ANNALS OF MEDICINE
2025, VOL. 57, NO. 1, 2442073
https://doi.org/10.1080/07853890.2024.2442073

RESEARCH ARTICLE

OPEN ACCESS Check for updates

Temporal trends in gender, etiology, severity and outcomes of acute pancreatitis in a third-tier Chinese city from 2013 to 2021

Yining Huang[a], Minhao Qiu[a], Shuang Pan[a], Yan Zhou[b], Xiaoyi Huang[b], Yinglu Jin[b], Maddalena Zippi[c], Sirio Fiorino[d], Vincent Zimmer[e] and Wandong Hong[a]

[a]Department of Gastroenterology and Hepatology, The First Affiliated Hospital of Wenzhou Medical University, Wenzhou, China; [b]School of the First Clinical Medical Sciences, Wenzhou Medical University, Wenzhou, China; [c]Unit of Gastroenterology and Digestive Endoscopy, Sandro Pertini Hospital, Rome, Italy; [d]Medicine Department, Internal Medicine Unit, Budrio Hospital Azienda USL, Budrio, Italy; [e]Department of Medicine II, Saarland University Medical Center, Saarland University, Homburg, Germany

ABSTRACT

Background: To evaluate temporal trends in gender, etiology, severity, outcomes, cost and median length of stay (MLS) in patients with acute pancreatitis (AP) in a third-tier Chinese city.

Methods: Patients with AP admitted to a university hospital between January 2013 and December 2021. Relationships between etiology, prevalence of severe acute pancreatitis (SAP) and survey years were investigated by joinpoint regression analysis.

Results: A total of 5459 (male 62.3%) patients with AP were included. Between January 2013 and December 2021, we observed: (a) the prevalence of biliary diseases-related AP was stable, while the prevalence of hypertriglyceridemia (HTG)-associated AP (P_{trend} = 0.04) and alcohol-associated AP (P_{trend} < 0.0001) both increased; (b) there was an increase in crude prevalence of SAP from 4.97% to 12.2% between 2013 and 2021 (P_{trend} < 0.0001); (c) compared to female populations, male gender had a higher prevalence of AP; (d) there was a decrease in MLS from 11 days to 8 days (P_{trend} < 0.0001) and in median cost of hospitalization (MCH) for all patients (from 20,166 to 12,845 YUAN) (P_{trend} < 0.0001); (e) the overall in-hospital mortality rate was 1.28% (70/5459) for patients with AP. There was no statistically significant in the time trend of mortality during the study period (P_{trend} = 0.5873). At multivariate analysis, survey year was associated with prevalence of SAP after adjustment by age and biliary diseases (OR: 1.07; 95% CI: 1.03–1.12). Based on the stratification by severity of disease, the decrease of MLS and MCH was more significant in non-SAP vs. SAP patients.

Conclusions: Over the observational period, the proportion of male patients with AP, prevalence of age-adjusted rate of HTG and alcohol-associated AP and SAP increased, while MLS and MCH for all patients decreased, and the time trend of mortality of AP was stable.

HIGHLIGHTS

- This is the first study to evaluate temporal trends in gender, etiology, severity and outcomes of acute pancreatitis in a third-tier Chinese city.
- Rigorous statistical methods such as Joinpoint regression and subgroup analysis were performed.

ARTICLE HISTORY
Received 25 November 2023
Revised 5 November 2024
Accepted 12 November 2024

KEYWORDS
Acute pancreatitis; predictor; severity; temporal trend; prevalence; epidemiology

1. Introduction

Acute pancreatitis (AP) is one of the most common gastrointestinal causes for hospitalization and it is characterized by high cost of hospitalization around the world [1]. In the past several decades, the prevalence of AP rose with an annual percent change of 3.07% [1], which leads to an increased burden on public health system. Clinical courses in most patients with AP are mild and self-limited, but about 20–30% of patients develop a severe form of acute pancreatitis (SAP). It is characterized by persistent organ failure and high mortality [2]. Understanding the epidemiology of AP is essential to properly using health care, developing the optimal therapeutic strategies of AP and improving the disease management capability [3,4].

