China	Zhuhai	2011	1	2011	1
China	Ziliujing District	2009	1	2009	1
China	Ziliujing District, Zigong	2011	1	2011	1
China	Zixing	2011	1	2011	1
China	Zoucheng	2011	1	2011	1
Colombia	Bucaramanga	2003–2007	5	2003–2007	0
Colombia	Cali	1962–2007	40	1962–2007	0
Colombia	Manizales	2003–2007	5	2003–2007	0
Colombia	National Registry	2003–2010	0	2003–2010	0
Colombia	Pasto	2003–2007	5	2003–2007	0
Costa Rica	National Registry	1980–2011	33	1980–2013	0
Cote d'Ivoire	National Registry	1995–1997	3	1995–1997	0
Croatia	National Registry	1988–2010	23	1988–2010	8
Cuba	National Registry	1968–1987	11	1968–1986	0
Cuba	Villa Clara	1995–2007	7	1995–2007	0
Cyprus	National Registry	1998–2007	9	1998–2007	4
Czech Republic	National Registry	1983–2010	27	1983–2010	5
Denmark	National Registry	1953–2014	50	1953–2014	35
Ecuador	Cuenca	2003–2007	5	2003–2007	0
Ecuador	Quito	1985–2007	25	1985–2007	0
Egypt	Aswan	2008	1	2008	0
Egypt	Damietta	2009	1	2009	0
Egypt	Gharbiah	1999–2007	9	1999–2007	0
Egypt	Minia	2009	1	2009	0
Estonia	National Registry	1968–2011	44	1968–2009	5
Fiji	National Registry	1998–2010	13	1998–2010	11
Finland	National Registry	1953–2014	50	1953–2014	35
France	Bas Rhin	1975–2007	33	1975–2007	0
France	Calvados	1978–2007	30	1978–2007	0
France	Calvados Digestive	1978–2009	6	1978–2009	0
France	Cote d'Or	1980–2009	30	1980–2009	0
France	Doubs	1977–2009	36	1977–2009	0
France	Finistere Digestive	1984–2009	26	1984–2009	0
France	Haut Rhin	1988–2009	21	1988–2009	0
France	Herault	1987–2009	26	1987–2009	0
France	Isere	1979–2009	30	1979–2009	0
France	Loire Atlantique	1991–2009	18	1991–2009	0
France	Manche	1994–2009	19	1994–2009	0
France	Nord	2005–2009	3	2005–2009	0
France	Normandy	2002–2009	8	2002–2009	0
France	Somme	1982–2009	27	1982–2009	0
France	Tarn	1982–2009	27	1982–2009	0
France	Vendee	1998–2007	10	1998–2007	0
French Polynesia	French Polynesia	1988–2002	0	NA	NA
Germany	Bavaria	2002–2007	0	2002–2007	0
Germany	Berlin	1998–2007	2	1998–2007	0
Germany	Brandenburg	1998–2007	2	1998–2007	0
Germany	Bremen	2000–2008	0	2000–2008	0
Germany	Eastern States (former GDR)	1964–1989	22	1964–1989	0
Germany	Free State of Saxony	1998–2007	2	1998–2007	0
Germany	Hamburg	1969–2009	16	1969–2010	2
Germany	Lower Saxony	2003–2007	0	2003–2007	0
Germany	Mecklenburg	1998–2007	2	1998–2007	0
Germany	Mecklenburg–West Pomerania	1998–2007	0	1998–2007	0
Germany	Munich	1998–2007	0	1998–2007	0
Germany	National Registry	2000–2010	11	2000–2010	11
Germany	North Rhine Westphalia	1998–2007	2	1994–2007	2
Germany	Rhineland Palatinate	2000–2007	0	2000–2007	0
Germany	Saarland	1968–2007	30	1968–2007	30
Germany	Saxony–Anhalt	1998–2007	2	1998–2007	0
Germany	Schleswig Holstein	1998–2007	2	1998–2007	2
Germany	Thuringen	1998–2007	2	1998–2007	0
Germany	Westphalia	1998–2007	0	1998–2007	0
Greece	National Registry	1990–1991	0	1990–1991	0
Greenland	Greenland	1980–2014	35	1980–2014	32
Grenada	St. George's Central Hospital	1996–2000	5	1996–2000	0
Guinea	Conakry	1992–1995	4	1992–1995	0
Hungary	County Szabolcs-Szatmar	1962–1987	18	1962–1987	0
Hungary	County Vas	1962–1987	20	1962–1987	0
Hungary	Miskolc	1962–1966	0	1962–1966	0
Hungary	National Registry	2001–2011	11	2001–2011	0
Iceland	National Registry	1955–2014	50	1955–2014	35
India	Ahmedabad	1983–2005	12	NA	NA
India	Ahmedabad Rural	2006–2010	5	NA	NA
India	Ahmedabad Urban	2006–2013	7	NA	NA
India	Aizawl	2005–2014	5	NA	NA
India	Aurangabad	2005–2014	9	NA	NA
India	Bangalore	1982–2012	24	NA	NA
India	Barshi Expanded	2009–2012	2	NA	NA
India	Barshi Rural	1988–2014	20	NA	NA
India	Bhopal	2004–2013	11	NA	NA
India	Cachar	2007–2014	7	NA	NA
India	Chandigarh Union Territory	2013	1	NA	NA
India	Chennai	1982–2013	34	NA	NA
India	Delhi	1993–2012	21	NA	NA
India	Dibrugarh	2005–2014	11	NA	NA
India	DindigulAmbilikkai	2003–2013	7	NA	NA
India	Imphal	2005–2014	5	NA	NA
India	Kamrup Urban	2005–2014	11	NA	NA
India	Karunagappally	1991–2007	17	NA	NA
