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Original Article

The growing burden of dementia in Asia: Comparative insights from Japan, China, and India

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ABSTRACT

Background: Alzheimer's disease and other dementias (ADODs) are increasingly becoming a major public health concern in rapidly ageing Asia. We compared the disease burden across Japan, China, and India at different demographic stages.

Design: The Global Burden of Disease Study of 2023 was used to analyze the incidence, prevalence, mortality, and disability-adjusted life years (DALYs) in 1990–2023. Decomposition analysis identified drivers of DALYs trends. DALYs associated risk factors were quantified. The Auto-Regressive Integrated Moving Average model was used to predict future disease burden.

Results: In 2023, China had the highest absolute burden, with age-standardized incidence and prevalence rates of 156.63 (95% uncertainty interval [UI]: 136.58–175.49) and 918.83(95% UI: 784.59–1,058.24) per 100,000, respectively. Japan recorded the highest age-standardized mortality rate (31.25 [8.47–71.42] per 100,000). India had the highest annual increase in mortality and DALYs, with estimated annual percentage changes of 0.91 (95% confidence interval [95% CI] 0.80–1.03) and 0.51 (0.45–0.56), respectively. Decomposition analysis revealed distinct drivers: Japan was dominated by epidemiological changes; China was driven by both aging and epidemiological changes; India was mainly due to population growth and epidemiological changes. Ambient particulate matter was the leading risk factor across all countries, though India faced a unique household air pollution burden. DALYs are predicted to increase in all three countries significantly by 2038.

Conclusions: The ADODs burden remains substantial, driven by distinct demographic and epidemiological factors in Japan, China, and India. Tailored strategies for prevention and management are essential to address the growing burden.

1. Introduction

Alzheimer's disease and other dementias (ADODs) are a leading and growing public health challenge that has an impact on over 50 million people worldwide [1,2]. As an essential cause of disability and care dependence in the elderly, ADODs pose a substantial emotional and socioeconomic impact on families, healthcare systems, and societies [3–6]. Driven by global population aging, the prevalence of dementia will reach almost 150 million by 2050 [7]. A hallmark of this projected escalation is the geographic transition wherein emerging economic regions, especially Asia, will bear most of the impact [7,8].

Although world population aging is accelerating, there is considerable heterogeneity at national and regional levels. According to the Global Burden of Disease (GBD) reports, it has been found that the underlying drivers of ADODs burden, such as demographic aging, age-specific incidence, and exposure to risk factors, vary significantly between countries due to the differences in socioeconomic status, health care infrastructure, and culture [9]. The need for detailed, nation-specific analyses of the epidemic is thus highlighted by the fact that a global narrative by itself is inadequate for effective national-level policy planning. However, comparative studies that methodically measure and contrast the ADODs' burden in different countries are still scarce.

China, Japan, and India are three different prototypical representations of population aging and socioeconomic growth. Japan represents a developed aging society distinguished by having the largest proportion of seniors in the world. The high-quality healthcare in the country and its longstanding experience of dealing with dementia give a clear picture

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of a relatively mature epidemic phase [10,11]. For China, it has the largest population of people living with dementia in the world and has been experiencing population aging faster than ever [12]. With its evolving healthcare system and huge population, China shows a scenario of compressed epidemiologic transition, where the increase in cases of dementia is occurring at an unprecedented historical velocity. In contrast, India is a relatively younger population but with the largest base of people, and is still at an early stage within this transition. It represents the potential future front of the dementia epidemic where the number of cases will become much larger, but the public awareness and health system preparedness are limited [13,14]. Comparing these three demographic titans provides valuable insights into how the burden of ADODs unfolds across diverging periods of aging, development, and socioeconomic growth [2].

Using comprehensive data from the GBD 2023 study, we systematically estimated and compared the burden and trends of ADODs in Asia, focusing on China, Japan, and India. We hope to provide robust, evidence-based insights for developing tailored prevention strategies and health system preparedness—applicable not only to these nations but also to the global community confronting the escalating dementia crisis.

2. Materials

2.1. Data sources

The 2023 GBD study provided standardized estimates of incidence, prevalence, mortality, and disability-adjusted life years (DALYs) of 375 diseases and injuries in 204 countries and territories. The GBD database incorporated data from census records, population surveys, surveillance systems, and published literature. Detailed methodologies have been described elsewhere [15–17]. Data were accessed through the tool of the Global Health Data Exchange query. We estimated ADODs' burden in Asia, including Japan, China, and India, from 1990 to 2023. Detailed filtering critiria was displyed in Supplementary Table S1. The STROCSS guidelines for reporting were adhered to in this study [18]. Since anonymized public datasets were used, no ethical review was necessary.

2.2. Estimation framework

The GBD framework utilized advanced modeling approaches to evaluate the ADODs' burden [15]. Incidence and prevalence were estimated through the Bayesian meta-regression tool, DisMod-MR 2.1. Mortality metrics for ADODs were produced with the Cause of Death Ensemble model, integrating multiple statistical models to produce robust and internally consistent estimates of ADODs' burden.

DALYs quantified the overall burden of disease by integrating fatal and nonfatal health outcomes, enabling cross-national and temporal comparisons [19]. DALYs was derived by summing two components: years of life lost (YLLs) and years lived with disability (YLDs), expressed as: DALYs = YLLs + YLDs.

Dementia was defined based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-III, DSM-IV, or DSM-V) or criteria from the International Classification of Diseases [7]. This category includes Alzheimer's disease and all other major dementing disorders.

2.3. Risk factors

We used the GBD 2023 comparative risk assessment (CRA) framework to assess how particular risk factors affected the ADODs' burden [7,20]. Within this framework, risk factors are included based on the World Cancer Research Fund criteria [21], which require consistent epidemiological evidence. For instance, the inclusion of environmental factors such as ambient particulate matter pollution and household air pollution is justified by meta-analyses of prospective studies that have demonstrated strong associations with dementia risk.