Several studies have reported the prevalence of AP in mainland China [4–6]. Fan et al. revealed that the

CONTACT Wandong Hong xhnk-hwd@163.com Department of Gastroenterology and Hepatology, The First Affiliated Hospital of Wenzhou Medical University, Nanbaixiang, Ouhai District, Wenzhou City, Zhejiang Province 325000, China

number of patients with AP increased annually from 241 in 2011 to 453 in 2016 [5]. Zheng et al. reported that gallstone was the main etiological factor of AP, and the prevalence of hyperlipidaemia-related AP significantly rose between 2006 and 2010 in Beijing [4]. However, almost all of the studies come from the first-tier cities, such as Shanghai, Beijing and Guangzhou in the Mainland China [4–6]. There are several differences between first-tier cities and third-tier cities, including diet pattern and medical resources. For example, Xiong et al. demonstrated that the proportion of animal-sourced foods increased from 11% in 1980 to 27% in 2017 in Chinese diet [7]. The dietary pattern of Beijing gradually transformed into animal-sourced foods pattern, which was similar to that in Western countries [7]. In addition, first-tier cities have richer medical resources. Wan et al. showed that Beijing, Shanghai and Guangzhou ranked the top three in terms of medical resource scoring [8]. Yuan et al. noted that Beijing, Shanghai and Tianjin had higher high-quality health resource density index than other Chinese cities [9]. However, there is a paucity of studies on prevalence of AP in the third-tier Chinese cities, for instance, Wenzhou city (a city with a resident population of 9.25 million) [10,11].

China is undergoing a rapid economic development and an improvement of civil life [12]. Meanwhile, the prevalence of several diseases decreased in past few decades. For example, a study from Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2019 Hepatitis B Collaborators demonstrated that the global prevalence of chronic HBV infection decreased by 31.3% between 1990 and 2019 [13]. Jiang et al. revealed that the prevalence of pulmonary tuberculosis (PTB) decreased from 72.95/100,000 in 2005 to 52.18/100,000 in 2016 [14]. Li et al. also reported that, from 1990 to 2017, the age-standardized prevalence for esophageal cancer declined from 19.38 to 12.23 per 100,000 population [15]. Thus, we hypothesized that the prevalence of SAP could be declined due to socioeconomic development and improvement of medical conditions. However, to our best knowledge, up to now, information on temporal trends in prevalence of SAP in the Mainland China is scarce. In addition, the sex effects on prevalence of AP and SAP are unclear though it is now becoming widely recognized that there are important sex differences in many diseases.

Joinpoint regression analysis is a widely used method, which plays a vital role in analysing the epidemiological trends during the development of diseases [16]. It can identify the joinpoint in the trend data, and then divides the overall trend into smaller segments [16]. In addition, it is able to describe the trend change characteristics of diseases [17]. Up to now, the effect of survey-year on the prevalence of AP has not been analysed by joinpoint regression analysis in the literature.

To better formulate treatment plans and manage the disease, understanding the epidemiological characteristics of AP will be beneficial. Therefore, we aim to conduct the first study to investigate the temporal trends in the prevalence of AP and its relationship with the etiology, severity and outcomes of AP in the city of Wenzhou.

2. Patients and methods

2.1. Study design and subject selection

This was a 9-year cross-sectional study conducted in the First Affiliated Hospital of Wenzhou Medical University. This hospital recognized as a tertiary hospital, is the biggest hospital with 3380 approved beds in Southern Zhejiang Province, with medical services meeting the health needs of nearly 30 million people in southern Zhejiang, northern Fujian and eastern Jiangxi Province. There were 4,392,000 outpatient and emergency visits, 167,000 discharges and 88,000 operations in this hospital in 2020. Similar to the study by Brindise et al. [18], patients' data for our analysis were obtained from the electronic medical records of the First Affiliated Hospital of Wenzhou Medical University from January 2013 to December 2021. International Classification of Diseases, Tenth Revision (ICD-10) was used to identify the inpatients with AP. Data with missing value were excluded from this study.

2.2. Data collection

The clinical data of patients, including age, gender, alcohol, smoking, in-hospital mortality, length of hospital stay and cost of hospitalization, were gathered from electronic medical records. And subjects with missing data were excluded. Our patients were also subdivided into five age groups: ≤39 years, 40–49 years, 50–59 years, 60–69 years and ≥70 years.