India	Kolkata	2005–2012	6	NA	NA
India	Kollam	2006–2014	8	NA	NA
India	Manipur	2006–2010	5	NA	NA
India	Manipur ExclImphal West	2009–2014	5	NA	NA
India	Mansa District	2013	1	NA	NA
India	Meghalaya	2010–2014	5	NA	NA
India	Mizoram	2003–2010	10	NA	NA
India	Mizoram ExclAizawl	2005–2014	5	NA	NA
India	Mumbai	1964–2012	50	NA	NA
India	Nagaland	2010–2014	4	NA	NA
India	Nagpur	1980–2013	20	NA	NA
India	NaharlagunExclPapum Pare	2012–2014	3	NA	NA
India	Papum Pare	2012–2014	3	NA	NA
India	Pasighat	2012–2014	3	NA	NA
India	Patiala District	2012–2014	3	NA	NA
India	Pune	1973–2013	32	NA	NA
India	S.A.S Nagar District	2013	1	NA	NA
India	Sangrur District	2013	1	NA	NA
India	Sikkim	2003–2014	14	NA	NA
India	Silchar	2005–2006	2	NA	NA
India	Tamil Nadu	2012–2013	2	NA	NA
India	Tripura	2010–2014	4	NA	NA
India	Trivandrum	1991–2014	21	NA	NA
India	Wardha	2010–2014	5	NA	NA
Iran	Ardabil	1985–2008	8	1985–2008	0
Iran	Golestan	1996–2007	8	1996–2007	0
Iran	National Registry	2003–2007	8	2003–2007	0
Iraq	National Registry	2007–2011	3	2007–2011	0
Ireland	National Registry	1994–2010	16	1994–2010	0
Ireland	Southern Ireland	1980–1992	12	1980–1992	0
Israel	National Registry	1960–2010	13	1960–2010	0
Italy	Alto Adige	2003–2006	4	2003–2006	0
Italy	Biella	1995–2007	13	1995–2007	0
Italy	Brescia	1999–2007	7	1999–2006	0
Italy	Catania and Messina	2003–2005	3	2003–2005	0
Italy	Catanzaro	2003–2007	5	2003–2007	0
Italy	Como	2003–2007	5	2003–2007	0
Italy	Ferrara	1991–2007	17	1991–2007	0
Italy	Florence	1985–2002	18	1985–2002	0
Italy	Florence and Prato	1985–2007	21	1985–2005	0
Italy	Friuli Venezia Giulia	2003–2007	5	2003–2007	0
Italy	Genoa	1986–2007	18	1986–2006	0
Italy	Latina	1983–2007	12	1983–2007	0
Italy	Lecco	2003–2007	5	2003–2007	0
Italy	Macerata	1991–2000	10	1991–2000	0
Italy	Mantua	2003–2007	3	2003–2005	0
Italy	Milan	1999–2007	8	1999–2006	0
Italy	Modena	1988–2007	23	1988–2007	0
Italy	Naples	1998–2007	10	1998–2007	0
Italy	National Registry	2006–2009	4	2006–2009	4
Italy	North East Italy	1995–2002	8	1995–2002	0
Italy	Nuoro	2003–2007	5	2003–2007	0
Italy	Palermo	2003–2007	4	2003–2006	0
Italy	Parma	1978–2007	30	1978–2007	0
Italy	Ragusa	1978–2007	31	1981–2007	0
Italy	Reggio Emilia	1998–2007	10	1998–2007	0
Italy	Romanga	1985–2007	22	1986–2007	0
Italy	Salerno	1998–2007	9	1998–2007	0
Italy	Sassari	1993–2007	15	1993–2007	0
Italy	Sondrio	1998–2007	14	1998–2007	0
Italy	South Lombard	2003–2005	3	2003–2005	0
Italy	South Tyrol	2003–2007	0	NA	NA
Italy	Syracuse	1999–2007	9	1999–2007	0
Italy	Torino	1984–2007	23	1985–2007	0
Italy	Trapani	2003–2006	4	2003–2006	0
Italy	Trento	2003–2006	4	2003–2006	0
Italy	Trieste	1983–1992	6	1984–1992	0
Italy	Umbria	1994–2007	13	1994–2007	1
Italy	Varese	1976–2007	32	1976–2007	0
Italy	Veneto	1988–2007	17	1988–2006	0
Jamaica	National Registry	1958–2007	25	1958–2007	0
Japan	Aichi	1998–2007	11	1998–2007	1
Japan	Fukui	1998–2007	10	1998–2007	0
Japan	Fukuoka	1974–1975	2	1974–1975	0
Japan	Hiroshima	1978–2007	28	1978–2007	0
Japan	Miyagi	1959–2007	35	1959–2007	0
Japan	Nagasaki	1973–2007	35	1973–2007	0
Japan	National Registry	1975–2010	36	1958–2013	36
Japan	Niigata	2003–2007	5	2003–2007	0
Japan	Okayama	1966–1969	0	1966–1969	0
Japan	Osaka	1963–2007	38	1963–2007	0
Japan	Saga	1984–2007	18	1984–2007	0
Japan	Yamagata	1983–2002	23	1983–2002	0
Jordan	National Registry	2001–2008	8	2001–2008	0
Kenya	Nairobi	2000–2002	3	2000–2002	0
Kuwait	National Registry	1979–2007	28	1979–2007	0
Kyrgyzstan	National Registry	1986–1987	2	1986–1987	0
La Martinique	La Martinique	1981–2002	0	NA	NA
La Reunion	La Reunion	1988–1994	0	NA	NA
Latvia	National Registry	1983–2007	24	1983–2007	5
Lebanon	National Registry	1998–2007	4	1998–2007	0
Libya	Benghazi	2003–2005	3	2003–2005	0
Lithuania	National Registry	1978–2011	33	1978–2011	2
Malawi	Blantyre	1994–2007	10	1994–2007	0
Malaysia	National Registry	2003	1	2003	0
Malaysia	Penang	1998–2007	9	1998–2007	0