We extracted the burden data of attributable risk factors in China, India, and Japan. Detailed filtering critiria was displyed in Supplementary Table S2. The population attributable fraction (PAF) was estimated, that is, the burden could be reduced if exposures to risk factors were to be lower than a theoretical low risk exposure level [22]. To handle the hierarchical organization of GBD risk factors and prevent double-counting of attributable burdens, we applied a multi-step filtering process during analysis. First, we excluded aggregate Level-1 and Level-2 categories (e.g., all risk factors, air pollution, or metabolic risk) to ensure granularity. Second, we focused exclusively on specific Level-3 or Level-4 factors with positive contributions. Finally, to allow for a direct comparison of the leading risk factors, these factors were ranked based on the mean PAF.

2.4. Decomposition analysis

To quantify the key determinants of the temporal trends in DALYs, we performed the decomposition analysis developed by Das Gupta [20]. The total change in ADODs DALYs between 1990 ($D1990$) and 2023 ($D2023$) was decomposed into the following distinct factors: (1) population growth (G_{effect}); (2) the aging of the population (A_{effect}); and (3) epidemiological change (E_{effect}). The epidemiological change refers to the age-specific rates, namely the portion of change that remains after accounting for demographic factors (population growth and population aging). The formula is expressed as follows:

$$\Delta D_{\text{total}} = D_{2023} - D_{1990} = G_{\text{effect}} + A_{\text{effect}} + E_{\text{effect}}$$

To ensure comparability across the three countries, all DALY rates were age-standardized using the GBD world standard population. The contribution rate of each factor (C_{factor}) was defined as the absolute change attributed to that factor ($\text{Effect}_{\text{factor}}$) divided by the total DALYs in the 1990 baseline year (D_{1990}):

$$C_{\text{factor}} = \text{Effect}_{\text{factor}} / D_{1990} \times 100\%$$

2.5. Forecasting dementia DALYs burden

To predict the absolute burden of ADODs DALYs from 2024 to 2038, an Auto-Regressive Integrated Moving Average (ARIMA) model combined with demographic projections was used [23]. First, we modeled the historical trends (1990–2023) of the all-age DALYs rate using the ARIMA algorithm.[21] Optimal parameters (p, d, q) were identified automatically via the Akaike Information Criterion [24]. The model's goodness of fit was evaluated using Root Mean Square Error (RMSE) and Mean Absolute Percentage Error (MAPE). Residual diagnostics were conducted using the Ljung-Box Q test, ensuring no significant autocorrelation remained in the residuals. The projection was set with 95% Uncertainty Interval (UI). Second, the projected rates were multiplied by the corresponding future population estimates (Medium Variant) from the 2024 United Nations World Population Prospects.

2.6. Statistical analyses

Age-standardized rates (ASRs) were estimated to enable comparisons between populations with disparate age structures [25]. Trends over time were assessed with the estimated annual percentage change (EAPC) with a corresponding 95% confidence interval (CI) [26]. All statistical procedures were performed using R (version 4.5.0).

3. Results

3.1. Trends of dementia from 1990 to 2023

Trend analyses revealed distinct temporal patterns across countries (Table 1). The age-standardized incidence rate (ASIR) of ADODs increased significantly in Japan (EAPC 0.18, 95% CI 0.13–0.23) and

Table 1
Trends of ADODs burden in China, India, and Japan from 1990 to 2023.

Location	1990 Number (95% UI)	ASR (95% UI)	2023 Number (95% UI)	ASR (95% UI)	1990–2023 EAPC (95% CI)
Incidence					
Japan	178,822.42 (152,890.30–201,577.58)	112.22 (97.02–127.23)	594,831.02 (514,097.87–685,923.02)	115.60 (99.75–131.02)	0.18 (0.13 to 0.23)
China	755,780.35 (637,684.83–854,210.94)	126.71 (108.32–143.87)	3,476,643.72 (2,998,723.03–3,884,421.61)	156.63 (136.58–175.49)	0.41 (0.34 to 0.49)
India	231,672.41 (200,726.61–263,365.92)	76.81 (66.52- 87.57)	774,870.03 (665,280.66–879,146.05)	76.48 (65.99–87.58)	−0.07 (−0.11 to −0.02)
Prevalence					
Japan	986,585.55 (839,494.37–1,141,547.58)	626.12 (534.90–725.95)	3,379,249.66 (2,858,237.45–3,977,148.68)	643.49 (549.27–746.06)	0.18 (0.12 to 0.23)
China	4,352,314.74 (3,633,202.03–5,012,548.56)	735.54 (614.67–845.18)	20,299,242.84 (17,341,557.35–23,309,840.30)	918.83 (784.59–1,058.24)	0.40 (0.31 to 0.48)
India	1,307,115.79 (1,127,376.92–1,499,413.53)	428.64 (365.06–492.92)	4,332,454.31 (3,713,182.01–4,972,757.46)	424.87 (362.25–488.73)	−0.07 (−0.11 to −0.03)
Death					
Japan	38,990.25 (9628.12- 96,996.19)	28.49 (7.03–70.85)	208,589.54 (58,917.22–474,905.23)	31.25 (8.47–71.42)	0.03 (−0.03 to 0.09)
China	122,411.00 (29,123.72–341,119.34)	27.91 (6.89–73.63)	592,517.41 (147,634.46–1,393,374.02)	28.99 (7.18–67.92)	0.07 (−0.05 to 0.19)
India	28,895.09 (7281.52–79,456.51)	12.62 (3.07–36.10)	140,944.12 (33,142.96–368,480.15)	17.12 (4.03–44.87)	0.91 (0.80 to 1.03)
DALYs					
Japan	706,549.84 (308,227.14–1,455,151.23)	472.30 (203.17–974.61)	2,929,590.96 (1,285,096.11–5,903,304.88)	509.84 (223.16–1,014.68)	0.06 (0.02 to 0.10)
China	2,813,267.20 (1,276,793.95–6,411,019.58)	509.08 (223.97–1,146.10)	11,717,745.57 (5,738,534.11–22,632,432.41)	543.04 (263.22–1,057.96)	0.09 (0.01 to 0.18)
India	740,347.32 (338,149.81–1,628,320.30)	253.77 (113.49–551.14)	2,906,310.42 (1,260,363.44–6,259,851.63)	302.47 (130.71-652.90)	0.51 (0.45 to 0.56)

Abbreviations: ADODs, Alzheimer's disease and other dementias; ASR, age standardized rate; CI, confidence interval; DALYs, disability-adjusted life-years; EAPC, estimated annual percentage change; UI, uncertainty interval.