2.3. Definition of disease severity and etiology

The diagnostic criteria of AP include at least two of the following features: (1) characteristic abdominal pain of AP; (2) serum amylase and/or lipase more than three times the upper limit of the normal value; (3) characteristic signs of AP at B ultrasound (US), computed tomography (CT) or magnetic resonance imaging (MRI) [19]. SAP is defined as persistent organ failure (more than 48 h) in patients with AP. Organ failure was diagnosed as a modified Marshall score ≥2, which means that at least one of three organ systems (respiratory, cardiovascular and renal system) is functionally damaged [20]. Biliary AP is considered when the gallstone is confirmed by imaging methods including abdominal US, CT or endoscopic retrograde cholangiopancreatography (ERCP) [4,21]. Hypertriglyceridemia-related AP (HTG-AP) is defined as the serum triglyceride level higher than 1000 mg/dL (11.3 µmol/L) within 24 h of admission [4]. Alcohol-associated AP is considered if patients have consumed alcohol more than 50 g per day in past 5 consecutive years or have a history of excessive alcohol intake before the onset of AP [21].

2.4. Statistical analysis

χ^2 test was used to analyse categorical variables which were presented by counts and proportions. Continuous data were analysed by a Shapiro–Wilk test to evaluate whether it had a normal distribution. Continuous variables were presented as mean ± standard deviation (SD) or median and interquartile range (IQR), and tested with the independent-samples *t*-test or the Kruskal–Wallis nonparametric test. Linear trend of categorical and continuous variables was tested by a Royston extension of the Cochran–Armitage test and a nonparametric Wilcoxon rank sum test, respectively [22]. In addition, a univariate joinpoint regression was used to analyse the relationships between survey year of subjects and prevalence of gender, etiology and SAP. The annual percentage change (APC) with corresponding 95% confidence interval (CI) was calculated [23]. The annual trends of crude and age-standardized rate were reported. The direct standardization method using the World Population Standard (2000–2025) was used to calculate the age-standardized prevalence [22].

Univariate logistic regression analysis was used to identify potential risk factors of SAP. Variables reaching statistical difference were gone into the multivariate logistic regression analysis. Odds ratios (ORs) were calculated, with 95% CI.

Two-sided $p < .05$ was reported as statistically significant. Joinpoint Trend Analysis Software Version 4.7.0.0 and STATA version 12.0 (College Station, TX) were used for all analyses.

3. Results

3.1. Baseline characteristics

A total of 5459 (male 62.3%) patients with AP were enrolled in this study. Biliary disease, alcohol-abuse

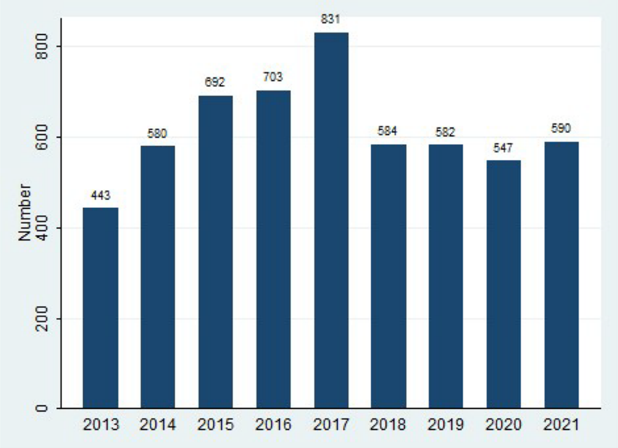

Figure 1. The number of patients with AP by survey year.

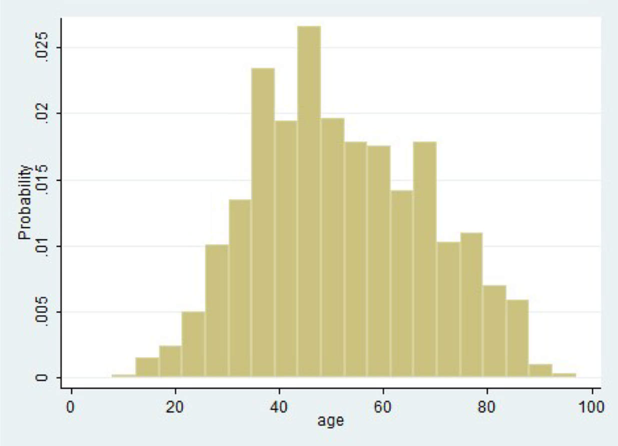

Figure 2. Probability of AP in different ages.

