Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Pancreatitis burden in China from 1990 to 2023 and projections to 2050 based on the 2023 Global Burden of Disease Study

Jingyuan Bian
Qingpu Branch of Zhongshan Hospital Affiliated to Fudan University, Department of General Surgery
Yadong Xu
Qingpu Branch of Zhongshan Hospital Affiliated to Fudan University, Department of General Surgery
Dong Xu
Qingpu Branch of Zhongshan Hospital Affiliated to Fudan University, Department of General Surgery
Feng Yang
2511980306@qq.com

Qingpu Branch of Zhongshan Hospital Affiliated to Fudan University, Department of General Surgery

Research Article

Keywords: Pancreatitis, Age, Risk factor, Gender, Trend

Posted Date: November 11th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11077263/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Pancreatitis burden in China from 1990 to 2023 and projections to 2050 based on the 2023 Global Burden of Disease Study

First Author: Jingyuan Bian MD

Address: No.1158 Gongyuan East Road, Qingpu Branch of Zhongshan Hospital Affiliated to Fudan University, Department of General Surgery. SHANGHAI, China

E-mail: bjy08150114@163.com

Second Author: Yadong Xu MD

Address: No.1158 Gongyuan East Road, Qingpu Branch of Zhongshan Hospital Affiliated to Fudan University, Department of General Surgery. SHANGHAI, China

E-mail: 981250389@qq.com

Third Author: Prof. Dong Xu MD

Address: No.1158 Gongyuan East Road, Qingpu Branch of Zhongshan Hospital Affiliated to Fudan University, Department of General Surgery. SHANGHAI, China

E-mail: 1156404948@qq.com

Corresponding Author: Feng Yang MD

Address: No.1158 Gongyuan East Road, Qingpu Branch of Zhongshan Hospital Affiliated to Fudan University, Department of General Surgery. SHANGHAI, China

E-mail: 2511980306@qq.com

Abstract

Background Pancreatitis is a common inflammatory disease with rising incidence and a trend toward affecting younger populations, imposing a substantial global burden. In China, rapid socioeconomic changes have shaped unique epidemiological patterns, necessitating updated assessments to guide policy.

Methods Using Global Burden of Disease data from 1990 to 2023, this study evaluated pancreatitis burden in China by age and sex, analyzed trends, and projected outcomes to 2050.

Results In 2023, China had approximately 515,000 prevalent cases, 460,000 incident cases, 9,000 deaths, and 263,000 disability-adjusted life years (DALYs) due to pancreatitis. Age-standardized rates per 100,000 were 24.26 for prevalence, 23.7 for incidence, 0.42 for mortality, and 13.11 for DALYs, with higher burdens in males. From 1990 to 2023, absolute burdens rose significantly (average annual percentage change: prevalence 1.15%, incidence 0.72%, mortality 1.12%, DALYs 0.33%), while age-standardized rates declined, faster in females. Cases peaked in the 45–80 age group, with rates increasing uniformly with age. Decomposition analysis identified population aging and growth as primary burden drivers, while epidemiological changes were protective. Alcohol-attributable DALYs increased from 10.36% to

14.52%, and deaths from 8.7% to 12.49%. Projections to 2050 show stable age-standardized prevalence and incidence, with steady declines in mortality and DALYs.

Conclusion Although age-standardized rates declined, China's aging population will sustain a rising pancreatitis burden, concentrated in middle-aged and elderly groups. Future policies should prioritize alcohol control and targeted prevention

Keywords: Pancreatitis, Age, Risk factor, Gender，Trend

1. Introduc

Pancreatitis is a severe inflammatory disease of the pancreas, characterized by high incidence, rapid increase, a trend toward affecting younger populations, and swift disease progression. It can rapidly evolve from a mild, self-limiting episode to life-threatening severe acute pancreatitis. The incidence of pancreatitis in China is approximately 13–45 per 100,000 population. A review study by Jordan P. Iannuzzi et al. suggested that the global overall incidence of acute pancreatitis is increasing by 3.07% annually[1]. In contrast, a study by Wu et al. in Shanghai, China, reported an annual increase of 5.1% for pancreatitis and 13.7% for severe acute pancreatitis[2]. This disease not only causes immense suffering for patients but also carries a high mortality rate in severe cases, prolonged hospital stays, and substantial medical costs, placing a heavy burden on China's healthcare system[3, 4]. In recent years, profound changes in lifestyle, dietary structure, and population aging in China, alongside the continuous introduction and implementation of

health policies, have led to significant shifts in the epidemiological landscape of pancreatitis. As the world's most populous developing country, China has undergone remarkable socioeconomic transformation and rapid changes in residents' lifestyles over the past decades. Accelerated industrialization and urbanization have been accompanied by unhealthy behaviors such as high-fat diets, increased smoking and alcohol consumption, and reduced physical activity. Consequently, the prevalence of pancreatitis-related risk factors like obesity, hyperlipidemia, and gallstones has been continuously rising[5]. At the same time, advancements in medical diagnostic capabilities and the continuous improvement of disease registry systems have led to the identification and recording of more pancreatitis cases. These factors collectively contribute to a disease burden trend for pancreatitis in China that shares similarities with Western countries yet possesses unique characteristics, presenting new challenges for disease management and prognosis. However, comprehensive research on the long-term, systematic changes in the epidemiological characteristics of pancreatitis in China remains insufficient. Accurately revealing the changing trends in incidence and population distribution characteristics of pancreatitis is of significant clinical importance for assessing disease burden and guiding prevention and treatment strategies.

2. Methods

2.1 Data Source

Data on pancreatitis from 1990 to 2023 were obtained from the Global Health Data Exchange (GHDx) query tool (https://ghdx.healthdata.org/gbd-2021). This study collected data on incidence, mortality, Disability-Adjusted Life Years (DALYs), and related risk factors for pancreatitis in China from the 1990–2023 GBD study, disaggregated by sex (male/female) and age (19 age groups, from <5 years to ≥95 years, in 5-year intervals). Age-standardized rates (ASRs) were calculated based on the standard population age structure used in the GBD 2021 study to ensure comparability across time and different populations, eliminating the influence of population aging. The calculation involved three steps: first, dividing the study population into age groups (e.g., 5-year groups) and calculating the rate (e.g., incidence or mortality) for each group; second, selecting a "standard population" (e.g., the global standard population used in GBD studies); and finally, multiplying the actual rate for each age group by the proportion of that age group in the standard population and summing these products to obtain the final ASR. All estimates are presented with 95% uncertainty intervals (95% UI), based on the 2.5th and 97.5th percentiles of 1000 draws from the uncertainty distribution. Projected population data for the 2023–2050 period were sourced from a public online repository (https://ghdx.healthdata.org/record/ihme-data/global-population-forecasts-2017-2100). Detailed methodologies of the GBD study have been described previously. Corresponding population data were subsequently retrieved to project the age-

standardized incidence rate (ASIR) of pancreatitis to 2050. The GBD study adheres to the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER).