China (EAPC 0.41, 95% CI 0.34–0.49) over the 33 years. In contrast, India experienced a modest decline (EAPC –0.07, 95% CI –0.11 to –0.02). Age-standardized prevalence rate (ASPR) showed similar trends.

Interestingly, the rise in age-standardized mortality rate (ASMR) was the most prominent in India, with an EAPC of 0.91, 95% CI 0.80–1.03, which was considerably higher than the rise in Japan, with an EAPC of 0.03, 95% CI –0.03 to 0.09, and China, with an EAPC of 0.07, 95% CI −0.05 to 0.19. Similarly, the age-standardized DALY rate (ASDR) increased in all three countries, with the most prominent rise in India, with an EAPC of 0.51, 95% CI 0.45–0.56, followed by China (0.09 [0.01–0.18]) and Japan (0.06 [0.02–0.10]) (Table 1) .

3.2. Burden of dementia in Japan, China, and India in 2023

In 2023, Japan reported an estimated 594,831.02 (95% UI 514,097.87–685,923.02) new cases of ADODs, corresponding to an ASIR of 115.60 (95% UI 99.75–131.02) per 100,000 individuals. The total number of prevalent cases was 3,379,249.66 (95% UI 2,858,237.45–3,977,148.68), with an ASPR of 643.49 (95% UI 549.27–746.06) per 100,000 population. ADODs accounted for 208,589.54 (95% UI 58,917.22–474,905.23) deaths and 2,929,590.96 (95% UI 1,285,096.11–5,903,304.88) DALYs, yielding an ASMR of 31.25 (95% UI 8.47–71.42), and an ASDR of 509.84 (95% UI 223.16–1,014.68) per 100,000 individuals (Table 1).

China bore the heaviest burden among the three countries, with 3,476,643.72 (95% UI 2,998,723.03–3,884,421.61) incident cases (ASIR: 156.63, 95% UI 136.58–175.49) and 20,299,242.84 (95% UI 17,341,557.35–23,309,840.30) prevalent cases (ASPR: 918.83, 95% UI 784.59–1,058.24). Deaths attributable to ADODs reached 592,517.41 (95% UI 147,634.46–1,393,374.02), corresponding to an ASMR of 28.99 (95% UI 7.18–67.92). DALYs totaled 11,717,745.57 (95% UI 5,738,534.11–22,632,432.41), with an age-standardized DALY rate of 543.04 (95% UI 263.22–1,057.96) per 100,000 population (Table 1).

India exhibited a lower age-standardized burden but a significant absolute number of cases, reporting 774,870.03 (95% UI 665,280.66–879,146.05) incident cases (ASIR: 76.48, 95% UI 65.99–87.58) and 4,332,454.31 (95% UI 3,713,182.01–4,972,757.46) prevalent cases (ASPR: 424.87, 95% UI 362.25–488.73). The country recorded 140,944.12 (95% UI 33,142.96–368,480.15) deaths (ASMR: 17.12, 95% UI 4.03–44.87) and 2,906,310.42 (95% UI 1,260,363.44–6,259,851.63) DALYs, with an ASDR of 302.47 (95% UI 130.71–652.90) per 100,000 population (Table 1).

3.3. Age and sex patterns

Gender disparities were a dominant feature of the ADODs burden in all three countries. Women had higher rates than men in terms of incidence, prevalence, mortality, and DALYs, and this pattern was consistent throughout the 1990–2023 years (Fig. 1). In 2023, the female-to-male rate ratios (RRs) for ASPR and ASIR were 1.33 (1.05–1.63) and 1.32 (1.06–1.57) in Japan, 1.43 (95% CI: 1.13–1.73) and 1.39 (1.13–1.63) in China, and 1.14 (0.90–1.39) and 1.14 (0.92–1.38) in India, respectively (Supplementary Table S3). The gender disparities typically peaked in late life (Fig. 2), and detailed age-specific RRs were shown in Supplementary Table S4.

Age-stratified analysis revealed that the primary burden of ADODs was predominantly borne by the elderly group. The age-related aggregation was most dominant in China, wherein there were 15.80 million prevalent cases in the ≥70 years old age group, compared with 4.49 million in people below 70 years. The respective estimates were 3.01 million (≥70 years) and 1.32 million (<70 years) in India, and 3.12 million (≥70 years) and 0.25 million (<70 years) in Japan (Fig. 3). The trajectory of ADODs burden in Fig. 3 showed that the slope of the ≥70 age group was sharp in all three countries, whereas the <70 age group was relatively stable.

3.4. Drivers of DALYs change between 1990 and 2023

The absolute burden of dementia DALYs demonstrated a high increase over the 1990–2023 period in all three countries, and total percentage increases were approximately more than 300% compared to the 1990 baseline (Fig. 4).

In Japan, there was a rise of around 325 percent. Population growth contributed very little to it (around 16%), which is consistent with stable trends of populations in Japan. Nevertheless, population aging played an important role, causing a projected 130 percent change compared to