and hypertriglyceridemia (HTG) were recorded in 47.7%, 30.9% and 5.6% of these subjects, respectively. A higher proportion of these three etiological factors was observed in male gender. In particular, (a) in terms of biliary AP, the ratio of male versus female was 1.17 (54% vs. 46%, $p < .001$), (b) male patients accounted for 95.4% in patients with alcoholic AP ($p < .001$) and (c) 73.5% of individuals with HTG-AP were male ($p < .001$). Smoking habit was found in 1681 patients and, as expected, it was more common in male sex (98.7% vs. 1.3%). During the study period, the number of patients with AP increased from 443 in 2013 to 590 in 2021; however, this variation has reached no statistical significance (P_{trend} = 0.706) (Figure 1). As shown in Figure 2, probability of AP occurrence varied in different ages, the median age was 51 (IQR 40–65) years. The distribution of gender among five age groups of patients with AP (≤39 years, 40–49 years, 50–59 years, 60–69 years and ≥70 years) was shown in Figure 3. In the population included in our study, a higher proportion of AP was observed in male- than female-gender and in younger individuals. A total of 40 patients underwent open surgical necrosectomy, 8 patients underwent laparoscopic necrosectomy and 12 patients underwent percutaneous or endoscopic drainage during 2013 and 2021.

3.2. Temporal trends of gender, age and etiology

As shown in Figure 4, the proportion of male gender increased from 55.1% in 2013 to 64.9% in 2021 (P_{trend} = 0.0001), with the percentage of each age

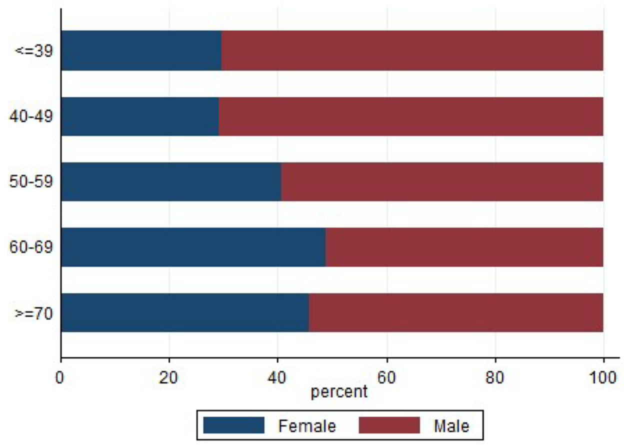

Figure 3. Distribution of gender among five age groups of patients with AP (≤39 years, 40–49 years, 50–59 years, 60–69 years and ≥70 years).

group fluctuating but remaining stable during the study period. As expected, based on joinpoint regression analysis, age-adjusted proportion of male increased significantly with survey year (APC = 2.26; 95% CI 0.59–3.96; p = .015) (Figure 5). The prevalence of biliary diseases-related AP showed no significant change across survey years (P_{trend} = 0.24), while the prevalence of HTG-associated AP slowly and gradually increased during all survey years from 3.6% in 2013 to 5.4% in 2021 (P_{trend} = 0.04) (Figure 6). There was a gradual increase in prevalence of alcohol-associated AP from 28.9% in 2013 to 35.4% in 2021 (Figure 6) (P_{trend} < 0.0001). As expected, based on joinpoint regression analysis, age-adjusted rate of biliary-related AP had not significantly changed with survey year (Figure 7) (APC = −0.04; 95% CI −2.98 to 2.99; p = .976). And the association between crude rate of hyperlipidaemia-induced AP and the survey years did not reach statistical significance (APC = 4.77; 95% CI −6.39 to 17.26; p = .361) (Figure 8). Based on joinpoint regression analysis, age-adjusted rate of alcohol-related AP increased significantly with survey year (Figure 9) (APC = 3.93; 95% CI 1.47–6.43; p = .0066).

