Investigation of Disease Burden and Prediction of Future Trends for Type 2 Diabetes in the Elderly: A Global and Chinese Analysis from 1990 to 2021 (Postprint)

Authors: Zhao Xiaoxiao, Ke Lixin, Xun Yangqin, Wang Haibo, Gao Wulin, Qiao Tianci, Lu Xiaohui, Wu Jibiao, Lu Cuncun, Wu Jibiao, Cuncun Lu

Date: 2025-03-25T00:00:00+00:00

Abstract

Background: Type 2 diabetes mellitus (T2DM) in the elderly has become a major public health challenge affecting population health globally and in China, making it imperative to clarify the associated disease burden.

Objective: To analyze the disease burden of elderly T2DM globally and in China from 1990 to 2021 and predict future trends, thereby providing reference for public health and medical decision-making.

Methods: Data on incidence and mortality burden for T2DM patients aged 60 years and above globally and in China from 1990 to 2021 were extracted and compiled from the Global Burden of Disease (GBD) 2021 database. Based on the GBD 2021 standard population, age-standardized incidence and mortality rates were estimated for the elderly T2DM population. Joinpoint regression was used to calculate the average annual percent change (AAPC) to assess trends in disease burden. Subgroup analyses were conducted based on age and sex, and decomposition analysis was employed to explore the relative effects of three factors—population aging, population growth, and epidemiological changes—on the changes in disease burden. A Bayesian model was used to predict incidence and mortality cases from 2022 to 2035.

Results: In 2021, there were 6,047,049 and 800,764 incidence cases of elderly T2DM globally and in China, respectively, representing increases of 178.68% and 220.28% compared to 1990. From 1990 to 2021, the global age-standardized incidence rate showed an overall upward trend (AAPC=1.21%, P<0.001), whereas China' s overall upward trend was not statistically significant (AAPC=0.29%, P=0.189). In 2021, there were 1,304,150 and 149,972 deaths from elderly T2DM globally and in China, respectively, representing increases of 164.68%

and 197.98% compared to 1990. From 1990 to 2021, the global age-standardized mortality rate showed an overall upward trend (AAPC=0.32%, P<0.001), while China' s trend remained relatively stable (AAPC=0.01%, P=0.922). Additionally, both globally and in China, incidence and mortality cases were higher in females than in males in 1990 and 2021, with the 60-64 age group accounting for the highest proportion of incidence cases in 2021, and the 70-74 age group accounting for the highest proportion of mortality cases. Decomposition analysis revealed that population growth was the main influencing factor for the increase in incidence and mortality cases of elderly T2DM globally and in China. Predictive analysis indicated that the incidence and mortality cases of elderly T2DM globally, as well as mortality cases in China, will continue to show an upward trend from 2022 to 2035.

Conclusion: The incidence and mortality burden of elderly T2DM remains heavy globally and in China. There is an urgent need to further strengthen and formulate more effective public health policies and clinical prevention and control strategies to play an active role in reducing the fundamental burden of elderly T2DM.

Full Text

Investigation and Future Trend Prediction of Disease Burden of Elderly Type 2 Diabetes Mellitus Globally and in China from 1990 to 2021

ZHAO Xiaoxiao[1],[2], KE Lixin[3], XUN Yangqin[4], WANG Haibo[5], GAO Wulin[1], QIAO Tianci[1], LU Xiaohui[1], WU Jibiao[2], *LU Cuncun*[6]

[1]Affiliated Hospital of Shandong University of Traditional Chinese Medicine, Jinan 250014, China
[2]Shandong University of Traditional Chinese Medicine, Jinan 250399, China
[3]Department of Pediatrics, University of Groningen, University Medical Center Groningen, Groningen 9713GZ, Netherlands
[4]School of Population Medicine and Public Health, Chinese Academy of Medical Sciences & Peking Union Medical College, Beijing 100730, China
[5]Department of Critical Care Medicine, Affiliated Hospital of Gansu University of Chinese Medicine, Lanzhou 730000, China
[6]Institute of Basic Research in Clinical Medicine, China Academy of Chinese Medical Sciences, Beijing 100700, China

Corresponding authors: WU Jibiao, Professor; E-mail: wujibiao1963@163.com; LU Cuncun; E-mail: lu17metrics@163.com

Funding: Shandong Provincial Natural Science Foundation Youth Project (NO.ZR2022QH123)

Abstract

Background: Type 2 diabetes mellitus (T2DM) among the elderly has become a significant public health problem both globally and in China, posing a substantial threat to population health. Clarifying the related disease burden is extremely urgent.