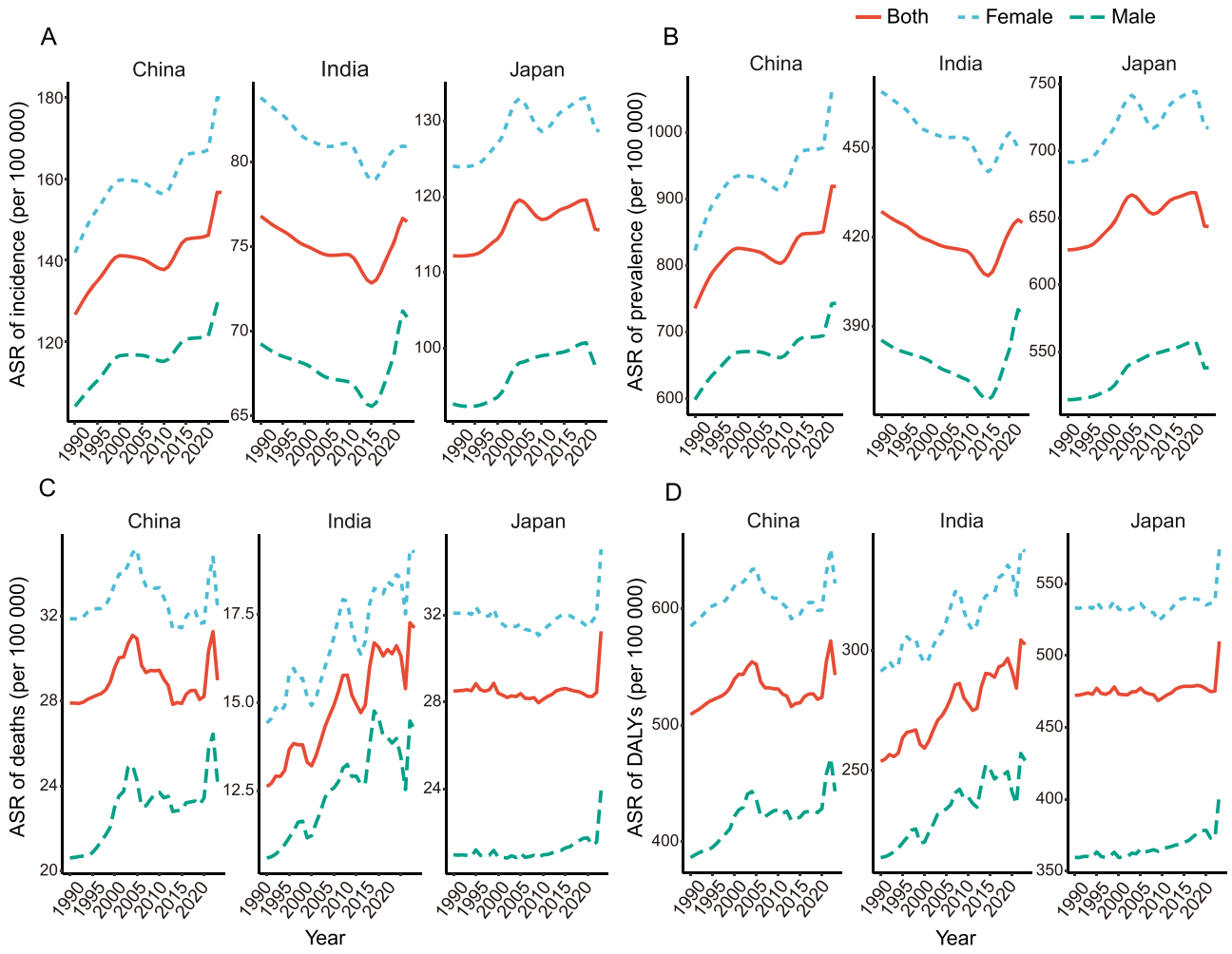

Fig. 1. Trends of ASRs of ADODs in Japan, China, and India from 1990 to 2023. (A) Age-standardized incidence rate; (B) Age-standardized prevalence rate; (C) Age-standardized death rate; (D) Age-standardized DALYs rate. The solid lines represent the overall population, the dashed light blue lines denote females, and the dashed green lines indicates males. Rates are expressed per 100,000 population. (ADODs=Alzheimer's disease and other dementias; ASRs=Age-standardized rates).

the baseline. Remarkably, epidemiological change made up the biggest proportion at close to 180 percent of the growth.

China had the largest total increase among the three countries (about 330%). The increase was caused by a combination of two contributors: demographic and epidemiological changes. Population aging was one major contributor (145% approximately) consistent with the fact that there has been a rapid increase in the number of elderly people in China. Epidemiological transition also played an important part (about 135 percent). Unlike Japan, population growth remained a moderate (approximately 50 percent) contributor to the total burden.

Although India showed an increase of DALYs (around 300%), it had a different pattern. Population increase was the major contributor, accounting for more than 100 percent increase, while epidemiological change accounted for around 110% of the trend. In contrast, population aging contributed around 80%.

3.5. Risk factors for dementia related DALYs

The analysis of the attribution showed that the profile of modifiable risk factors of ADODs in Japan, China, and India in 2023 was highly heterogeneous. The most important risk factor was environmental exposure to ambient particulate matter across the three countries, which had the greatest effect in China (accounting for 32.7% of the ADODs burden), followed by Japan (22.4%) and India (21.2%). The second most important driver was high fasting plasma glucose and it had a high attributable fraction in Japan (21.0%), followed by China (17.7%) and India (15.9%). There was a surprising discrepancy in household air pollution due to solid fuel usage. It was one of the leading contributors in India (17.7%). By comparison, it contributed minimally in China (4.8%) and almost negligibly in Japan (0.1%). Regarding behavioral risks, smoking played a modest role, with China (5.6%) having the highest effect, while it was lower in India (2.9%) and Japan (3.3%). High body-mass index contributed a small (less than 2%) percentage across all three countries in 2023 (Fig. 5).

3.6. Future forecasts in the burden of dementia DALYs

The forecasting analyses predicted that the growth of dementia-related DALYs will continue in all three countries. The optimal model parameters (e.g., goodness-of-fit statistics (MAPE $< 2\%$), and diagnostic performance (Ljung-Box test $p > 0.05$) for each country were summarized in Supplementary Table S5. By 2038, the DALYs of India will grow to 4.4 million with an increase of 52% over 15 years. China is expected to reach roughly 15.2 million with a 32% growth. Japan is projected to grow the fastest to about 9.5 million, representing a 188% growth (Fig. 6).