Malaysia	Sarawak	1998–2002	5	1998–2002	0
Mali	Bamako	1987–1996	11	1987–1996	0
Malta	National Registry	1969–2010	27	1969–2010	15
Mongolia	National Registry	2003–2007	0	2003–2007	0
Morocco	Greater Casablanca	2004	1	2004	0
Mozambique	Lourenco Marques	1956–1960	0	1956–1960	0
Namibia	National Registry	2000–2009	10	2000–2009	0
Netherlands	Eindhoven	1973–2007	27	1973–2007	0
Netherlands	Maastricht	1986–2002	3	1986–2002	0
Netherlands	National Registry	1989–2015	19	1989–2007	0
Netherlands	Three Provinces	1960–1962	0	1960–1962	0
New Zealand	National Registry	1968–2014	32	1983–2014	5
Nigeria	Calabar	2009–2013	5	2009–2013	0
Nigeria	Ibadan	1960–1969	0	1960–1969	0
Nigeria	Midwestern Nigeria	NA	NA	2008–2009	0
Norway	National Registry	1953–2014	50	1953–2014	35
Oman	National Registry	1993–2012	20	1993–2012	0
Pakistan	South Karachi	1995–2002	8	1995–2002	0
Palestine	West Bank	2010–2011	2	2010–2011	0
Panama	National Registry	1988–2011	23	1988–2011	12
Paraguay	Asuncion Region	1988–1989	2	1988–1989	0
Peru	Lima	1990–1991	2	1990–1991	0
Peru	Trujillo	1984–2002	19	1984–2002	1
Philippines	Manila	1983–2007	25	1983–2007	0
Philippines	Rizal	1978–2007	20	1978–2007	0
Poland	Cieszyn	1968–1977	5	1973–1977	0
Poland	Cieszyn and NowySacz	1968–1972	5	1968–1972	0
Poland	Cracow	1968–2006	26	1973–2006	0
Poland	Cracow City and District	1965–1972	5	1965–1972	0
Poland	Four Rural Areas	1965–1966	0	1965–1966	0
Poland	Katowice	1965–1977	5	1965–1974	0
Poland	Kielce	1988–2007	13	1988–2007	0
Poland	Lower Silesia	1984–2007	14	1984–2007	0
Poland	National Registry	1999–2011	13	1999–2011	13
Poland	NowySacz	1973–1986	13	1973–1986	0
Poland	Opole	1985–1987	3	1985–1987	0
Poland	Rzeszow	2003–2007	0	2003–2007	0
Poland	Warsaw	1988–2002	11	1988–2002	0
Poland	Warsaw Rural	1968–1987	15	1968–1987	0
Poland	Warsaw Urban	1965–2002	27	1965–2002	0
Portugal	Azores	1997–2011	14	1981–2012	15
Portugal	Centre	2003–2007	5	2003–2007	5
Portugal	North Portugal	2000–2006	7	2000–2006	7
Portugal	Porto	1998–2002	5	1998–2002	0
Portugal	South Portugal	1998–2007	10	1998–2007	0
Portugal	Vila Nova de Gaia	1983–1997	10	1983–1997	0
Puerto Rico	National Registry	NA	26	NA	NA
Qatar	National Registry	2003–2007	5	2003–2007	0
Romania	Banat Region	1967	0	1967	0
Romania	Cluj	2007	1	2007	1
Romania	County Cluj	1974–1987	14	1974–1987	0
Romania	County Timis	1970–1972	3	1970–1972	0
Romania	Timisoara	2008	1	2008	0
Russia	St Petersburg	1983–2007	19	1983–2007	0
Samoa	National Registry	1980–1988	9	1980–1988	0
Saudi Arabia	National Registry	1994–2012	10	1994–2012	0
Saudi Arabia	Riyadh	2003–2007	5	2003–2007	0
Senegal	Dakar	1969–1974	6	1969–1974	0
Serbia	Central Serbia	2003–2007	4	2003–2007	5
Serbia	National Registry	1999–2002	4	1999–2002	0
Serbia	Vojvodina	1988–1997	10	1988–1997	0
Seychelles	National Registry	2009–2011	3	2009–2011	0
Singapore	National Registry	1950–2008	44	1950–2008	0
Slovakia	National Registry	1968–2007	42	1968–2010	30
Slovenia	National Registry	1956–2010	49	1956–2010	8
South Africa	Johannesburg, Bantu	1953–1955	0	1953–1955	0
South Africa	National Registry	2003–2011	4	2003–2011	0
South Africa	PROMEC	1998–2007	10	1998–2007	0
South Korea	Busan	1996–2007	2	1996–2007	0
South Korea	Daegu	1997–2007	2	1997–2007	0
South Korea	Daejeon	1998–2007	0	1998–2007	0
South Korea	Gwangju	1998–2007	0	1998–2007	0
South Korea	Incheon	1998–2007	0	1998–2007	0
South Korea	Jejudo	2000–2007	3	2000–2007	0
South Korea	Kangwha County	1986–1997	12	1986–1997	0
South Korea	National Registry	1999–2012	12	1999–2012	0
South Korea	Seoul	1993–2007	5	1993–2007	0
South Korea	Ulsan	1999–2007	0	1999–2007	0
Spain	Albacete	1991–2007	16	1991–2007	6
Spain	Asturias	1988–2007	17	1988–2007	5
Spain	Balears	1988–2005	18	1988–2005	0
Spain	Basque Country	1986–2007	20	1986–2008	4
Spain	Canary Islands	1993–2006	10	1993–2006	0
Spain	Ciudad Real	2004–2007	4	2004–2007	0
Spain	Cuenca	1993–2007	15	1993–2007	5
Spain	Girona	1980–2007	27	1980–2008	23