Objective: To assess the disease burden of T2DM among the elderly population globally and in China from 1990 to 2021, project future trends, and offer insights to inform public health and medical decision-making.

Methods: Data on incidence and mortality burdens of individuals aged 60 years and above with T2DM in China and worldwide were extracted from the Global Burden of Disease (GBD) 2021 database. Age-standardized incidence and mortality rates were estimated based on the GBD 2021 standard population. Joinpoint regression was utilized to calculate the average annual percentage change (AAPC) for assessing disease burden trends. Subgroup analyses were performed based on age and sex, and decomposition analysis examined how aging, population growth, and epidemiological changes impacted disease burden. Bayesian models were employed to forecast incidence and mortality between 2022 and 2035.

Results: In 2021, the global incidence of T2DM among the elderly stood at 6,047,049 cases, while in China it reached 800,764 cases, representing increases of 178.68% and 220.28%, respectively, compared to 1990. From 1990 to 2021, the global age-standardized incidence rate exhibited a significant overall upward trend (AAPC=1.21%, P<0.001), whereas the trend in China was not statistically significant (AAPC=0.29%, P=0.189). The number of deaths among elderly T2DM patients in 2021 in the global and Chinese populations was 1,304,150 and 149,972, respectively, marking increases of 164.68% and 197.98% compared to 1990. Throughout the same period, the global age-standardized mortality rate displayed a consistent upward trend (AAPC=0.32%, P<0.001), while the trend in China remained relatively stable (AAPC=0.01%, P=0.922). Notably, both incidence and mortality numbers for females in 1990 and 2021, globally and in China, exceeded those of males. Meanwhile, the 60-64 age group had the highest proportion of incidences in 2021, while the 70-74 age group had the highest proportion of deaths. Population growth emerged as the primary driver of the rise in incidence and mortality among elderly T2DM patients in both global and Chinese populations, as revealed by decomposition analysis. The projection indicates a continued increase in the incidence and mortality of elderly T2DM patients worldwide and in China from 2022 to 2035.

Conclusion: The persistent heavy burden of incidence and mortality among elderly individuals with T2DM in both global and Chinese populations necessitates urgent strengthening and formulation of more effective public health policies and clinical prevention and control strategies to alleviate the fundamental burden associated with this demographic.

Keywords: Type 2 diabetes mellitus; Older adult; Disease burden; Epidemiological feature; Predictive analysis

Introduction

Type 2 diabetes mellitus (T2DM), also known as non-insulin-dependent diabetes or adult-onset diabetes, is a metabolic disorder characterized by hyperglycemia, insulin resistance, and relative insulin deficiency. T2DM frequently co-occurs with obesity, metabolic dysfunction-associated steatotic liver disease, hypertension, and other chronic conditions. Moreover, T2DM represents a major risk factor for atherosclerotic cardiovascular diseases, stroke, and myocardial infarction, while also potentially causing renal damage, retinopathy, neuropathy, and compromised immune function, significantly impacting patients' quality of life and life expectancy. Current treatments for T2DM, including insulin and oral hypoglycemic agents, are well-established, and novel antidiabetic drugs including sodium-glucose cotransporter-2 (SGLT-2) inhibitors and glucagon-like peptide-1 (GLP-1) receptor agonists continue to emerge, providing new opportunities for improved T2DM management.

According to research reports, China has become the country with the largest elderly population aged 60 years and above globally, reaching 267 million by the end of 2021. As China' s aging population continues to grow, the disease burden of elderly T2DM will further intensify. The Global Burden of Disease (GBD) study, led by the Institute for Health Metrics and Evaluation at the University of Washington with participation from multiple countries and regions, represents a comprehensive epidemiological investigation project. This dataset encompasses health impact indicators for various diseases, injuries, and risk factors, serving as the most representative data source for investigating disease epidemiological trends, with the latest available data extending to 2021. Analyzing specific disease epidemiological characteristics across countries helps governments and research institutions understand disease burden, thereby facilitating the development of effective public health policies and clinical intervention strategies and enabling subsequent evaluation of implemented health measures. Therefore, this study aims to utilize the latest GBD data to conduct a detailed analysis of incidence and mortality burden of elderly T2DM globally and in China from 1990 to 2021, while predicting disease burden from 2022 to 2035, to provide important references for developing and evaluating T2DM public health policies and clinical management strategies.