2.2 Statistical Analysis and Future Burden Prediction Model

The average annual percentage change (AAPC) was calculated to describe trends in the ASRs of the pancreatitis burden. If the lower limit of the AAPC and its 95% confidence interval is greater than 0, the age-standardized indicator is considered to be increasing; if less than 0, it is decreasing; and if it includes 0, the trend is considered stable. AAPC analysis was performed using Joinpoint regression software (Version 5.0.2, National Cancer Institute, USA). This model employs a log-linear model, allows a maximum of 4 joinpoints, and uses permutation tests to automatically identify time points with significant trend changes.

1. Data Source and Forecasting Framework

This study extracted historical data on pancreatitis in China from the Global Burden of Disease (GBD) study for the period 1990–2023. Annual point estimates of age-standardised incidence rates (ASIR), mortality rates (ASMR), prevalence rates (ASPR), and disability-adjusted life-year rates (ASDR) were obtained. To project future disease burden, we employed the Autoregressive Integrated Moving Average (ARIMA) model to extrapolate these indicators from 2024 to 2050.

2. Model Structure and Parameter Selection

The ARIMA model represents a time series as a linear combination of its own past values (autoregressive component, AR) and past forecast errors (moving average component, MA), with differencing (I) applied to achieve stationarity. The general model formulation is:

$$\Phi(B)(1-B)^d y_t = \Theta(B)\varepsilon_t$$

where y_t is the age-standardised rate at year t, B is the backshift operator, d is the order of differencing, Φ and Θ are polynomials for the AR and MA components, respectively, and ε_t denotes white noise.

To enhance model applicability, we used the automatic ARIMA algorithm (auto.arima in R) to search over candidate combinations of orders (p, d, q) based on the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). The algorithm selects the best-fitting model that balances goodness-of-fit and parsimony. For each sex and outcome measure, the chosen parameters exhibited satisfactory statistical properties (detailed model outputs are provided in the Appendix).

3. Prediction Interval Estimation

Using the fitted ARIMA models, we generated point forecasts for 2024–2050 via 27-step-ahead predictions ($h = 27$). Uncertainty in the forecasts was propagated from the residual variance structure of the model, and prediction intervals were constructed using a normal approximation. Specifically, the 2.5th and 97.5th percentiles of the

forecast distribution were taken as the 95% prediction intervals (PI) to reflect the plausible range of future observations.

4. Model Diagnostics and Evaluation

Model adequacy: We assessed residual autocorrelation using the Ljung–Box Q test and tested for normality with the Shapiro–Wilk test. Residuals were confirmed to be white noise, indicating that the models adequately captured the information in the time series.

Model selection metrics: For each fitted model, we recorded AIC, BIC, and log-likelihood values to compare alternative parameterisations. All final models yielded relatively low AIC values, suggesting a favourable trade-off between bias and complexity.

Convergence and stability: Because ARIMA parameters are estimated via maximum likelihood estimation (MLE) with iterative optimisation, we verified convergence status (as indicated by the convergence flag in the fit1 output) and confirmed that all parameter estimates converged stably.

5. Software Implementation and Statistical Significance

All data preprocessing, modelling, and visualisation were performed in R software (version 4.3.1). Core computations relied on the forecast package (including auto.arima and forecast functions), supplemented

by tidyverse and ggplot2 for data manipulation and plotting. For all statistical tests (including residual diagnostics and subsequent comparative analyses), a two-sided $P < 0.05$ was considered statistically significant.

3. Results

3.1 The number of prevalent cases of pancreatitis was 353,805.18 (95% UI: 238,760.01–499,012.66) in 1990 and 514,765.73 (95% UI: 358,296.04–696,838.56) in 2023, representing a relative increase of 0.45 (95% UI: 0.20–0.73) over the period. The age-standardized prevalence rate (ASPR) decreased from 35.32 (95% UI: 23.87–50.18) per 100,000 population in 1990 to 24.26 (95% UI: 17.31–32.67) in 2023, a relative change of –0.31 (95% UI: –0.41 to –0.23). The corresponding AAPC values were 1.15 (95% CI: 0.99–1.31) for prevalence counts and –1.10 (95% CI: –1.33 to –0.86) for ASPR. The number of incident cases of pancreatitis rose from 363,245.11 (95% UI: 291,599.19–433,873.06) in 1990 to 460,361.40 (95% UI: 392,258.77–532,175.50) in 2023, a relative increase of 0.27 (95% UI: 0.16–0.39). The age-standardized incidence rate (ASIR) declined from 35.35 (95% UI: 29.07–41.57) per 100,000 population in 1990 to 23.70 (95% UI: 20.27–27.47) in 2023, a relative change of –0.33 (95% UI: –0.36 to –0.30). The AAPC for incidence counts was 0.72 (95% CI: 0.66–0.78), while that for ASIR was –1.25 (95% CI: –1.38 to –1.13). Sex-specific analysis revealed similar trends in both prevalence and incidence for males and females. **(Table 1).**

Table 1: Changes in the incidence and prevalence of pancreatitis in China from 1990 to 2023

Categories	Prevelence (95% UI)		Incident cases (95% UI)	
	Numbers	ASPRs per 100000	Numbers	ASIRs per 100000
1990	353,805.18(238,760.01-499,012.66)	35.32 (23.87, 50.18)	363245.11(291599.19-433873.06)	35.35 (29.07, 41.57)
2023	514765.73(358296.04-696838.56)	24.26 (17.31, 32.67)	460,361.40(392,258.77-532,175.50)	23.7 (20.27, 27.47)
Change	0.45 (0.2- 0.73)	-0.31 (-0.41, -0.23)	0.27 (0.16, 0.39)	-0.33 (-0.36, -0.3)
AAPC	1.15(0.99,1.31)	-1.10(-1.33, -0.86)	0.72(0.66,0.78)	-1.25(-1.38, -1.13)
Male				
1990	211,736.85(143,144.98-292,367.01)	41.81 (27.9, 59.2)	213616.21(173378.82-259945.61)	40.2 (33.02, 47.38)