Spain	Granada	1985–2007	22	1985–2007	23
Spain	La Rioja	1993–2007	12	1993–2007	13
Spain	Mallorca	1988–2007	14	1988–2007	0
Spain	Murcia	1983–2007	24	1983–2007	25
Spain	Navarra	1973–2007	32	1973–2008	31
Spain	Tarragona	1980–2007	25	1980–2007	24
Spain	Zaragoza	1968–2000	33	1968–2000	0
Sri Lanka	National Registry	2001–2005	6	2001–2005	0
Sweden	National Registry	1958–2014	50	1958–2014	35
Sweden	Stockholm	1990–2010	21	1990–2010	0
Sweden	Sweden except Stockholm	1990–2010	21	1990–2010	0
Switzerland	Basel	1981–2007	7	1981–2007	0
Switzerland	Geneva	1970–2008	19	1970–2008	29
Switzerland	Graubunden	1989–1997	0	1989–1997	0
Switzerland	Graubunden and Glarus	1989–2009	0	1980–2009	20
Switzerland	National Registry	1986–2013	25	1989–2013	0
Switzerland	Neuchatel	1974–2007	13	1974–2008	5
Switzerland	St Gallen – Appenzell	1980–2009	9	1980–2009	29
Switzerland	Ticino	1996–2007	0	1996–2007	0
Switzerland	Valais	1989–2007	0	1989–2007	0
Switzerland	Vaud	1975–2007	13	1975–2008	5
Switzerland	Zurich	1980–2009	9	1980–2009	0
Taiwan	National Registry	1980–2007	28	1980–2007	28
Thailand	Bangkok	1995–2007	11	1995–2007	0
Thailand	Chiang Mai	1983–2007	29	1983–2007	0
Thailand	Chonburi	2001–2007	8	2001–2007	0
Thailand	KhonKaen	1988–2007	19	1988–2007	0
Thailand	Lampang	1993–2007	18	1993–2007	0
Thailand	Lop Buri	2001–2003	3	2001–2003	0
Thailand	NakhonPhanom	2001–2003	3	2001–2003	0
Thailand	PrachuapKhiri	2001–2003	3	2001–2003	0
Thailand	Rayong	2001–2003	3	2001–2003	0
Thailand	Songkhla	1993–2007	16	1993–2007	0
Thailand	SuratThani	2001–2003	3	2001–2003	0
Thailand	UbonRatchathani	2001–2003	3	2001–2003	0
Thailand	UdonThani	2001–2003	3	2001–2003	0
The Gambia	National Registry	1987–1998	15	1987–1998	0
Trinidad and Tobago	National Registry	1995–2006	12	1995–2006	12
Tunisia	Centre Sousse	1998–2002	5	1998–2002	0
Tunisia	North Tunisia	2003–2005	3	2003–2005	0
Turkey	Ankara	2002–2005	4	2002–2005	0
Turkey	Antalya	1998–2008	13	1998–2008	0
Turkey	Edirne	2002–2007	6	2002–2007	0
Turkey	Eight Provinces	2006–2007	2	2006–2007	0
Turkey	Erzurum	2002–2005	4	2002–2005	0
Turkey	Eskisehir	2002–2005	4	2002–2005	0
Turkey	Izmir	1998–2008	14	1998–2008	0
Turkey	Nine Provinces	2008	1	2008	0
Turkey	Samsun	2002–2005	4	2002–2005	0
Turkey	Trabzon	2002–2007	5	2002–2007	0
Uganda	Kampala	1954–2013	24	1954–2013	0
Ukraine	National Registry	2000–2010	7	2000–2010	4
United Kingdom	Aryshire	1970–1972	3	1970–1972	0
United Kingdom	East Anglia	1988–1997	0	1988–1997	0
United Kingdom	East Midlands	1981–2014	34	1981–2014	20
United Kingdom	East Scotland	1973–1987	5	1973–1987	0
United Kingdom	East of England	1981–2014	33	1981–2014	20
United Kingdom	England	1993–2007	10	1993–2007	0
United Kingdom	England and Wales	1979–1990	0	1979–1990	0
United Kingdom	Greater London	1981–2014	34	1981–2014	20
United Kingdom	Merseyside and Cheshire	1959–2002	11	1959–2002	0
United Kingdom	North East England	1981–2014	34	1981–2014	20
United Kingdom	North East Scotland	1973–1987	5	1973–1987	0
United Kingdom	North Scotland	1973–1987	5	1973–1987	0
United Kingdom	North West England	1973–2014	40	1973–2014	20
United Kingdom	Northern England and Yorkshire	1998–2007	0	1998–2007	0
United Kingdom	Northern Ireland	1993–2011	18	1993–2011	0
United Kingdom	Oxford	1963–2007	18	1963–2007	0
United Kingdom	Scotland	1963–2014	40	1963–2014	25
United Kingdom	South East England	1981–2014	34	1981–2014	20
United Kingdom	South East Scotland	1973–1987	5	1973–1987	0
United Kingdom	South Thames	1960–2007	20	1960–1997	0
United Kingdom	South West England	1960–2014	37	1960–2014	20
United Kingdom	Thames	1998–2007	0	1991–2007	0
United Kingdom	Trent	1963–2007	3	1963–2007	0
United Kingdom	Wales	1981–2011	31	1981–2011	20
United Kingdom	Wessex	1988–1992	0	1988–1992	0
United Kingdom	West Midlands	1960–2014	44	1960–2014	20
United Kingdom	West Scotland	1975–1992	0	1975–1992	0
United Kingdom	Yorkshire	1983–2002	7	1983–2002	0