Methods

1.1 Data Sources

All data used in this study were extracted from the recently published GBD 2021 database, accessible at https://vizhub.healthdata.org/gbd-results/. To conduct

this research, we extracted incidence and mortality data for T2DM among individuals aged 60 years and above (defined as "elderly population") in China, globally, and across five sociodemographic index (SDI) regions from 1990 to 2021. The data extraction process involved sequentially selecting "Cause of death or injury" under "GBD Estimate," then "Incidence" and "Deaths" under "Measure," "Number" and "Rate" under "Metric," "Diabetes mellitus type 2" under "Cause," "Global," "China," and the five SDI regions under "Location," age groups from "60-64 years" to "95+ years" in 5-year intervals under "Age," "Female," "Male," and "Both" under "Sex," and all years from "1990" to "2021" under "Year," before downloading the data.

The SDI is an evaluation metric developed by the GBD collaborative group based on rankings of per capita income, average education level, and total fertility rate across all countries and regions, used to measure sociodemographic development level. The index ranges from 0 to 1, with higher values indicating greater sociodemographic development. The GBD collaborative group classifies 204 countries/territories into five SDI regions: low (<0.466), low-middle (0.466-0.619), middle (0.620-0.712), high-middle (0.713-0.810), and high (>0.810). China had an SDI of 0.722 in 2021, placing it in the high-middle SDI region.

1.2 Statistical Analysis

All statistical analyses and graphing were performed using R 4.4.0 and Excel 2019. First, using the GBD 2021 standard world population as reference, we estimated incidence numbers, mortality numbers, age-standardized incidence rates, age-standardized mortality rates, and their 95% confidence intervals (CIs) for the population aged 60 years and above. Second, with the maximum number of joinpoints set at 5, we employed Joinpoint regression to calculate the annual percent change (APC) and average annual percentage change (AAPC) with 95% CIs for age-standardized incidence and mortality rates of elderly T2DM to assess temporal trends in epidemiological characteristics. APC reflects disease standardized rate trends within a specific time segment, while AAPC reflects overall trends throughout the entire analysis period. If the upper limit of the 95% CI for APC/AAPC is less than 0, it indicates a decreasing trend; if the lower limit is greater than 0, it indicates an increasing trend; and if it includes 0, it indicates a relatively stable trend.

Additionally, subgroup analyses were conducted based on sex and age groups to fully describe disease burden among elderly T2DM patients. Simultaneously, we performed decomposition analysis using the method proposed by Das Gupta to examine the relative contributions of three factors—aging, population growth, and epidemiological changes—to changes in elderly T2DM disease burden, with the sum of their respective contributions equaling 100% within the same region. Finally, based on a Bayesian age-period-cohort model, we predicted incidence and mortality numbers for elderly T2DM from 2022 to 2035 to assess future burden trends. All statistical tests were two-sided, with statistical significance

defined as 95% CI not including 0 or P<0.05.

Results

2.1 Trends in Incidence Burden of Elderly T2DM Globally and in China

In 2021, the total, female, and male incidence numbers of elderly T2DM globally were 6,047,049, 3,034,395, and 3,012,654 cases, respectively, representing increases of 178.68%, 169.40%, and 187.24% compared to 1990. Age-standardized incidence rates showed an overall upward trend from 1990 to 2021, with average annual increases of 1.21% (95%CI=1.13%-1.30%), 1.19% (95%CI=1.14%-1.24%), and 1.20% (95%CI=1.10%-1.30%), respectively, all statistically significant (P<0.001). Meanwhile, although female incidence numbers were higher than male numbers in both 1990 and 2021 globally, female age-standardized incidence rates were lower than male rates (Table 1 and Figure 1 [Figure 1: see original paper]A).