2023	307030.5(211217.31-419258.89)	29.29 (20.66, 40.14)	261,646.88(223,788.38-305,842.66)	27.63 (3.56, 32.32)
Change	0.45 (0.2, 0.7)	-0.3 (-0.38, -0.22)	0.22 (0.13, 0.34)	-0.31 (-0.34, -0.28)
AAPC	1.14(0.99,1.29)	-1.04(-1.27, -0.8)	0.62(0.55,0.69)	-1.16(-1.22, -1.1)
Female				
1990	142,068.33(93,724.50-205,137.10)	28.76 (19, 42.11)	149628.9(119635-175466.75)	30.13 (24.78, 35.31)
2023	207735.23(145356.53-286687.89)	19.23 13.71, 25.96)	198,714.52(168,806.37-230,588.87)	19.58 (16.77, 22.45)
Change	0.46 (0.13, 0.77)	-0.33 (-0.46, -0.22)	0.33 (0.21, 0.46)	-0.35 (-0.38, -0.32)
AAPC	1.16(0.96,1.36)	-1.23(-1.36, -1.11)	0.86(0.73,0.99)	-1.35(-1.39, -1.31)

Data source: https://ghdx.healthdata.org/gbd-2023

3.2 The number of deaths due to pancreatitis was 6,629.76 (95% UI: 3,978.02–10,380.93) in 1990 and 9,028.99 (95% UI: 6,906.07–11,582.74) in 2023, representing

a relative increase of 0.36 (95% UI: –0.21 to 1.32) over the period. The age-standardized mortality rate (ASMR) decreased from 0.81 (95% UI: 0.48–1.28) per 100,000 population in 1990 to 0.42 (95% UI: 0.32–0.54) in 2023, a relative change of –0.48 (95% UI: –0.71 to –0.09). The corresponding AAPC values were 1.12 (95% CI: 0.80–1.45) for death counts and –1.70 (95% CI: –1.94 to –1.46) for ASMR.The number of DALYs due to pancreatitis was 246,978.97 (95% UI: 153,295.65–375,755.35) in 1990 and 262,495.94 (95% UI: 202,494.81–338,849.08) in 2023, a relative increase of 0.06 (95% UI: –0.33 to 0.77). The age-standardized DALY rate (ASDR) declined from 25.00 (95% UI: 15.44–37.70) per 100,000 population in 1990 to 13.10 (95% UI: 10.15–16.68) in 2023, a relative change of –0.48 (95% UI: –0.67 to –0.14). The AAPC for DALY counts was 0.33 (95% CI: 0.06–0.60), while that for ASDR was –1.81 (95% CI: –2.13 to –1.49). Subgroup analysis by sex showed similar trends in mortality and DALYs for both males and females. (Table 2)

Table 2: Changes in mortality and DALYs due to pancreatitis in China from 1990 to 2023

Categories	Mortality (95% UI)		DALYs (95% UI)	
	Numbers	ASDRs per 100000	Numbers	DALYs per 100000
1990	6629.76 (3978.02, 10380.93)	0.81 (0.48, 1.28)	246978.97 (153295.65, 375755.35)	25 (15.44, 37.7)

2023	9028.99 (6906.07, 11582.74)	0.42 (0.3, 0.54)	262495.94 (202494.81, 338849.08)	13.1 (10.15, 16.68)
Change	0.36 (-0.21, 1.32)	-0.48 (-0.71, -0.09)	0.06 (-0.33, 0.77)	-0.48 (-0.67, -0.14)
AAPC	1.12(0.8,1.45)		0.33(0.06,0.6)	-1.81(-2.13, -1.49)
Male				
1990	3502.75 (1989, 6053.12)	0.84 (0.48, 1.46)	143532.06 (81117.94, 244341.5)	27.94 (16.25, 46.81)
2023	5329.75 (3639.58, 7478.84)	0.53 (0.37, 0.74)	167324.25 (118581.72, 224990.89)	17.05 (12.11, 22.87)
Change	0.52 (-0.21, 2.04)	-0.37 (-0.67, 0.24)	0.17 (-0.36, 1.12)	-0.39 (-0.66, 0.1)
AAPC	1.50(1.16,1.83)	-1.32(-1.68, -0.95)	0.64(0.35,0.92)	-1.42(-1.66, -1.17)
Female				
1990	3127.01 (1560.65, 5479.45)	0.76 (0.4, 1.35)	103446.91 (58835.97 , 174923.64)	21.59 (12.32, 36.4)
2023	3699.25 (2425.17, 5307.33)	0.32 (0.21, 0.46)	95171.69 (66100.15 , 133788.29)	9.05 (6.31, 12.45)

Change	0.18 (-0.43, 1.22)	-0.58 (-0.8, -0.2)	-0.08 (-0.48, 0.51)	-0.58 (-0.77, -0.3)
AAPC	0.62(0.33,0.92)	-2.43(-2.64, -2.22)	-0.18(-0.45,0.08)	-2.54(-2.84, -2.24)

Data source: https://ghdx.healthdata.org/gbd-2023

3.3 From 1990 to 2023, the ASIR of pancreatitis in China showed a declining trend from 1995 to 2000, after which it remained stable. Incidence rates were consistently higher in males than in females. In 2023, the number of incident cases was 261,646.88 (95% UI: 223,788.38–305,842.66) in males and 198,714.52 (95% UI: 168,806.37–230,588.87) in females, with corresponding ASIRs of 27.63 (95% UI: 23.56–32.32) and 19.58 (95% UI: 16.77–22.45) per 100,000 population, The number of deaths due to pancreatitis remained stable despite the increase in incidence, indicating a declining trend in mortality. The ASDR was 0.53 (95% UI: 0.37–0.74) per 100,000 in males and 0.32 (95% UI: 0.21–0.46) in females, with male mortality significantly higher than female mortality. DALYs due to pancreatitis remained stable after 2000. The age-standardized DALY rate (ASDR) decreased from 25.00 (95% UI: 15.44–37.70) per 100,000 in 1990 to 13.10 (95% UI: 10.15–16.68) in 2023. In 2023, the ASDR was 17.05 (95% UI: 12.11–22.87) for males and 9.05 (95% UI: 6.31–12.45) for females. [Fig 1]