4. Discussion

This study offers an in-depth analysis of the ADODs burden in Japan,

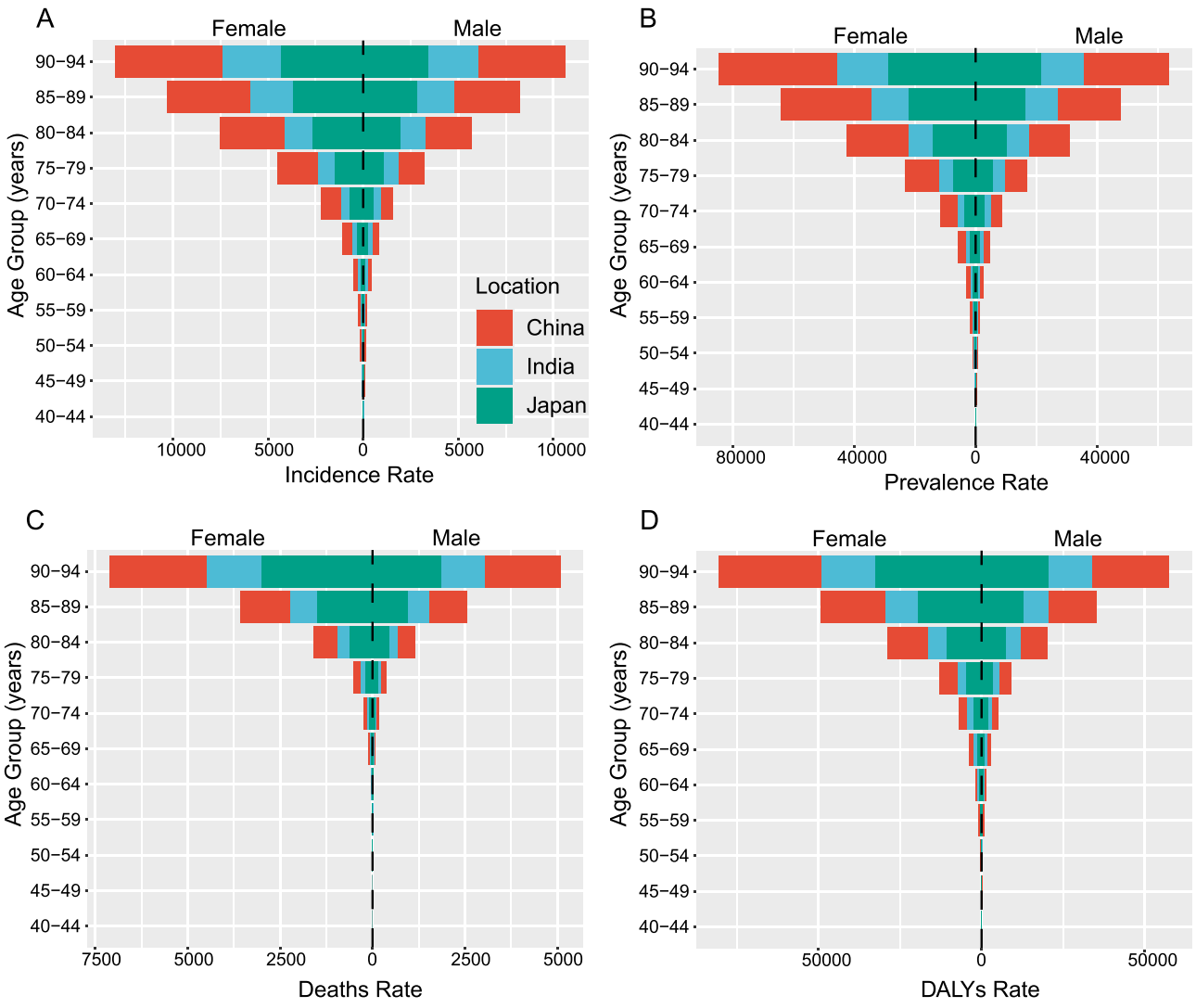

Fig. 2. Age- and sex-specific rates of ADODs in China, India, and Japan in 2023. (A) Incidence rate; (B) Prevalence rate; (C) Deaths rate; (D) DALYs rate. The left side of the vertical axis shows rates for females, and the right side shows rates for males. The red bars represent China, light blue bars represent India, and green bars represent Japan. (ADODs=Alzheimer's disease and other dementias).

China, and India throughout the year 1990–2023, revealing large variations in trends and contributors behind the disparities. Of the three nations, China had the greatest number of ADODs and displayed the highest ASIR, ASPR, and ASDR. Japan had the highest ASMR. In contrast, India had the lowest ASRs of all four indicators, but its mortality and DALYs increased most significantly. The burden of ADODs was disproportionately greater in women and significantly rose with age. The main positive driver increasing the DALY burden in Japan was epidemiological changes. Population aging and epidemiological changes were the main driving forces in China, while population growth was the key driver in India. Air pollution and high levels of fasting plasma glucose were found to be the major risk factors contributing to the ADODs-associated DALYs in Japan and China. Conversely, India was uniquely impacted by the household air pollution due to the use of solid fuels, which was a major additional contributor. Forecasts with the ARIMA model suggested the absolute DALY burden of all three countries would continue growing over the next 15 years.

In line with earlier research, our results show a significant and increasing burden of ADODs in three of Asia's most populated countries [8,10,12,14,27]. There were significant differences in the epidemiological profiles between countries. In China, our estimated prevalence of ADODs in 2023 aligns with the previous estimates reported by Jia et al., who reported a prevalence of 6.0% among adults aged $\geq$ 60 years based on 2015–2018 data [28]. Moreover, our results are consistent with the trajectory projected by Liu et al., who showed that the unstandardised prevalence of dementia could reach 11.0% for the population aged $\geq$ 50 years by 2050 under an upward incidence scenario [29]. Furthermore, the China Alzheimer's Report 2025 supports the high burden, which estimates the standardised prevalence of dementia reached 900.8 per 100,000 (95% UI 770.9 to 1043.2) in 2021 [30]. The rapid escalation observed in our study is in line with the report's finding that China has entered a severe ageing phase by the end of 2022 (with the population aged $\geq$ 60 years reaching 280 million) [30]. Regarding Japan, despite possessing the oldest population in the world, it had relatively moderate ASRs. This phenomenon may reflect superior diagnostic capacity and proactive risk management rather than under-reporting. Specifically, Japan's healthcare service level, exemplified by the Long-Term Care Insurance (LTCI) system, ensures high surveillance sensitivity. However, this detection effect may be counterbalanced by the prevention dividend. The Hisayama Study shows that Japan's long-standing prevention and management of vascular risk factors, as well as advocacy of healthy lifestyle behaviors, may effectively reduce the ADODs' prevalence and incidence [31]. In India, the lower ASRs coupled with a sharp rise in mortality and DALYs may be attributed to a transitional epidemiological