In 2021, the total, female, and male incidence numbers of elderly T2DM in China were 800,764, 429,058, and 371,706 cases, respectively, representing increases of 220.28%, 232.73%, and 208.80% compared to 1990. Although age-standardized incidence rates showed overall increasing trends from 1990 to 2021, only the change in female age-standardized incidence rate was statistically significant (P=0.001). Meanwhile, both incidence numbers and age-standardized incidence rates for females were higher than for males in China in 1990 and 2021 (Table 1 and Figure 1B). Additionally, compared to 1990, both incidence numbers and age-standardized incidence rates in 2021 increased significantly across all five global SDI regions, with the high SDI region showing the most pronounced growth trend in age-standardized incidence rate, increasing by an average of 2.19% annually from 1990 to 2021 (95%CI=2.09%-2.29%; P<0.001).

2.2 Trends in Mortality Burden of Elderly T2DM Globally and in China

Compared to 1990, the total, female, and male mortality numbers of elderly T2DM globally in 2021 increased by 164.68%, 150.29%, and 183.61%, respectively. Age-standardized mortality rates showed an overall upward trend from 1990 to 2021, with average annual increases of 0.32% (95%CI=0.22%-0.42%), 0.24% (95%CI=0.12%-0.36%), and 0.41% (95%CI=0.27%-0.54%), respectively, all statistically significant (P<0.001). Meanwhile, although female mortality numbers were higher than male numbers in both 1990 and 2021 globally, female age-standardized mortality rates were lower than male rates (Table 2 and Figure 1 [Figure 1: see original paper]C).

In 2021, the total, female, and male mortality numbers of elderly T2DM in China were 149,972, 78,572, and 71,400 cases, respectively, representing increases of 197.98%, 158.61%, and 257.93% compared to 1990. From 1990 to

2021, the overall trend in age-standardized mortality rate was relatively stable, but female age-standardized mortality rate showed a decreasing trend (AAPC=-0.34%, 95%CI=-0.64% to -0.05%; P=0.022), while male rate showed an increasing trend (AAPC=0.50%, 95%CI=0.21%-0.80%; P=0.001), both statistically significant. Meanwhile, female mortality numbers were higher than male numbers in China in both 1990 and 2021; however, while female age-standardized mortality rate was higher than male rate in 1990, it was lower than male rate in 2021 (Table 2 and Figure 1D). Additionally, compared to 1990, mortality numbers in 2021 increased significantly across all five global SDI regions, but trends in age-standardized mortality rates varied. High SDI regions showed an overall decreasing trend, while middle, low-middle, and low SDI regions showed increasing trends, all statistically significant, whereas the high-middle SDI region showed a relatively stable overall trend (P=0.683).

2.3 Age Group Analysis of Elderly T2DM Disease Burden Globally and in China

Subgroup analysis by 5-year age groups for elderly T2DM patients in 2021 revealed consistent patterns across regions (Figure 2 [Figure 2: see original paper]). The 60-64 age group accounted for the highest proportion of incidence numbers globally, in China, and across SDI regions, followed by the 65-69 age group. Specifically, the 60-64 age group accounted for 40.68% of total elderly T2DM incidence numbers in China, while the 65-69 age group accounted for 34.52%, with these two age groups combined exceeding three-quarters of China' s total elderly T2DM incidence in 2021. The high-middle SDI region had the highest proportion in the 60-64 age group at 46.88%. Regarding mortality numbers, the 70-74 age group had the highest proportion globally, in China, and in middle and low-middle SDI regions, while the 80-84 age group had the highest proportion in high and high-middle SDI regions, and the 65-69 age group had the highest proportion in low SDI regions.

2.4 Decomposition Analysis of Changes in Elderly T2DM Disease Burden Globally and in China

Decomposition analysis of the three factors affecting changes in elderly T2DM disease burden (aging, population growth, and epidemiological change) showed that population growth was the primary contributor to increases in both incidence and mortality numbers globally, accounting for 68.77% and 82.14% of the change, respectively (Figure 3 [Figure 3: see original paper]). Similarly, population growth was the main driver of increases in incidence and mortality numbers in China, contributing 96.46% and 89.36%, respectively. However, in high SDI regions, epidemiological change was the primary factor for increased incidence numbers (53.28%), followed by population growth (51.55%), while population growth remained the main factor for increased mortality numbers. In contrast, epidemiological change had a reducing effect on mortality number increases in high SDI regions (-104.09%). In other SDI regions, population growth primar-

ily drove increases in elderly T2DM incidence numbers, with epidemiological change playing a secondary role in the growth of both incidence and mortality numbers.