United Kingdom	Yorkshire and the Humber	1981–2014	34	1981–2014	20
United States	Alabama	1998–2011	10	1998–2007	0
United States	Alameda County	1969–1987	5	1983–1987	0
United States	Alaska	1998–2011	10	1998–2007	0
United States	Alaska Natives	1992–2013	0	NA	NA
United States	Arizona	1998–2011	10	1998–2007	0
United States	Arkansas	2001–2011	5	2003–2007	0
United States	Atlanta	1973–2013	39	1973–2013	36
United States	California	1998–2011	10	1998–2007	0
United States	California except SF, SJ–M, & LA	2000–2013	14	2000–2013	9
United States	Central California	1988–1992	5	1988–1992	0
United States	Colorado	1998–2011	10	1998–2007	0
United States	Connecticut	1960–2013	41	1960–2013	37
United States	Delaware	1999–2011	5	2003–2007	0
United States	Detroit	1969–2013	41	1973–2013	37
United States	District of Columbia	1998–2011	5	1998–2002	0
United States	El Paso	1960–1970	0	1960–1970	0
United States	Florida	1998–2011	10	1998–2007	0
United States	Georgia	1998–2011	10	1998–2007	0
United States	Greater Georgia	1973–2013	14	1973–2013	13
United States	Hawaii	1960–2013	46	1960–2013	37
United States	Idaho	1998–2011	10	1998–2007	0
United States	Illinois	1998–2011	10	1998–2007	0
United States	Indiana	1998–2011	10	1998–2007	0
United States	Iowa	1969–2013	41	1973–2013	37
United States	Kansas	1999–2011	0	NA	NA
United States	Kentucky	1973–2013	19	1973–2013	19
United States	Los Angeles	1973–2013	41	1973–2013	24
United States	Louisiana	1973–2013	29	1973–2013	18
United States	Maine	1998–2011	10	1998–2007	0
United States	Maryland	1999–2011	0	NA	NA
United States	Massachusetts	1998–2011	10	1998–2007	0
United States	Michigan	1998–2011	10	1998–2007	0
United States	Minnesota	1999–2011	0	NA	NA
United States	Mississippi	2003–2011	5	2003–2007	0
United States	Missouri	1998–2011	10	1998–2007	0
United States	Montana	1998–2011	10	1998–2007	0
United States	National Registry	1962–2007	0	1962–2007	0
United States	Nebraska	1999–2011	5	2003–2007	0
United States	Nevada	1959–2010	0	1959–1966	0
United States	New Hampshire	1999–2011	5	2003–2007	0
United States	New Jersey	1973–2013	24	1973–2013	19
United States	New Mexico	1969–2013	45	1969–2013	37
United States	New Orleans	1974–2007	17	1983–2007	0
United States	New York	1993–2011	15	1993–2007	0
United States	New York City	1978–1987	0	NA	NA
United States	New York except New York City	1959–1987	0	1959–1961	0
United States	North Carolina	1999–2011	5	2003–2007	0
United States	North Dakota	1999–2011	5	2003–2007	0
United States	Ohio	1998–2011	10	1998–2007	0
United States	Oklahoma	1998–2011	10	1998–2007	0
United States	Oregon	1998–2011	10	1998–2007	0
United States	Pennsylvania	1998–2011	10	1998–2007	0
United States	Rhode Island	1998–2011	10	1998–2007	0
United States	Rural Georgia	1973–2013	22	1973–2013	24
United States	San Francisco	1969–2007	29	1973–2007	0
United States	San Francisco, Oakland, San Mateo, and Surrounding Area	1973–2013	41	1973–2013	36
United States	San Jose Monterey	1973–2013	22	1973–2013	24
United States	Seattle	1973–2013	40	1973–2013	36
United States	South Carolina	1998–2011	10	1998–2007	0
United States	South Dakota	2001–2011	5	2003–2007	0
United States	Tennessee	2003–2011	5	2003–2007	0
United States	Texas	1998–2011	10	1998–2007	0
United States	Utah	1966–2013	41	1973–2013	37
United States	Vermont	1998–2011	10	1998–2007	0
United States	Virginia	2003–2011	5	2003–2007	0
United States	Washington	1998–2011	10	1998–2007	0
United States	West Virginia	1998–2011	10	1998–2007	0
United States	Wisconsin	1998–2011	10	1998–2007	0
United States	Wyoming	1999–2011	5	2003–2007	0
Uruguay	Montevideo	1990–1995	6	1990–1995	0
Uruguay	National Registry	2002–2007	8	2002–2007	0
Vietnam	Hanoi	1991–1997	8	1991–1997	0
Vietnam	Ho Chi Minh	1995–1998	4	1995–1998	0
Zimbabwe	Bulawayo	1963–1972	5	1963–1972	0
Zimbabwe	Harare	1990–2006	17	1990–2006	0
Zimbabwe	National Registry	2005–2006	2	2005–2006	0