3.3. Prevalence and risk factors of severe acute pancreatitis

In contrast to the annual trends in number of AP cases, there was an obvious increase in crude

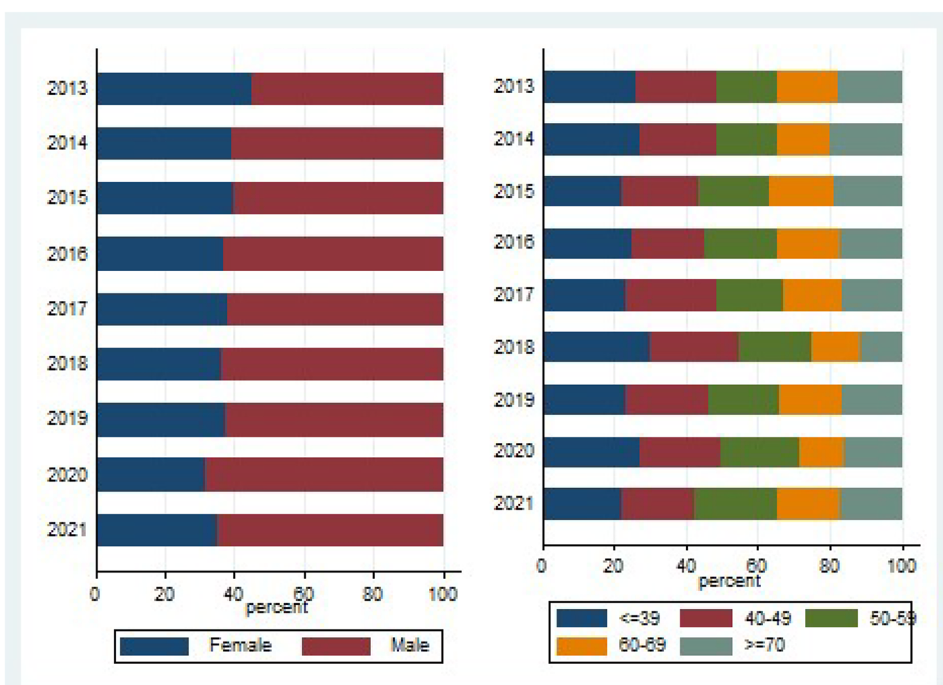

Figure 4. Distribution of sex and age groups (≤39 years, 40–44 years, 45–49 years, 50–54 years, 55–59 years, 60–64 years and ≥65 years) among patients with AP by survey year.