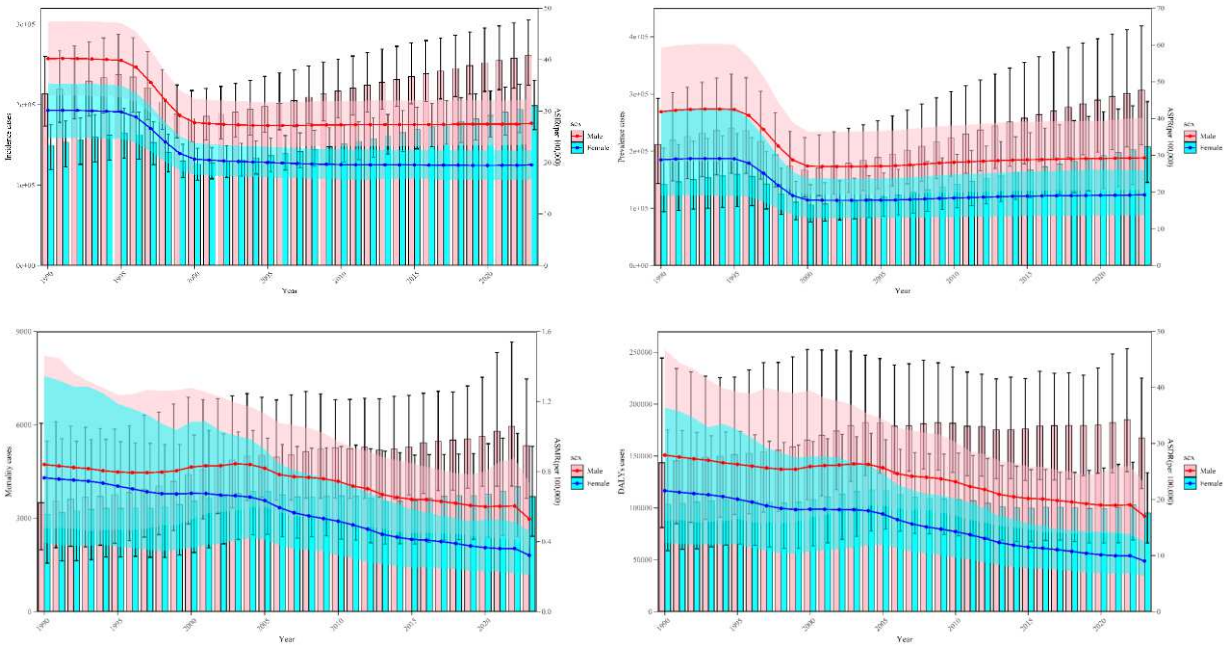


Fig 1. Trends in prevalence, incidence, mortality, DALYs counts and ASPR, ASIR, ASMR, ASDR for pancreatitis in China, 1990-2023

3.4 Age-specific burden analysis for pancreatitis in China in 2023 showed that incident cases were primarily concentrated in the 30–80 age group, with the proportion of females beginning to exceed that of males in populations over 60 years old. Regarding incidence rates, rates were similar between males and females in the 60–80 age range, while male incidence was significantly higher than female incidence in other age groups. Deaths from pancreatitis were mainly concentrated in the 65–85 age group. Between ages 15 and 85, the number of deaths was significantly higher in males than in females. Mortality rates increased progressively with age, with a steeper increase observed in patients over 65 years old. DALYs were primarily concentrated in the 45–75 age group. For patients over 80 years old, DALYs were significantly higher in males than in females, and age-standardized DALY rates (ASDRs) increased

progressively with age. [Fig 2]

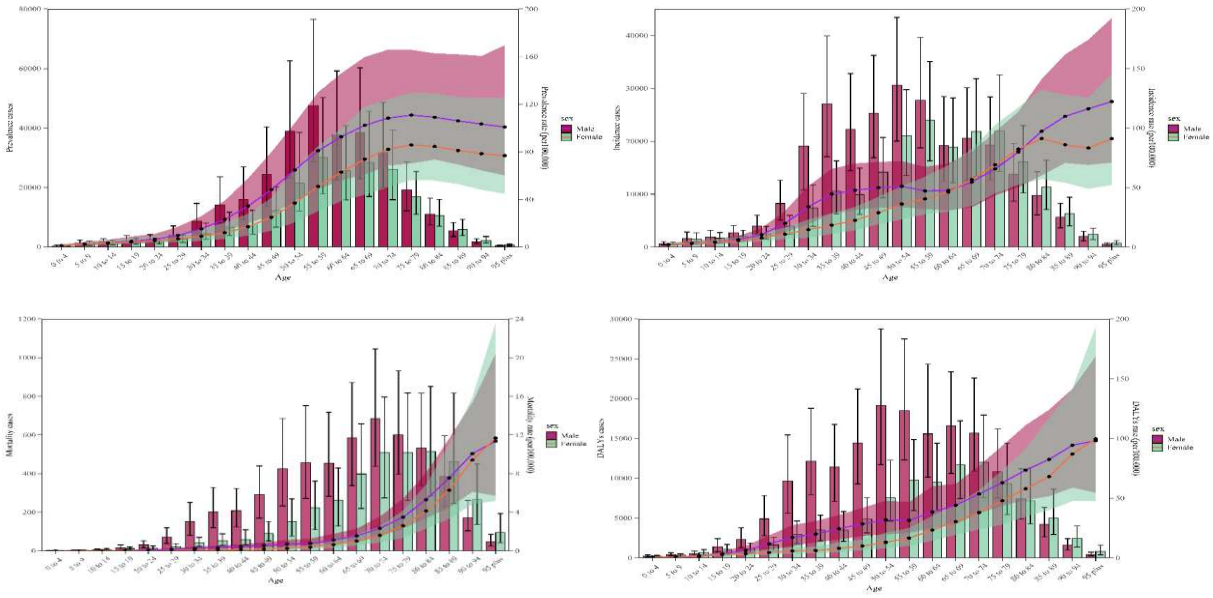


Fig 2. Age-specific trends in prevalence, incidence, mortality, and DALYs counts, along with ASPR, ASIR, ASMR, and ASDR for pancreatitis in China, 2023

3.5 Decomposition analysis of the pancreatitis disease burden revealed that population aging and population growth were the main factors contributing to the increase in incidence, mortality, and DALYs, while epidemiological changes acted as protective factors. These contributions were roughly similar in proportion between males and females. [Fig 3]