2.5 Predictive Analysis of Elderly T2DM Disease Burden Globally and in China

Based on the Bayesian age-period-cohort model, we predicted incidence and mortality numbers for elderly T2DM from 2022 to 2035 globally and in China (Figure 4 [Figure 4: see original paper]A and 4B). The projections indicate that incidence and mortality numbers among elderly T2DM patients globally will continue to rise from 2022 to 2035 for both sexes. In China, incidence numbers for the total population, females, and males are expected to plateau or even show decreasing trends, while mortality numbers will continue to increase for the total population, females, and males.

Discussion

This study found that over the 32-year period from 1990 to 2021, the absolute numbers of incidence and mortality among elderly T2DM populations increased overall globally, in China, and across the five SDI regions. These results suggest that despite numerous prevention and control measures implemented over the past decades to reduce the disease burden of elderly T2DM, both global and Chinese populations continue to face a heavy burden. This necessitates strengthened implementation of existing strategies and development of more effective public health policies and clinical management approaches.

Regional differences in sociodemographic development and healthcare service levels may differentially impact elderly T2DM disease burden. For example, increased incidence in high SDI regions may be associated with lifestyle changes resulting from better socioeconomic development, while decreased mortality may be related to higher levels of medical care. In China, although age-standardized incidence and mortality trends among the overall elderly T2DM population remained relatively stable, the disease burden showed sex disparities, with female incidence numbers, mortality numbers, and age-standardized incidence rates being higher than male rates in both 1990 and 2021. Globally, female incidence and mortality numbers also exceeded male numbers. These differences may be related to physiological and pathological differences between sexes, such as premature menopause increasing T2DM risk in women, women having higher body mass index and fasting glucose as risk factors before T2DM onset, and female T2DM patients having higher cardiovascular complication risks, with cardiovascular disease being the main cause of death in T2DM patients.

Age subgroup analysis revealed that the 60-64 age group accounted for the highest proportion of elderly T2DM incidence numbers globally and in China, indicating that T2DM onset peaks in the early elderly stage. This may be related to lifestyle changes after retirement, declining metabolic rates, and initial

emergence of chronic diseases in this age group. Therefore, early management targeting this age group, such as lifestyle modification and early screening, may play an important role in preventing T2DM onset and progression in this population. For example, a clinical trial published in *The Lancet* demonstrated that substantial weight reduction (>15%-20%) through dietary replacement and behavioral changes could effectively induce T2DM remission. A recently published meta-analysis of individual patient data further identified meat consumption, particularly processed and unprocessed red meat, as a risk factor for T2DM across different populations.

The peak mortality for T2DM patients globally and in China occurred in the 70-74 age group, while in high and high-middle SDI regions, the peak occurred in the 80-84 age group. This aligns with existing research and may reflect advantages in healthcare levels, chronic disease management capacity, and patient survival extension in high SDI regions, resulting in death occurring at older ages. In contrast, limited medical resources and inadequate chronic disease management capacity in middle and low SDI regions contribute to relatively earlier mortality peaks.

Three-factor decomposition analysis identified population growth as the most important factor driving increases in elderly T2DM incidence and mortality globally, contributing 68.77% and 82.14%, respectively. In China, this effect was even more pronounced, with contribution rates reaching 96.46% and 89.36%. As the population base increases, the absolute numbers of elderly T2DM incidence and mortality will inevitably rise, particularly in developing countries with relatively insufficient medical resources and chronic disease management capacity. Further predictions for 2022-2035 indicate that global elderly T2DM incidence and mortality will continue to rise, while China' s incidence will plateau but mortality will continue to increase significantly. Considering that elderly patients often have multiple comorbidities and higher mortality risk, this partially explains the rising mortality trends globally and in China.

We recommend strengthening early screening for China' s early elderly population aged 60-64, promoting healthy lifestyle education, particularly weight control and dietary improvement, to prevent T2DM onset. Given the high incidence numbers, mortality numbers, and age-standardized incidence rates among Chinese female elderly T2DM patients, health promotion efforts should be enhanced to increase public health awareness, encourage active disease management, and promote more effective utilization of medical resources. Considering China' s intensifying population aging, more comprehensive T2DM prevention and control strategies should be developed, with strengthened community monitoring and chronic disease management, improved medical service levels, and extended patient survival with guaranteed quality of life. For patients with multiple comorbidities such as metabolic dysfunction-associated steatotic liver disease, hypertension, and cardiovascular disease, treatment plans should be optimized based on the "shared decision-making" concept between doctors and patients. For example, integrated traditional Chinese and Western medicine ap-