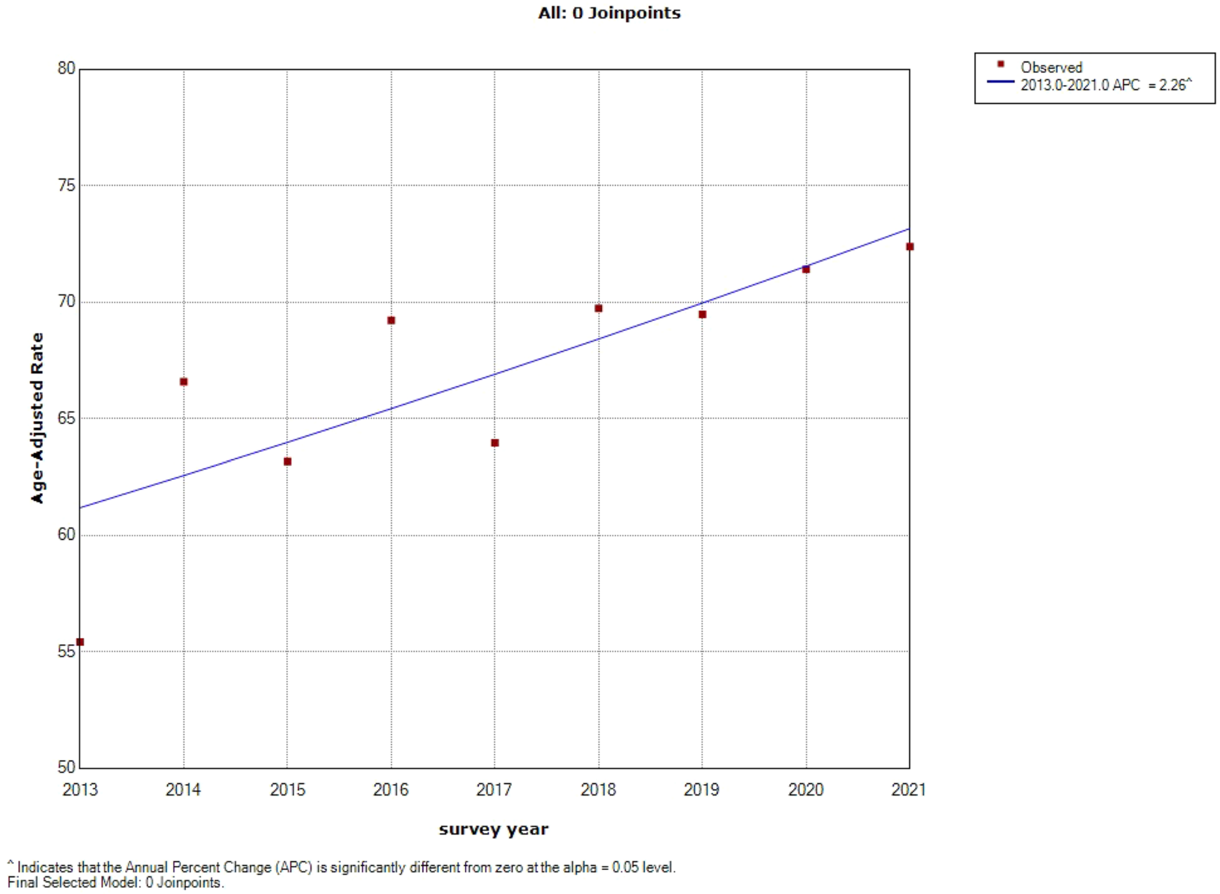

Figure 5. The relationship between survey year and the age-adjusted proportion of male.

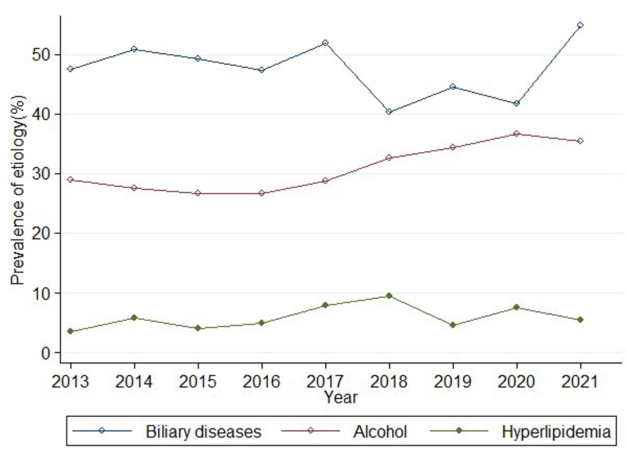

Figure 6. Prevalence of AP in different survey years stratified by etiology.

prevalence of SAP from 4.97% in 2013 to 12.2% in 2021 (Figure 10) ($P_{trend} < 0.0001$). As shown in Figure 11, there was a linear association between survey year and age-adjusted rate of SAP. The prevalence of SAP increased slightly year by year and the result was statistically significant (APC = 11.79; 95% CI 2.17–22.31; p = .022) (Figure 11). As shown in Figure 12, univariate logistic regression indicated that age, biliary diseases and survey year but not gender and smoking were associated with the prevalence of SAP. Multivariate logistic regression analysis indicated that survey year (OR: 1.07; 95% CI: 1.03–1.12; p < .001) was still associated with an increased prevalence of SAP after adjusted by age and biliary diseases (Figure 12).

3.4. Median length of stay and median cost of hospitalization

As shown in Figure 13, the median length of stay (MLS) for all patients decreased from 11 (IQR 7–17) days in 2013 to 8 (IQR 5–12) days in 2021 ($P_{trend} < 0.0001$). When stratified by severity of disease, subgroup analysis suggested that the MLS for patients with non-SAP decreased from 11 (IQR 7–16) days in 2013 to 7 (IQR 5–11) days in 2021 ($P_{trend} < 0.0001$). At the same time, the MLS of patients with SAP fluctuated with survey years but had a slight decrease from 19.5 (IQR 9–31) days in 2013 to 18 (IQR 10–29) days in 2021 (P_{trend} = 0.002).