NA, not available.

Table S2 Number of site-years for bladder cancer mortality data

Cause	VR GBD 2015	VR GBD 2016	VR change GBD 2015 to GBD 2016	VA GBD 2015	VA GBD 2016	VA change GBD 2015 to GBD 2016	CR GBD 2015	CR GBD 2016	CR change GBD 2015 to GBD 2016	Total GBD 2015	Total GBD 2016	Total change GBD 2015 to GBD 2016
Bladder cancer	10,100	16,010	59%	–	–	–	2,426	2,656	9%	12,526	18,666	49%

GBD, Global Burden of Disease; VR, vital registration system data; VA, verbal autopsy data; CR, cancer registry data.

Table S1 Sociodemographic Index groupings by geography, based on 2016 values

Location	SDI quintile
Andorra	High SDI
Australia	High SDI
Austria	High SDI
Belgium	High SDI
Brunei	High SDI
Canada	High SDI
Croatia	High SDI
Cyprus	High SDI
Czech Republic	High SDI
Denmark	High SDI
Estonia	High SDI
Finland	High SDI
France	High SDI
Georgia	High SDI
Germany	High SDI
Greece	High SDI
Iceland	High SDI
Ireland	High SDI
Italy	High SDI
Japan	High SDI
Latvia	High SDI
Lithuania	High SDI
Luxembourg	High SDI
Malta	High SDI
Netherlands	High SDI
New Zealand	High SDI
Norway	High SDI
Poland	High SDI
Puerto Rico	High SDI
Singapore	High SDI
Slovakia	High SDI
Slovenia	High SDI
South Korea	High SDI
Sweden	High SDI
Switzerland	High SDI
Taiwan	High SDI
United Kingdom	High SDI
United States	High SDI
Virgin Islands, United States	High SDI
Antigua and Barbuda	High-middle SDI
Argentina	High-middle SDI
Armenia	High-middle SDI
Azerbaijan	High-middle SDI
Barbados	High-middle SDI
Belarus	High-middle SDI
Bermuda	High-middle SDI
Bulgaria	High-middle SDI
Chile	High-middle SDI
Cuba	High-middle SDI
Georgia	High-middle SDI
Greenland	High-middle SDI
Guam	High-middle SDI
Hungary	High-middle SDI
Iran	High-middle SDI
Israel	High-middle SDI
Kazakhstan	High-middle SDI
Kuwait	High-middle SDI
Lebanon	High-middle SDI
Libya	High-middle SDI
Macedonia	High-middle SDI
Malaysia	High-middle SDI
Mauritius	High-middle SDI
Montenegro	High-middle SDI
Northern Mariana Islands	High-middle SDI
Panama	High-middle SDI
Portugal	High-middle SDI
Qatar	High-middle SDI
Romania	High-middle SDI
Russia	High-middle SDI
Saudi Arabia	High-middle SDI
Serbia	High-middle SDI
Spain	High-middle SDI
The Bahamas	High-middle SDI
Trinidad and Tobago	High-middle SDI
Turkey	High-middle SDI
Turkmenistan	High-middle SDI
Ukraine	High-middle SDI
United Arab Emirates	High-middle SDI
Albania	Middle SDI
Algeria	Middle SDI
American Samoa	Middle SDI
Bahrain	Middle SDI
Bosnia and Herzegovina	Middle SDI
Botswana	Middle SDI
Brazil	Middle SDI
China	Middle SDI
Colombia	Middle SDI
Costa Rica	Middle SDI
Dominica	Middle SDI
Dominican Republic	Middle SDI
Ecuador	Middle SDI
Egypt	Middle SDI
El Salvador	Middle SDI
Equatorial Guinea	Middle SDI
Fiji	Middle SDI
Grenada	Middle SDI
Guyana	Middle SDI
Indonesia	Middle SDI
Jamaica	Middle SDI
Jordan	Middle SDI
Maldives	Middle SDI
Mexico	Middle SDI
Moldova	Middle SDI
Mongolia	Middle SDI
Oman	Middle SDI
Paraguay	Middle SDI
Peru	Middle SDI
Philippines	Middle SDI
Saint Lucia	Middle SDI
Saint Vincent and the Grenadines	Middle SDI
Seychelles	Middle SDI
South Africa	Middle SDI
Sri Lanka	Middle SDI
Suriname	Middle SDI
Thailand	Middle SDI
Tunisia	Middle SDI
Uruguay	Middle SDI
Uzbekistan	Middle SDI
Venezuela	Middle SDI
Vietnam	Middle SDI
Bangladesh	Low-middle SDI
Belize	Low-middle SDI
Bhutan	Low-middle SDI
Bolivia	Low-middle SDI
Cambodia	Low-middle SDI
Cameroon	Low-middle SDI
Cape Verde	Low-middle SDI
Congo	Low-middle SDI
Federated States of Micronesia	Low-middle SDI
Gabon	Low-middle SDI
Ghana	Low-middle SDI
Guatemala	Low-middle SDI
Honduras	Low-middle SDI
India	Low-middle SDI
Iraq	Low-middle SDI
Kenya	Low-middle SDI
Kyrgyzstan	Low-middle SDI
Laos	Low-middle SDI
Lesotho	Low-middle SDI
Marshall Islands	Low-middle SDI
Mauritania	Low-middle SDI
Morocco	Low-middle SDI
Myanmar	Low-middle SDI
Namibia	Low-middle SDI
Nepal	Low-middle SDI
Nicaragua	Low-middle SDI
Nigeria	Low-middle SDI
North Korea	Low-middle SDI
Pakistan	Low-middle SDI
Samoa	Low-middle SDI
Sudan	Low-middle SDI
Swaziland	Low-middle SDI
Syria	Low-middle SDI
Tajikistan	Low-middle SDI
Timor-Leste	Low-middle SDI
Tonga	Low-middle SDI
Vanuatu	Low-middle SDI
Zambia	Low-middle SDI
Zimbabwe	Low-middle SDI
Afghanistan	Low SDI
Angola	Low SDI
Benin	Low SDI
Burkina Faso	Low SDI
Burundi	Low SDI
Central African Republic	Low SDI
Chad	Low SDI
Comoros	Low SDI
Cote d'Ivoire	Low SDI
Democratic Republic of the Congo	Low SDI
Djibouti	Low SDI
Eritrea	Low SDI
Ethiopia	Low SDI
Guinea	Low SDI
Guinea-Bissau	Low SDI
Haiti	Low SDI
Kiribati	Low SDI
Liberia	Low SDI
Madagascar	Low SDI
Malawi	Low SDI
Mali	Low SDI
Mozambique	Low SDI
Niger	Low SDI
Palestine	Low SDI
Papua New Guinea	Low SDI
Rwanda	Low SDI
Sao Tome and Principe	Low SDI
Senegal	Low SDI
Sierra Leone	Low SDI
Solomon Islands	Low SDI
Somalia	Low SDI
South Sudan	Low SDI
Tanzania	Low SDI
The Gambia	Low SDI
Togo	Low SDI
Uganda	Low SDI
Yemen	Low SDI