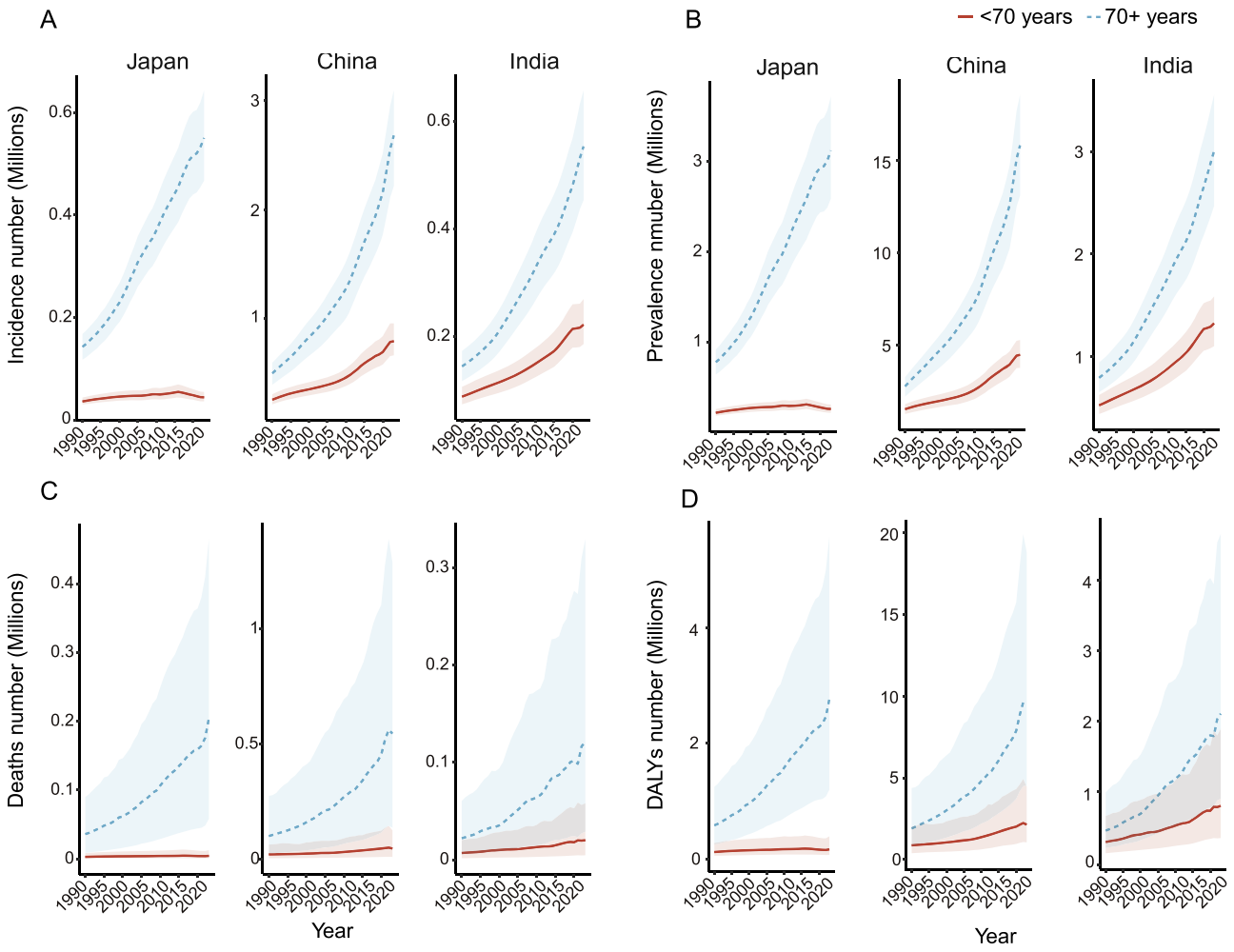

Fig. 3. Trends in the absolute number of ADODs in Japan, China, and India from 1990 to 2023, stratified by age group. (A) Incidence number; (B) Prevalence number; (C) Deaths number; (D) DALYs number. Solid red lines indicate the population aged <70 years, while dashed light blue lines represent those aged ≥70 years. Shaded areas represent the 95% uncertainty intervals. (ADODs=Alzheimer's disease and other dementias).

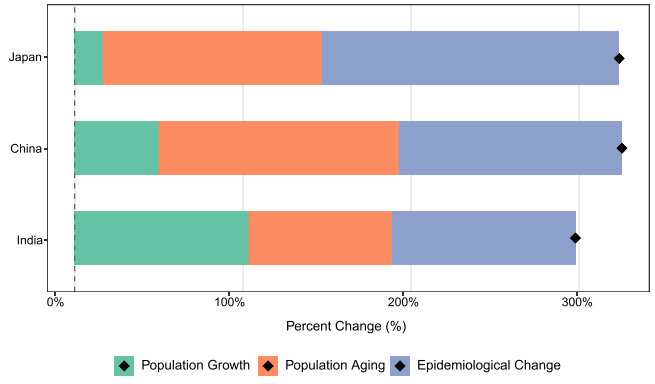

Fig. 4. Drivers of change in ADODs DALYs in Japan, China, and India, 1990–2023. The stacked bar chart illustrates the proportional contribution of population growth (green), population aging (orange), and epidemiological change (purple) to the overall percent change in DALYs. The black diamonds indicate the net percent change for each country. (ADODs=Alzheimer's disease and other dementias; DALYs=disability-adjusted life-years).