As shown in Figure 14, the median cost of hospitalization (MCH) for all patients reduced from 20,166 (IQR

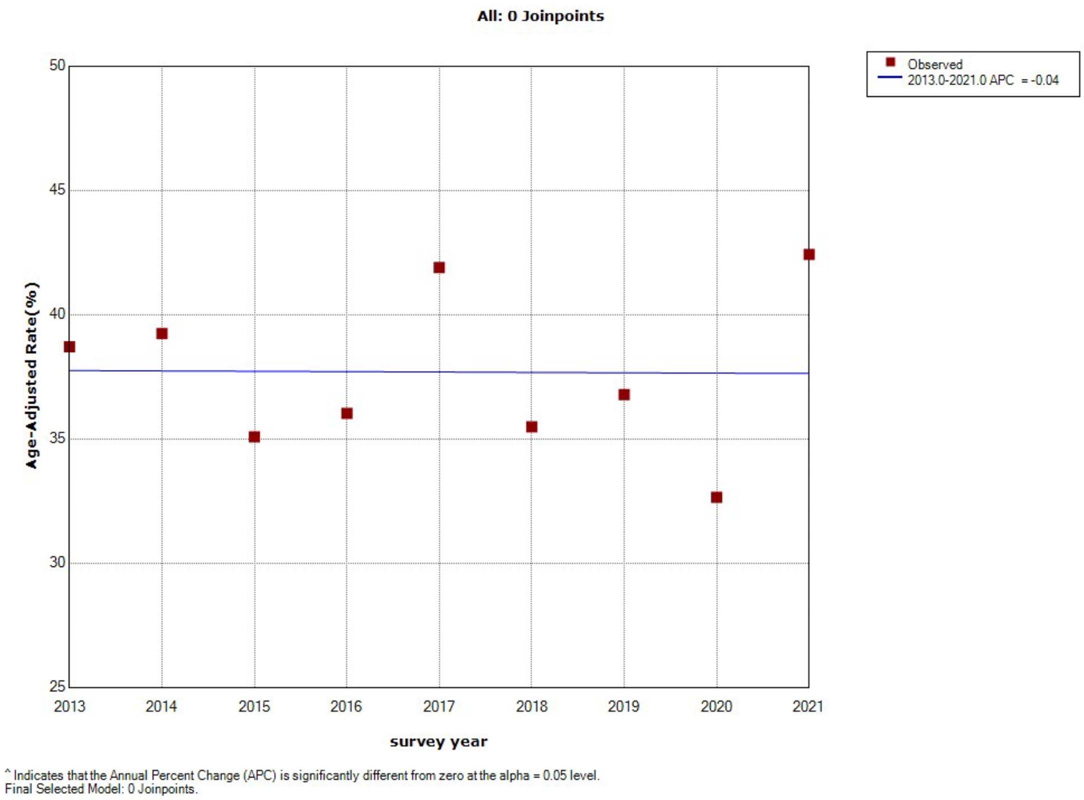

Figure 7. The relationship between survey year and the age-adjusted prevalence of biliary AP.