SDI, sociodemographic index.

Table S4 Covariates selected for CODEm for each GBD bladder cancer group and expected direction of covariate

Cause	Sex	Age start	Age end	Direction	Covariate
Bladder cancer	Male	15–19 years	95+ years	1	Alcohol (liters per capita)
Bladder cancer	Male	15–19 years	95+ years	1	cumulative cigarettes (10 years)
Bladder cancer	Male	15–19 years	95+ years	1	cumulative cigarettes (15 years)
Bladder cancer	Male	15–19 years	95+ years	1	cumulative cigarettes (5 years)
Bladder cancer	Male	15–19 years	95+ years	–1	Education (years per capita)
Bladder cancer	Male	15–19 years	95+ years	0	LDI (I$ per capita)
Bladder cancer	Male	15–19 years	95+ years	1	Population density (over 1,000 ppl/sqkm, proportion)
Bladder cancer	Male	15–19 years	95+ years	1	Population density (under 150 ppl/sqkm, proportion)
Bladder cancer	Male	15–19 years	95+ years	1	Smoking prevalence
Bladder cancer	Male	15–19 years	95+ years	1	Log-transformed SEV scalar: Bladder C
Bladder cancer	Male	15–19 years	95+ years	0	Sociodemographic index
Bladder cancer	Male	15–19 years	95+ years	–1	fruits adjusted (g)
Bladder cancer	Male	15–19 years	95+ years	–1	Vegetables adjusted (g)
Bladder cancer	Male	15–19 years	95+ years	–1	Healthcare access and quality index
Bladder cancer	Female	15–19 years	95+ years	1	Alcohol (liters per capita)
Bladder cancer	Female	15–19 years	95+ years	1	Cumulative cigarettes (10 years)
Bladder cancer	Female	15–19 years	95+ years	1	Cumulative cigarettes (15 years)
Bladder cancer	Female	15–19 years	95+ years	1	Cumulative cigarettes (5 years)
Bladder cancer	Female	15–19 years	95+ years	–1	Education (years per capita)
Bladder cancer	Female	15–19 years	95+ years	0	LDI (I$ per capita)
Bladder cancer	Female	15–19 years	95+ years	1	Population density (over 1,000 ppl/sqkm, proportion)
Bladder cancer	Female	15–19 years	95+ years	1	Population density (under 150 ppl/sqkm, proportion)
Bladder cancer	Female	15–19 years	95+ years	1	Smoking prevalence
Bladder cancer	Female	15–19 years	95+ years	1	Log-transformed SEV scalar: Bladder C
Bladder cancer	Female	15–19 years	95+ years	0	Sociodemographic index
Bladder cancer	Female	15–19 years	95+ years	–1	fruits adjusted (g)
Bladder cancer	Female	15–19 years	95+ years	–1	Vegetables adjusted (g)
Bladder cancer	Female	15–19 years	95+ years	–1	Healthcare access and quality index

CODEm, cause of death ensemble model; GBD, Global Burden of Disease.