proaches can control blood glucose and treat comorbidities. Numerous studies have demonstrated that Chinese herbal medicine and acupuncture have significant effects in reducing blood glucose, glucose variability, and improving quality of life in T2DM patients. For instance, an animal experiment found that Pueraria oral liquid, a traditional Chinese medicine, could reduce body weight, blood glucose, and lipid levels in T2DM rats while providing hepatic protection. Additionally, a recent randomized controlled trial published in *JAMA Internal Medicine* showed that Jinlida granules, a Chinese patent medicine, could reduce diabetes risk by ameliorating multiple metabolic abnormalities.

This study represents the first epidemiological investigation based on the GBD 2021 database to examine global and Chinese elderly T2DM incidence and mortality burden from 1990 to 2021, providing important evidence for healthcare resource allocation, health management, and disease prevention. However, several limitations exist. First, GBD data are estimated using Bayesian meta-regression models based on epidemiological data from various sources, and the accuracy of original data affects the reliability of GBD estimates, which may impact the accuracy of our results. Second, this study focused on overall trends in global and Chinese elderly T2DM incidence and mortality burden without deeply exploring specific causes and mechanisms underlying these trends, such as lifestyle, genetic factors, and environmental influences. Third, although future incidence and mortality were predicted, these projections may be affected by various uncontrollable factors such as health policy changes and medical technology development, potentially deviating from actual conditions. Furthermore, future regional surveys at the provincial and municipal levels in China are needed to better understand and clarify regional trends and disparities in elderly T2DM disease burden.

Author Contributions: ZHAO Xiaoxiao was responsible for data collection, chart production, and initial draft writing; KE Lixin and XUN Yangqin were responsible for data processing and manuscript revision; WANG Haibo, GAO Wulin, QIAO Tianci, and LU Xiaohui were responsible for data verification and manuscript revision; WU Jibiao provided research guidance, manuscript revision, and funding support; LU Cuncun was responsible for study design, statistical analysis, chart production, and manuscript revision.

Conflict of Interest: The authors declare no conflict of interest.

References

[**?**] Chinese Diabetes Society. Chinese guidelines for the prevention and treatment of type 2 diabetes mellitus (2020 edition) [J]. Chinese Journal of Endocrinology and Metabolism, 2021, 37(4): 311-398. DOI: 10.3760/cma.j.cn311282-20210304-00142.

[**?**] QI X L, LI J, CAUSSY C, et al. Epidemiology, screening, and co-management of type 2 diabetes mellitus and metabolic dysfunction-associated steatotic liver disease[J]. Hepatology, 2024. DOI: 10.1097/HEP.0000000000000913.

[?] XIONG S Z, JIANG W, WANG Y C, et al. Co-designing interventions to strengthen the primary health care system for the management of hypertension and type 2 diabetes in China[J]. Lancet Reg Health West Pac, 2024, 49: 101131. DOI: 10.1016/j.lanwpc.2024.101131.

[?] OSTROMINSKI J W, JEMMA CHO S M, VADUGANATHAN M, et al. Cardiorenal outcomes in middle-aged and older adults with type 1 and type 2 diabetes[J]. J Am Coll Cardiol, 2024, 84(14): 1363-1366. DOI: 10.1016/j.jacc.2024.06.024.

[?] JENKINS D J A, WILLETT W C, YUSUF S, et al. Association of glycaemic index and glycaemic load with type 2 diabetes, cardiovascular disease, cancer, and all-cause mortality: a meta-analysis of mega cohorts of more than 100 000 participants[J]. Lancet Diabetes Endocrinol, 2024, 12(2): 107-118. DOI: 10.1016/S2213-8587(23)00344-3.

[?] GU S W, XU J, FAN Y. Study on the correlation between sarcopenia and serum uric acid in elderly patients with type 2 diabetes mellitus[J]. Chinese Journal of Diabetes, 2024, 32(8): 613-616. DOI: 10.3969/j.issn.1006-6187.2024.08.010.

[?] ZHAO X Z, YANG B L, QIAO Y, et al. Construction and application of a risk prediction model for retinopathy in elderly patients with type 2 diabetes mellitus[J]. Chinese Journal of Diabetes, 2024, 32(8): 587-590. DOI: 10.3969/j.issn.1006-6187.2024.08.005.