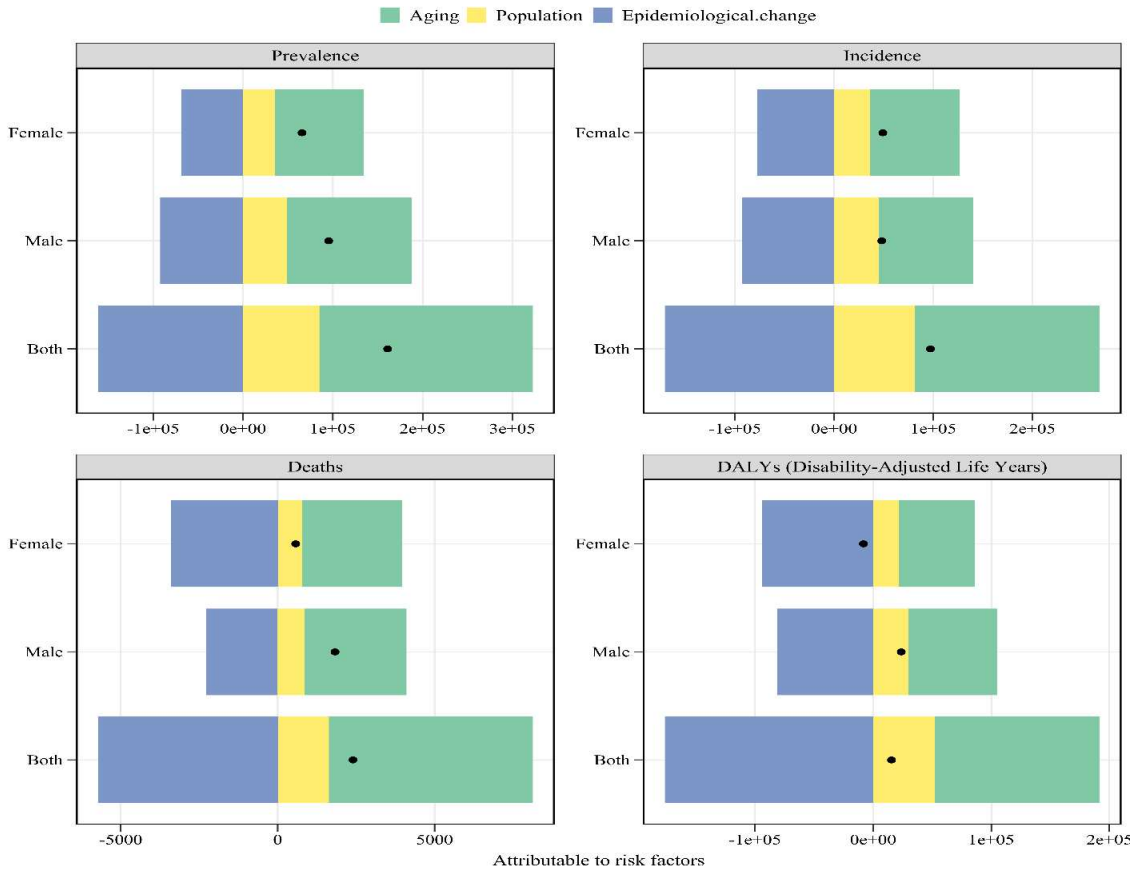


Fig 3. Contributing factors to the trends in pancreatitis in China, 1990–2023

3.6 In the analysis of etiological factors for pancreatitis, data on the burden attributable to alcohol consumption were extracted from the GBD study. From 1990 to 2023, the proportion of DALYs attributable to alcoholic pancreatitis increased from 10.36% to 14.52% overall. This increase was from 17.57% to 21.34% in males and from 1.02% to 1.80% in females. The proportion of deaths attributable to alcoholic pancreatitis increased from 8.7% to 12.49% overall, from 16.39% to 19.52% in males,

and from 1.03% to 1.76% in females. [Fig 4]

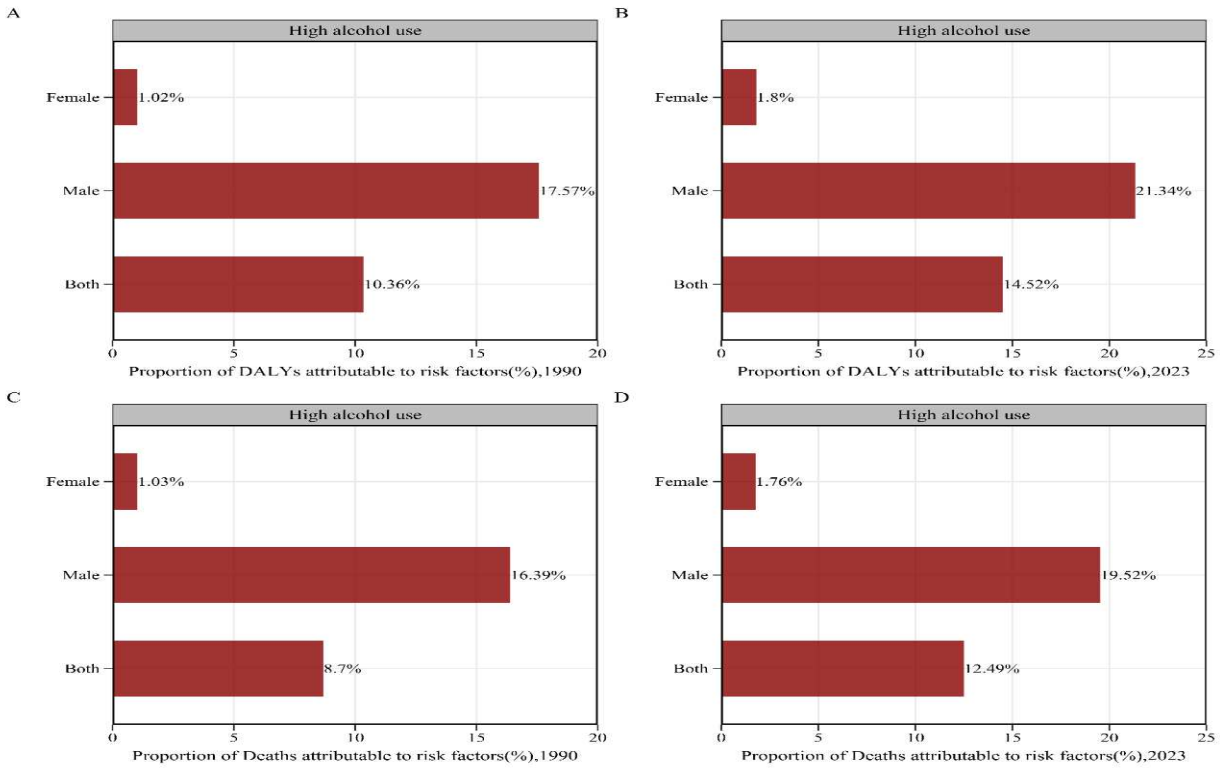


Fig 4. Contribution of Alcoholic Pancreatitis to DALYs and Mortality in 1990 and 2023

3.7 In projections of the pancreatitis burden, the ASIR for pancreatitis in China is projected to remain stable from 2023 to 2050, but the ASIR for males is projected to decline and converge with the female rate around 2045. ASPR is projected to remain stable. ASMR is projected to show a steady declining trend, with male mortality consistently higher than female mortality. ASDR is projected to follow a similar trend to ASMR. [Fig5]