Table S5 Comparison of GBD 2015 and GBD 2016 covariates used and level of covariates

Cause	Sex	Covariate	GBD 2015			GBD 2016		
			Level 1	Level 2	Level 3	Level 1	Level 2	Level 3
Bladder cancer	Male	Cumulative cigarettes (10 years)	X			X		
Bladder cancer	Male	Cumulative cigarettes (15 years)	X			X		
Bladder cancer	Male	Cumulative cigarettes (5 years)	X			X		
Bladder cancer	Male	Education (years per capita)			X			X
Bladder cancer	Male	LDI (I$ per capita)			X			X
Bladder cancer	Male	Sociodemographic index			X			X
Bladder cancer	Male	Smoking prevalence	X			X		
Bladder cancer	Male	Alcohol (liters per capita)		X			X	
Bladder cancer	Male	Log-transformed SEV scalar: Bladder C	X			X		
Bladder cancer	Male	Population density (under 150 ppl/sqkm, proportion)		X			X	
Bladder cancer	Male	Population density (over 1,000 ppl/sqkm, proportion)		X			X	
Bladder cancer	Female	Cumulative cigarettes (10 years)	X			X		
Bladder cancer	Female	Cumulative cigarettes (15 years)	X			X		
Bladder cancer	Female	Cumulative cigarettes (5 years)	X			X		
Bladder cancer	Female	Education (years per capita)			X			X
Bladder cancer	Female	LDI (I$ per capita)			X			X
Bladder cancer	Female	Sociodemographic index			X			X
Bladder cancer	Female	Smoking prevalence	X			X		
Bladder cancer	Female	Alcohol (liters per capita)		X			X	
Bladder cancer	Female	Log-transformed SEV scalar: Bladder C	X			X		
Bladder cancer	Female	Population density (under 150 ppl/sqkm, proportion)		X			X	
Bladder cancer	Female	Population density (over 1,000 ppl/sqkm, proportion)		X			X	

GBD, Global Burden of Disease.

Table S6 Results for CODEm model testing

Cause	Sex	Age start	Age end	Predictive validity					
				RMSE in	RMSE out	Trend in	Trend out	Coverage in	Coverage out
Bladder cancer (data rich)	Male	15–19 years	95+ years	0.238162	0.289199	0.193221	0.21405	0.998893	0.9979
Bladder cancer (global)	Male	15–19 years	95+ years	0.259512	0.358356	0.20438	0.211875	0.998849	0.993972
Bladder cancer (global)	Female	15–19 years	95+ years	0.279362	0.406151	0.217047	0.218843	0.995797	0.992228
Bladder cancer (data rich)	Female	15–19 years	95+ years	0.241778	0.308128	0.197425	0.236098	0.995139	0.99458

CODEm, cause of death ensemble model; RMSE, root mean square of errors.

Table S7 Percent change before and after Cod Correct by bladder cancer for all ages, both sexes combined, 2016

Cause	Cod Correct level	Percent change (%)
Bladder cancer	3	–2.19 (–3.56 to –0.52)

Table S8 Disability weights

Health state	Lay description	Estimate	Uncertainty interval
Cancer, diagnosis and primary therapy	Has pain, nausea, fatigue, weight loss and high anxiety	0.288	0.193–0.399
Cancer, controlled phase	Has a chronic disease that requires medication every day and causes some worry but minimal interference with daily activities	0.049	0.031–0.072
Cancer, metastatic	Has severe pain, extreme fatigue, weight loss and high anxiety	0.451	0.307–0.600
Terminal phase, with medication	Has lost a lot of weight and regularly uses strong medication to avoid constant pain. The person has no appetite, feels nauseous, and needs to spend most of the day in bed	0.540	0.377–0.687

Table S9 Decomposition analysis of bladder cancer incidence trends at the global and regional levels, and by SDI quintiles, both sexes, 2006 to 2016

Location	Incidence cases, No.		Expected incidence cases, 2016, No.		Change in incidence cases, 2006 to 2016, %			Overall change, %
	2006	2016	Given population growth alone	Given population growth and aging	Due to population growth	Due to change in age structure	Due to change in incidence rate	
Global	333,876 (329,918 to 337,714)	437,442 (426,709 to 447,912)	375,373	441,586	12.4	19.8	–1.2	31
High SDI	171,627 (169,324 to 173,991)	213,500 (206,159 to 220,038)	180,794	213,267	5.3	18.9	0.1	24.4
High-middle SDI	76,815 (75,044 to 78,668)	96,865 (93,605 to 100,135)	85,342	99,392	11.1	18.3	–3.3	26.1
Middle SDI	56,859 (55,417 to 58,408)	85,371 (80,381 to 87,836)	61,034	77,034	7.3	28.1	14.7	50.1
Low-middle SDI	23,940 (22,710 to 25,170)	34,771 (32,913 to 36,384)	27,918	32,388	16.6	18.7	10	45.2
Low SDI	6,011 (5,650 to 6,672)	8,223 (7,850 to 8,585)	7,952	8,197	32.3	4.1	0.4	36.8

SDI, sociodemographic index.