[?] HUANG F Y, FU Y, CHEN L. Effects of modified enteral nutrition regimen on blood glucose, intestinal mucosa, and immune function in elderly patients with type 2 diabetes mellitus and acute stroke[J]. Chinese Journal of Gerontology, 2024, 44(15): 3609-3613.

[?] BROWN E, HEERSPINK H J L, CUTHBERTSON D J, et al. SGLT2 inhibitors and GLP-1 receptor agonists: established and emerging indications[J]. Lancet, 2021, 398(10296): 262-276. DOI: 10.1016/S0140-6736(21)00536-5.

[?] CHEN X X, GILES J, YAO Y, et al. The path to healthy ageing in China: a Peking University-Lancet commission[J]. Lancet, 2022, 400(10367): 1967-2006. DOI: 10.1016/S0140-6736(22)01546-X.

[?] WU Q Y, YU S Y, CUI L L, et al. Interpretation of comorbidities of elderly diabetes in the "Chinese Guidelines for the Diagnosis and Treatment of Elderly Diabetes (2021 Edition)" from a nursing perspective[J]. Practical Geriatrics, 2023, 37(2): 213-216. DOI: 10.3969/j.issn.1003-9198.2023.02.027.

[?] ZENG T, JIA T W. Progress in methodology of the Global Burden of Disease study and its impact on disease burden of parasitic diseases[J]. Chinese Journal of Schistosomiasis Control, 2023, 35(3): 299-306. DOI: 10.16250/j.32.1374.2022287.

[?] COLLABORATORS G 2 D A I. Global incidence, prevalence, years lived with disability (YLDs), disability-adjusted life-years (DALYs), and healthy life

expectancy (HALE) for 371 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990-2021: a systematic analysis for the Global Burden of Disease Study 2021[J]. Lancet, 2024, 403(10440): 2133-2161. DOI: 10.1016/S0140-6736(24)00817-4.

[?] CHEN J H, WANG H B, KE L X, et al. Analysis of disease burden and future trend prediction of liver cancer attributable to non-alcoholic steatohepatitis in China from 1990 to 2021[J]. West China Medical Journal, 2025: 1-8. (2025-01-02). http://kns.cnki.net/KCMS/detail/detail.aspx?filename=HXYX20241231001&dbname=CJFD&dbcode=C

[?] JIT M, COOK A R. Informing public health policies with models for disease burden, impact evaluation, and economic evaluation[J]. Annu Rev Public Health, 2024, 45(1): 133-150. DOI: 10.1146/annurev-publhealth-060222-025149.

[?] ZHANG Q, ZHAO W X, DING Y H, et al. Interpretation of the reporting standards for disease burden studies (STROBE-D statement)[J]. Chinese Journal of Evidence-Based Medicine, 1-8[2025-02-26].

[?] SUN P, YU C, YIN L M, et al. Global, regional, and national burden of female cancers in women of child-bearing age, 1990-2021: analysis of data from the global burden of disease study 2021[J]. EClinicalMedicine, 2024, 74: 102713. DOI: 10.1016/j.eclinm.2024.102713.

[?] DUAN Z H, ZHANG M, XU J R, et al. Analysis and prediction of brain tumor mortality trends in China from 2000 to 2019[J]. Chinese General Practice, 2023, 26(6): 734-741. DOI: 10.12114/j.issn.1007-9572.2022.0630.

[?] DENG X X, LI H, ZHONG Y R, et al. Burden of liver cancer attributable to hepatitis B and alcohol globally, in China, and for five sociodemographic index regions from 1990 to 2021: a population-based study[J]. J Clin Transl Hepatol, 2025, 13(1): 1-14. DOI: 10.14218/JCTH.2024.00351.

[?] HUANG D L, LAI H Y, SHI X, et al. Global temporal trends and projections of acute hepatitis E incidence among women of childbearing age: Age-period-cohort analysis 2021[J]. J Infect, 2024, 89(4): 106250. DOI: 10.1016/j.jinf.2024.106250.

[?] ZHANG H, ZHOU X D, SHAPIRO M D, et al. Global burden of metabolic diseases, 1990-2021[J]. Metabolism, 2024, 160: 155999. DOI: 10.1016/j.metabol.2024.155999.