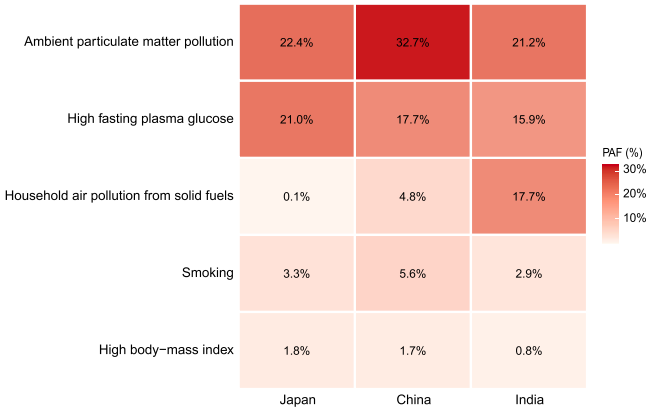

Fig. 5. Heatmap of top risk factors attributable to ADODs DALYs in Japan, China, and India, 2023. The values represent the PAF (%) of DALYs for the top risk factors across the three countries. Darker shades of red indicate higher PAF percentages. (ADODs=Alzheimer's disease and other dementias; ASR=Age-standardized rate; DALYs=disability-adjusted life-years; PAF=population attributable fraction).

phase. This trend is likely explained by the underdiagnosing process in earlier decades, the improving detection technology over time, and restricted access to long-term care services, causing more fatal cases, disability, and loss of a year of life.

In all three countries, ADODs burden increased significantly with age, especially among people aged 70 years or more, which is in accordance with the established association between aging and the risk

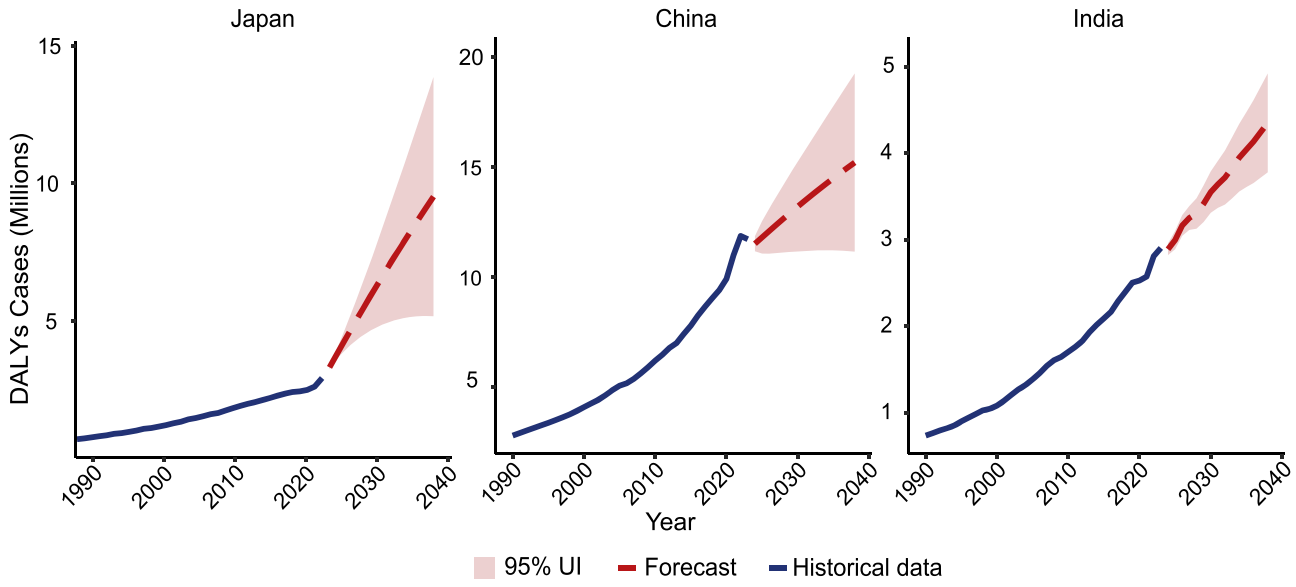

Fig. 6. Historical trends and future projections of ADODs DALYs in Japan, China, and India over the next 15 years. The solid blue line (historical period: 1990–2023) shows the fitted trend from the ARIMA model. The dashed red line (forecast period, 2024–2038) represents the projected values. The light pink shaded regions represent the 95% uncertainty intervals for the forecasted estimates. (ADODs=Alzheimer's disease and other dementias; ARIMA=Auto-Regressive Integrated Moving Average).

of developing dementia [32]. Several possible age-related biological processes could explain this relationship, such as the deposition of amyloid-β and tau pathology [33,34], age-related neuroinflammation and systemic inflammatory changes [35], and growing vascular pathology lesions [36,37]. These mechanisms probably act together to increase dementia vulnerability in elderly populations. Gender differences were also identified, and women had a larger proportion of ADODs compared to men in all the countries, as reported in the global literature [2,38,39]. It is possible that these gender differences are due to both biological factors (such as longer life expectancy and postmenopausal estradiol decline), as well as social determinants (such as women having less education and occupation opportunities at earlier life stages). However, quality and duration of life with dementia ultimately depend on societal investments in evidence-based care infrastructure and supportive community frameworks—particularly for vulnerable populations such as older adults and women. Addressing ADODs thus necessitates a two-pronged strategy: development of new drug research and the establishment of fair, sustainable, integrated, and dignity-driven care frameworks.

The most noteworthy result of our decomposition analysis was the positive effect of an epidemiological change on the DALYs in all three countries, which reflects the increasing intensity of the age-standardized ADODs burden universally in Asia. It contrasts the compressed morbidity of some other Western high-income populations, where the decline of age-specific incidence had started to stabilize the burden [40]. However, beneath this shared regional trajectory, our study discovers different driver patterns that represent the varying stages of demographic as well as epidemiological transitions in Japan, China, and India. Japan represents the post-transition stage where the burden was almost entirely determined by structural super-aging and epidemiological changes, while the impact of population growth was negligible. This matches a post-demographic profile wherein the issue is not the number of new elderly, but the intensity of disability in the oldest-old [41]. Conversely, India displays the typical profile of an early-to-middle transitional profile. Its burden is disproportionately multiplied by population growth and the aging process, together with changes in epidemiology. This combination of threats indicates that India not only combats rising risk factors but also continues to expand its underlying population at risk, resulting in a steadily increasing pool of vulnerable people that exceeds the capacity of its healthcare system to manage [13,42,43]. The intermediate situation occupied by China was under tremendous pressure due to the combination of high-speed population structural aging and intense epidemiological changes. This unusual combined driving pattern deciphers the marked upward trend in our ARIMA forecast of China because the nation is addressing the demographic momentum of an aging workforce and the epidemiological consequences of rapid urbanization simultaneously [28].