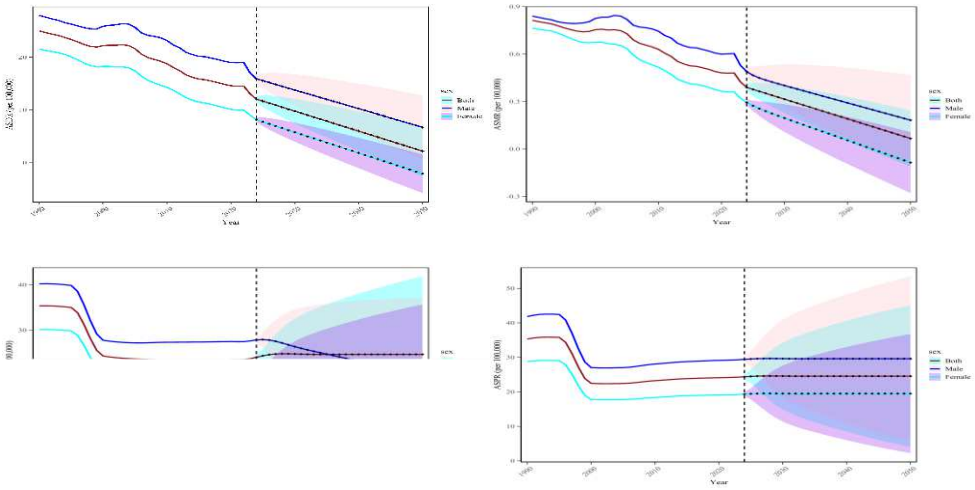


Fig 5. Forecasted changes in the age-standardized prevalence, incidence, mortality, and DALY rates of pancreatitis in China from 2023 to 2050

4. Discussion

This study reports the prevalence, incidence, mortality, DALYs, and ASRs for pancreatitis in China between 1990 and 2023. In 2023, there were approximately 515,000 prevalent cases, 460,000 incident cases, 9,000 deaths, and 263,000 DALYs. The ASRs for prevalence, incidence, mortality, and DALYs were 24.26 (17.31, 32.67), 23.7 (20.27, 27.47), 0.42 (0.30, 0.54), and 13.11 (10.15, 16.68) per 100,000 population, respectively. A study on the global burden of pancreatitis reported that in 2021, the global ASRs for prevalence, incidence, mortality, and DALYs were 69.0 (51.3, 91.3), 32.8 (28.9, 37.4), 1.5 (1.3, 1.7), and 48.4 (43.1, 55.3) per 100,000 population, respectively[6]. Research by Guoqing Ouyang et al. found that the global age-standardized prevalence and incidence rates were 76.2 and 20.6 per 100,000 population, respectively[7]. Comparative analysis revealed that the disease burden of

pancreatitis in China was significantly lower than the global average, particularly in terms of prevalence, where the global prevalence was nearly three times that of China, and DALYs were three times higher. This may be attributed to the GBD database's more detailed data collection processes in developed countries, resulting in higher ascertainment rates for pancreatitis. Additionally, risk factors such as high-fat diets, obesity, and alcohol consumption are more prevalent in developed countries, and their populations are more aged, contributing to the observed substantial numerical differences[8]. Moreover, chronic pancreatitis is a major contributor to increased prevalence and DALYs. However, the GBD database does not provide a stratified analysis of the disease burden for acute and chronic pancreatitis separately. A study by Amy Y. Xiao et al. reported that the global incidence of chronic pancreatitis was 9.62 cases per 100,000 person-years (7.86–11.78)[9]. In China, the incidence of chronic pancreatitis (CP) is approximately 13 per 100,000 population [10]. Given that the incidence of chronic pancreatitis in China is higher than the global average and is rising rapidly, enhancing research efforts on its risk factors is essential for guiding healthcare policy.

From 1990 to 2023, the prevalence and incidence of pancreatitis in China exhibited a biphasic trend: a decline and stabilization from 1990 to 2000, followed by a gradual increase in the number of cases post-2000. Notably, the age-standardized rates remained stable throughout. This stability in ASRs, despite rising case numbers, can be explained by the counterbalancing effects of an expanding and aging

population, dietary changes, and improved diagnostics, which have increased the pool of diagnosed patients [5].Concurrently, the popularization of medical knowledge and enhanced health awareness among the population have, to some extent, reduced the incidence of pancreatitis, leading to a balance between these factors. Decomposition analysis of the pancreatitis disease burden revealed that the factors contributing to the increase in ASPR, ASIR, ASMR, and ASDR were, in order, population aging and population growth. The intensification of population aging has driven an increase in the number of pancreatitis cases, rather than a uniform worsening of risk across all age groups, hence the stable trends observed after age standardization.

In the analysis of ASMR and ASDR for pancreatitis, a steady declining trend was observed, particularly noticeable after 2005. This decline is attributable to advancements in medical technology and the expansion of healthcare facilities. In terms of early diagnosis, the widespread use of high-resolution CT and MRI has enabled timely treatment for pancreatitis patients. Simultaneously, a deeper understanding of pancreatitis has spurred therapeutic innovations, especially the development of novel techniques for severe cases, such as percutaneous catheter drainage, minimally invasive retroperitoneal pancreatic necrosectomy, early enteral nutrition, and organ support therapies. These measures have collectively contributed to reducing mortality and DALYs in severe acute pancreatitis, effectively curbing the rise in death numbers despite the increasing number of pancreatitis cases[11-14]. Several recent clinical studies have reported encouraging findings. Notably, a

multicenter study by Lei Li et al. validated an exosomal miRNA classifier (Cmi), composed of miR-4265, miR-1208, and miR-3127-5p. This classifier exhibited significantly superior predictive accuracy for persistent organ failure (POF) relative to conventional scoring systems and biochemical markers. By enabling early risk stratification within the critical "golden window" post-onset, it fills a crucial void in early POF warning for acute pancreatitis (AP). The application of this tool in clinical practice holds significant potential to improve patient outcomes[15].Lucía Guilabert's PAN-PROMISE quantitatively integrates patient-reported experiences, closely correlates with key endpoints in acute pancreatitis (AP), and offers a combination of sensitivity, timeliness, and feasibility. It has also demonstrated significant efficacy in predicting the risk of infected pancreatic necrosis and mortality [16]. The clinical application of the COX-2 inhibitor imrecoxib and the traditional Chinese medicine formula Chaiqin Chengqi Decoction have both demonstrated statistically significant effects in the prevention and treatment of severe acute pancreatitis[16, 17]. The promotion of standardized treatment protocols for severe acute pancreatitis and the establishment of large-scale specialized treatment centers in China have also played a crucial role.