[?] LEVIN A T, OWUSU-BOAITEY N, PUGH S, et al. Assessing the burden of COVID-19 in developing countries: systematic review, meta-analysis and public policy implications[J]. BMJ Glob Health, 2022, 7(5): e008477. DOI: 10.1136/bmjgh-2022-008477.

[?] KAUTZKY-WILLER A, LEUTNER M, HARREITER J. Sex differences in type 2 diabetes[J]. Diabetologia, 2023, 66(6): 986-1002. DOI: 10.1007/s00125-023-05891-x.

[?] YANG J J. Analysis and prediction of factors affecting remaining life expectancy of the oldest-old based on Cox model and deep survival neural network[D]. Shanghai: Shanghai Normal University, 2023. DOI: 10.27312/d.cnki.gshsu.2023.000689.

[?] LEAN M E, LESLIE W S, BARNES A C, et al. Primary care-led weight management for remission of type 2 diabetes (DiRECT): an open-label, cluster-randomised trial[J]. Lancet, 2018, 391(10120): 541-551. DOI: 10.1016/S0140-6736(17)33102-1.

[?] LI C X, BISHOP T R P, IMAMURA F, et al. Meat consumption and incident type 2 diabetes: an individual-participant federated meta-analysis of 1·97 million adults with 100 000 incident cases from 31 cohorts in 20 countries[J]. Lancet Diabetes Endocrinol, 2024, 12(9): 619-630. DOI: 10.1016/S2213-8587(24)00142-0.

[?] COLLABORATORS G 2 D. Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021[J]. Lancet, 2023, 402(10397): 203-234. DOI: 10.1016/S0140-6736(23)01301-6.

[?] National Center for Gerontology, Chinese Geriatrics Society, Diabetes Professional Committee of China Association of Geriatric Care. Chinese guidelines for the diagnosis and treatment of elderly diabetes (2024 edition)[J]. Medical Journal of Peking Union Medical College Hospital, 2024, 15(4): 771-800.

[?] LU C C, LI X X, YANG K H. Trends in shared decision-making studies from 2009 to 2018: a bibliometric analysis[J]. Front Public Health, 2019, 7: 384. DOI: 10.3389/fpubh.2019.00384.

[?] NI Q, BU X W. Guidelines for diagnosis and treatment of elderly diabetes in traditional Chinese medicine[J]. Chinese Journal of General Practice, 2024, 22(8): 1272-1278. DOI: 10.16766/j.cnki.issn.1674-4152.2024.08.002.

[?] ZHAO N J, DAI C M, SUN W J, et al. Interpretation of the traditional Chinese medicine treatment section in the "Chinese Guidelines for the Prevention and Treatment of Type 2 Diabetes Mellitus (2020 Edition)" [J]. Chinese Journal of Diabetes, 2021, 13(4): 309-311. DOI: 10.3760/cma.j.cn115791-20210322-00142.

[?] YANG H B, SONG J Y, XU C, et al. Interventional effects of Pueraria oral liquid on T2DM rats and metabolomics analysis[J]. Biomed Pharmacother, 2024, 175: 116780. DOI: 10.1016/j.biopha.2024.116780.

[?] JI H Y, ZHAO X F, CHEN X Y, et al. Jinlida for diabetes prevention in impaired glucose tolerance and multiple metabolic abnormalities: the FOCUS randomized clinical trial[J]. JAMA Intern Med, 2024, 184(7): 727-735. DOI: 10.1001/jamainternmed.2024.1190.

[?] CAO F, LI D P, WU G C, et al. Global, regional and national temporal trends in prevalence for musculoskeletal disorders in women of childbearing age,

1990-2019: an age-period-cohort analysis based on the Global Burden of Disease Study 2019[J]. Ann Rheum Dis, 2024, 83(1): 121-132. DOI: 10.1136/ard-2023-224620.

[**?**] LIU S S, HE Y J, LI C Y, et al. Analysis of trends in disease burden of liver cancer attributable to alcohol consumption in China from 1990 to 2019[J]. Chinese Journal of Evidence-Based Medicine, 2024, 24(7): 776-782. DOI: 10.7507/1672-2531.202309068.

(Received: 2024-09-09; Revised: 2025-02-27)
(Editor: WANG Shiyue)

Note: Figure translations are in progress. See original paper for figures.