In line with the 2024 Lancet Commission, air pollutants are increasingly recognized as significant neurotoxins [44]. Biologically, PM2.5 may circumvent the blood-brain barrier, triggering neuroinflammation and amyloid-beta (Aβ) accumulation [45]. Simultaneously, the severe impact of high fasting plasma glucose in all three countries aligns with the worldwide evidence,[43,44] whereby insulin resistance and impaired cerebral metabolism may accelerate neurotoxicity, Aβ deposition, or tau pathology [46–50]. However, the attributable risk factors should be interpreted with caution. For instance, the association between air pollution and dementia may be influenced by residual confounding, such as socioeconomic status and lifestyle factors. Furthermore, as the risk factors were included within the GBD CRA framework, future efforts should incorporate a broader spectrum of risks to comprehensively assess ADODs drivers and to better inform prevention strategies.

To deal with these drivers effectively, policy integration and practical priorities should be tailored to the distinct risk profiles and socioeconomic status of each country. For Japan, the LTCI system should shift from long-term symptom management to primary prevention by implementing strict glucose management and cognitive screening for the middle-aged population. In China, while the Healthy China 2030 initiative has emphasized early screening and clinical management, the dual challenges from ambient particulate matter pollution and hyperglycemia underscore the need to integrate Dementia-Sensitive Urban Planning, such as establishing low-emission zones around geriatric facilities and expanding green buffer zones. Notably, India's unique burden from household air pollution highlights the challenge of environmental justice. Targeted prevention strategies should prioritize the transition to clean cooking fuels and leverage community health workers to promote brain health awareness. Ultimately, the life-course management of health is essential to alleviate the burden of ADODs.

By shifting the dementia prevention to begin at the age of 40 years, the national plans could transition from managing symptoms to mitigating the risk exposure. In future policy-making, these three nations should adopt the inter-sectoral approach, integrating environmental protection, metabolic health, and clean energy. Such an early-intervention and multi-dimensional approach is crucial to address the burden and impact of ADODs.

The forecasts in the next 15 years predict further growth in the magnitude of DALYs due to ADODs in each of the three countries, exerting significant strain on the health system, long-term care facilities, family and social services. This issue might be addressed through a multi-pronged approach, such as raising people's awareness, implementing life course approaches to modify those risk factors that can be changed, improving control of chronic comorbidities, enhancing early detection and prompt intervention, establishing dementia-friendly communities and sustainable care infrastructures, formulating individualized and fair national dementia policies, and promoting advanced research and innovation [10,11,51].

Strengths of this research are that it has applied standardized, comprehensive GBD data and methods that allow making cross-country comparisons within a longitudinal frame. Several limitations are worth noting. Firstly, although GBD estimates are based on rigorous statistical modeling, they have inherent uncertainties. These uncertainties are more pronounced in data-sparse regions where the diagnostic capability is low, or the reporting infrastructure is poorly developed (e.g., rural India), and the accuracy may be compromised. Such diagnostic and reporting disparities might skew GBD-based cross-national comparisons. For instance, the projected absolute burden of Japan is much higher than India, which may reflect the differences in health system maturity and case identification efficiency rather than the true epidemiological variation. Crucially, the epidemiological change in the decomposition analysis may be confounded by improved diagnostic detection and enhanced public awareness. Furthermore, the shift toward biological definitions of Alzheimer's disease, such as the advent of blood-based biomarkers, may introduce further uncertainty that leads to a surge in incidence reporting. Therefore, these factors should be considered in interpreting the findings. Secondly, the ARIMA models assume linear trends. They may not fully account for structural breaks, such as the emergence of anti-amyloid therapies, advancements in blood-based biomarkers, and major policy shifts. The projections represent a baseline scenario, assuming that current clinical and environmental trajectories remain constant. The forecasts should be interpreted as conservative estimations, and future research should employ dynamic models or incorporate scenario-based sensitivity analyses. Thirdly, there are spatial and temporal differences in the criteria used to diagnose, and the availability of neuroimaging might complicate comparisons between and across countries over time. Additionally, risk factor attribution relies on causality and counterfactual exposure distributions that do not fully capture the complex multifactorial nature of dementia. Fourthly, the study is conducted at the national level, and it lacks analysis on the urban–rural or regional level. This might mask disparities in healthcare access, risk factor exposure, and disease burden within countries. Lastly, the mix of all dementia subtypes restricts understanding of epidemiological patterns and risk factors attributable to the specific subtypes, such as Alzheimer's disease, vascular dementia, or frontotemporal dementia, which may limit targeted prevention and intervention management. These limitations highlight the need for more granular data and robust national surveillance systems to refine estimates of ADODs burdens and inform focused interventions.

5. Conclusion

ADODs are a serious and growing problem of public health in Japan, China, and India with heterogeneous epidemiological patterns. The implementation of tailored national dementia strategies and early intervention management is of paramount importance to address the impending effects on individuals, families, and societies.

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Ethics approval

Ethical approval was not required because all data were derived from a publicly accessible database.

Declaration of generative AI and AI-assisted technologies in the writing process

During manuscript preparation, the authors used Google Gemini 3 for language editing and grammatical refinement. The authors take full responsibility for the content of the publication.

Data vailability

The data were available at http://ghdx.healthdata.org/gbd-results-tool.

CRediT authorship contribution statement

Chen Zhang: Conceptualization, Writing – original draft, Methodology, Investigation, Formal analysis, Funding acquisition. **Xuhui Chen:** Investigation, Validation, Writing – review & editing. **Yongan Sun:** Writing – review & editing, Supervision, Funding acquisition.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

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