Complications of pancreatitis are also a growing concern in China. These include diabetes from endocrine insufficiency, and abdominal pain and osteoporosis from exocrine insufficiency. Critically, the rising incidence of chronic pancreatitis—whose mechanisms remain unclear and for which treatments are limited—is a major driver of

the overall disease burden[18, 19]. Age-specific burden analysis revealed that ASIR, ASMR, and ASDR for pancreatitis increased with age, while ASPR stabilized after age 75. Patients with pancreatitis were primarily concentrated in the 40–85 age group, exhibiting an approximately normal distribution on either side of this range. This distribution pattern is attributed to the larger population base in this age bracket, greater exposure to pancreatitis risk factors, and poorer prognosis due to diminished organ function in older patients[20, 21]. While ASIR, ASMR, and ASDR were consistently higher in males across all ages, the absolute numbers of cases and deaths in those over 80 were higher in females, probably due to the larger female population in this age group. This overall sex disparity is largely explained by males' greater exposure to risk factors such as alcohol, smoking, and high-fat diets[1, 19, 22]. Therefore, in the formulation of prevention and treatment policies for pancreatitis, priority should be given to middle-aged and elderly males, as well as to the regulation of high-risk factors such as alcohol consumption, smoking, and high-fat diets. The GBD study provides data on the contribution of alcohol to the pancreatitis burden: from 1990 to 2023, the proportion of DALYs attributable to alcohol increased from 10.36% to 14.52%, and the proportion of deaths increased from 8.7% to 12.49%. This indicates that alcohol consumption is a significant and growing contributor to the pancreatitis burden. Furthermore, research by Jordan P. Iannuzzi et al. suggests that the global incidence of alcohol-induced pancreatitis is increasing by 2.96% annually, while a study by Wu et al. covering Shanghai, China from 2009 to 2014 reported an

even higher annual growth rate of 19.8% for alcoholic pancreatitis in that region. This trend is closely linked to Chinese customs and drinking culture [1, 2], Therefore, China should prioritize the implementation of alcohol control policies. Effective implementation of such policies would also play a significant role in reducing cardiovascular and cerebrovascular diseases and accidental injuries[23, 24]. Projections of the pancreatitis disease burden indicate that ASIR and ASPR in China are expected to remain stable from 2023 to 2050, while ASMR and ASDR are projected to show a steady declining trend. These projections continue the trends observed from 1990 to 2023, suggesting that current policies have, to some extent, curbed the escalation of the pancreatitis burden.

A limitation of this study is that the database does not stratify the etiology of pancreatitis, hindering our understanding of trends for specific types such as biliary pancreatitis, hyperlipidemic pancreatitis, and alcoholic pancreatitis, and precluding targeted analyses. Furthermore, the lack of data stratification distinguishing chronic pancreatitis from acute pancreatitis makes it difficult to explore specific trends in chronic pancreatitis. Addressing these gaps requires establishing more detailed, China-specific pancreatitis databases to conduct further analyses that can effectively guide the formulation of national pancreatitis prevention and control policies.

Conclusion

Pancreatitis is a common digestive system disease with high incidence and variable clinical outcomes, imposing a substantial healthcare burden. In China, ASPR and ASIR have remained relatively stable since 1990, but the absolute number of patients has steadily increased. ASMR and ASDR have declined, although total death and DALY numbers have remained relatively stable. The disease burden is significantly higher in males than in females, likely due to greater male exposure to risk factors such as smoking, alcohol consumption, and obesity. Furthermore, the burden is primarily concentrated in the 45–80 age group. Projections for 2023–2050 reveal that while ASIR and ASPR may remain stable and ASMR and ASDR may decline, future population aging and the increasing incidence of chronic pancreatitis indicate that pancreatitis will remain a significant healthcare challenge. Future prevention and control policies should emphasize monitoring risk factors for pancreatitis and implementing screening for pancreatitis in middle-aged and elderly populations presenting with abdominal pain.

Abbreviation

Abbreviation	Full Term
GBD	Global Burden of Disease
GHDx	Global Health Data Exchange
DALYs	Disability-Adjusted Life Years
ASR	Age-Standardized Rate

ASPR	Age-Standardized Prevalence Rate
ASIR	Age-Standardized Incidence Rate
ASMR	Age-Standardized Mortality Rate
ASDR	Age-Standardized DALY Rate
AAPC	Average Annual Percentage Change
UI	Uncertainty Interval
CI	Confidence Interval
BAPC	Bayesian Age-Period-Cohort
INLA	Integrated Nested Laplace Approximations
RW	Random Walk
POF	Persistent Organ Failure
AP	Acute Pancreatitis
CP	Chronic Pancreatitis
Cmi	exosomal miRNA classifier

Contributions

Feng Yang analyzes and interprets patient data on pancreatitis, and was a major contributor to the writing of the manuscript. Dong Xu, Yadong Xu, Jingyuan Bijing contributed to the creation of the article icon and the revision of the paper, DX did the

article conception and image beautification, and all the authors read and approved the final manuscript.

Data and materials availability

The datasets generated and analyzed during this study are available in the Global Health Data Exchange (GHDx) repository, http://ghdx.healthdata.org/gbd-results-tool.

Funding

No Funding

Contributions

Feng Yang analyzes and interprets patient data on pancreatitis, and was a major contributor to the writing of the manuscript. Dong Xu, Yadong Xu, Jingyuan Bijing contributed to the creation of the article icon and the revision of the paper, DX did the article conception and image beautification, and all the authors read and approved the final manuscript.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Ethics approval and consent to participate

This study is part of [Author initials]'s doctoral programme and used publicly available, de-identified, aggregated data from the Global Burden of Disease Study 2023, provided by the Institute for Health Metrics and Evaluation (IHME). The GBD data are intended for statistical and research purposes and can be obtained from the Global Health Data Exchange (GHDx) under the IHME data use terms. [Author initials] accepted the relevant GBD/IHME data use agreement. The GBD data are derived from existing data sources that have received ethical approval or exemption, and the data are released only in aggregate form. The GBD datasets cannot identify individuals because the available detail is limited to non-identifiable aggregate levels and no individual identifiers are included. Therefore, ethical approval and consent to participate were not required.

Consent for publication

Not applicable. No identifiable individual person's data were included.

Reference

1. Iannuzzi JP, King JA, Leong JH, Quan J, Windsor JW, Tanyingoh D, Coward S, Forbes N, Heitman SJ, Shaheen AA *et al*: **Global Incidence of Acute Pancreatitis Is Increasing Over Time: A Systematic Review and Meta-Analysis**. *Gastroenterology* 2022, **162**(1):122-134.

2. Wu D, Tang M, Zhao Y, Zhou S, Xu X, Wang F, Liu H, Wu M: **Impact of Seasons and Festivals on the Onset of Acute Pancreatitis in Shanghai, China**. *Pancreas* 2017, **46**(4):496-503.

3. Hamesch K, Hollenbach M, Guilabert L, Lahmer T, Koch A: **Practical management of severe acute pancreatitis**. *European journal of internal medicine* 2025, **133**:1-13.

4. Leppäniemi A, Tolonen M, Tarasconi A, Segovia-Lohse H, Gamberini E, Kirkpatrick AW, Ball CG, Parry N, Sartelli M, Wolbrink D *et al*: **2019 WSES guidelines for the management of severe acute pancreatitis**. *World journal of emergency surgery : WJES* 2019, **14**:27.

5. Pancreatic Surgery Group, Chinese Society of Surgery, Chinese Medical Association. Guidelines for the diagnosis and treatment of acute pancreatitis in China (2021). Zhejiang Practical Medicine, 2021, 26(6): 511-519, 535. (in Chinese)

6. Liu B, Zhang X, Li J, Sun Z, Lin C, Ning C, Hong X, Zhu S, Shen D, Chen L *et al*: **The Global, Regional, and National Burden of Pancreatitis in 204 Countries and Territories, 1990-2021: A Systematic Analysis for the Global Burden of Disease Study 2021**. *Digestive diseases and sciences* 2025, **70**(7):2328-2339.

7. Ouyang G, Pan G, Liu Q, Wu Y, Liu Z, Lu W, Li S, Zhou Z, Wen Y: **The global, regional, and national burden of pancreatitis in 195 countries and**

territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *BMC medicine* 2020, **18**(1):388.

8. McGuigan A, Kelly P, Turkington RC, Jones C, Coleman HG, McCain RS: **Pancreatic cancer: A review of clinical diagnosis, epidemiology, treatment and outcomes**. *World journal of gastroenterology* 2018, **24**(43):4846-4861.

9. Xiao AY, Tan ML, Wu LM, Asrani VM, Windsor JA, Yadav D, Petrov MS: **Global incidence and mortality of pancreatic diseases: a systematic review, meta-analysis, and meta-regression of population-based cohort studies**. *The lancet Gastroenterology & hepatology* 2016, **1**(1):45-55.

10. Yi Jinhui, Wang Dan, Zhang Di, Wang Teng, Han Chao, Hu Lianghao, Liao Zhuan, Li Zhaoshen. Clinical information analysis of 10,533 cases of chronic pancreatitis: A 28-year clinical treatment summary from Changhai Hospital. Chinese Journal of Pancreatology, 2022, 22(4): 252-259. (in Chinese)11. De Lucia SS, Candelli M, Polito G, Maresca R, Mezza T, Schepis T, Pellegrino A, Zileri Dal Verme L, Nicoletti A, Franceschi F *et al*: **Nutrition in Acute Pancreatitis: From the Old Paradigm to the New Evidence**. *Nutrients* 2023, **15**(8).

12. Fung C, Svystun O, Fouladi DF, Kawamoto S: **CT imaging, classification, and complications of acute pancreatitis**. *Abdominal radiology (New York)* 2020, **45**(5):1243-1252.

13. Gomatos IP, Halloran CM, Ghaneh P, Raraty MG, Polydoros F, Evans JC, Smart HL, Yagati-Satchidanand R, Garry JM, Whelan PA *et al*: **Outcomes From Minimal Access Retroperitoneal and Open Pancreatic Necrosectomy in 394 Patients With Necrotizing Pancreatitis**. *Annals of surgery* 2016, **263**(5):992-1001.

14. Li Fei, Huang Bohan, Cao Feng. Minimally invasive surgical management strategies, techniques, and evaluation for infected pancreatic necrosis. Chinese Journal of Practical Surgery, 2024, 44(5): 512-516. (in Chinese)15. Li L, Zhang Q, Feng Y, Kong F, Sun F, Xie P, Zhao J, Yu H, Zhou J, Wu S *et al*: **A Novel Serum Exosomal MicroRNA Signature in the Early Prediction of Persistent Organ Failure in Patients With Acute Pancreatitis**. *Annals of surgery* 2025, **282**(1):93-99.

16. Kang X, Xia M, Wang J, Wang X, Luo H, Qin W, Liang Z, Zhao G, Yang L, Sun H *et al*: **Rectal diclofenac versus indomethacin for prevention of post-ERCP pancreatitis (DIPPP): a multicentre, double-blind, randomised, controlled trial**. *Gut* 2025, **74**(7):1094-1102.

17. He W, Ding L, Liu Z, Hua M, Zhou Y, Gong M, Sheng J, Wu X, Fan H, Shu H *et al*: **Low-Molecular-Weight Heparin Plus Insulin in**

Hypertriglyceridemic Acute Pancreatitis: A Randomized Clinical Trial. *JAMA network open* 2025, **8**(11):e2542124.

18. Petrov MS, Yadav D: **Global epidemiology and holistic prevention of pancreatitis**. *Nature reviews Gastroenterology & hepatology* 2019, **16**(3):175-184.

19. Vege SS, Chari ST: **Chronic Pancreatitis**. *The New England journal of medicine* 2022, **386**(9):869-878.

20. Baeza-Zapata AA, García-Compeán D, Jaquez-Quintana JO: **Acute Pancreatitis in Elderly Patients**. *Gastroenterology* 2021, **161**(6):1736-1740.

21. Tenner S, Vege SS, Sheth SG, Sauer B, Yang A, Conwell DL, Yadlapati RH, Gardner TB: **American College of Gastroenterology Guidelines: Management of Acute Pancreatitis**. *The American journal of gastroenterology* 2024, **119**(3):419-437.

22. Qiu M, Zhou X, Zippi M, Goyal H, Basharat Z, Jagielski M, Hong W: **Comprehensive review on the pathogenesis of hypertriglyceridaemia-associated acute pancreatitis**. *Annals of medicine* 2023, **55**(2):2265939.

23. Ronksley PE, Brien SE, Turner BJ, Mukamal KJ, Ghali WA: **Association of alcohol consumption with selected cardiovascular disease outcomes: a systematic review and meta-analysis**. *BMJ (Clinical research ed)* 2011, **342**:d671.

24. Chikritzhs T, Livingston M: **Alcohol and the Risk of Injury**. *Nutrients* 2021, **13**(8).