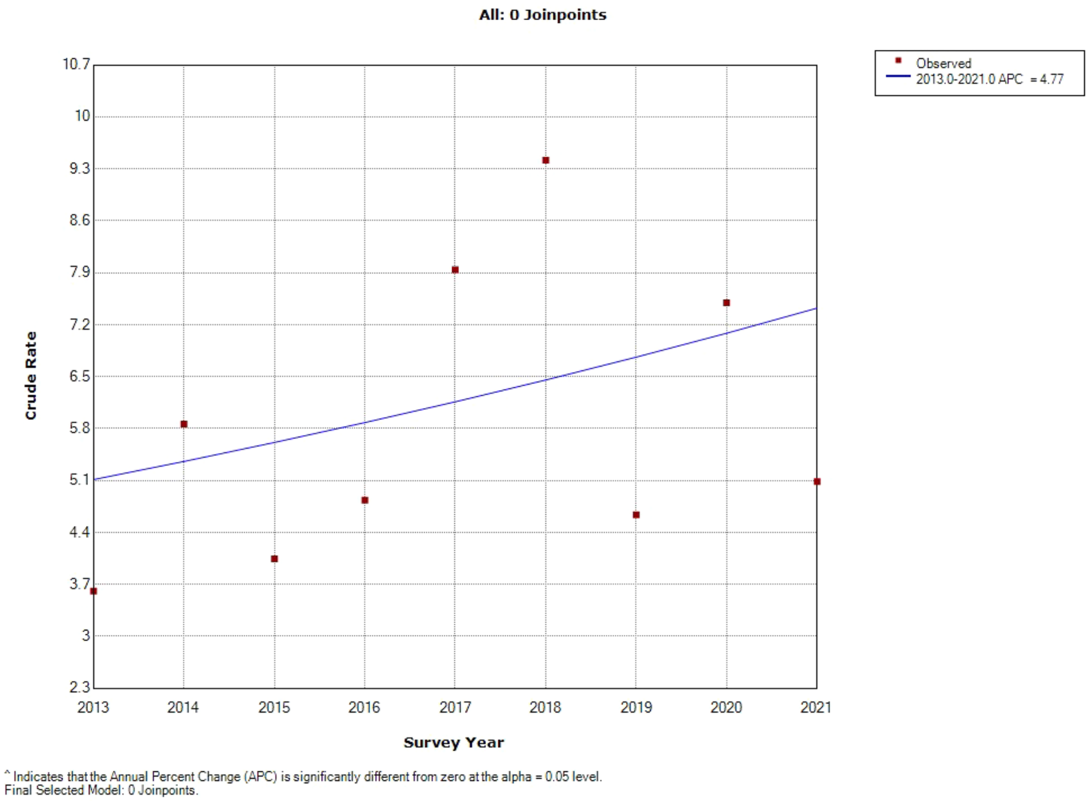

Figure 8. The relationship between survey year and prevalence of hyperlipidaemia induced AP.

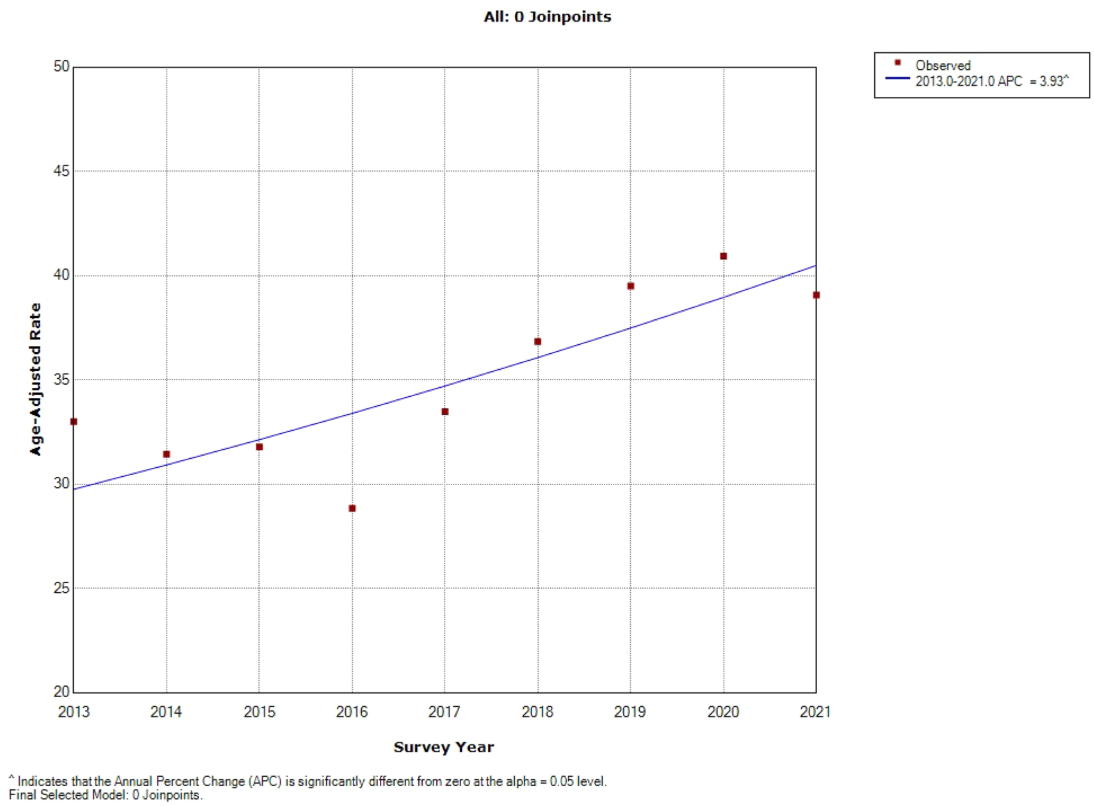

Figure 9. The relationship between survey year and the age-adjusted prevalence of alcoholic AP.

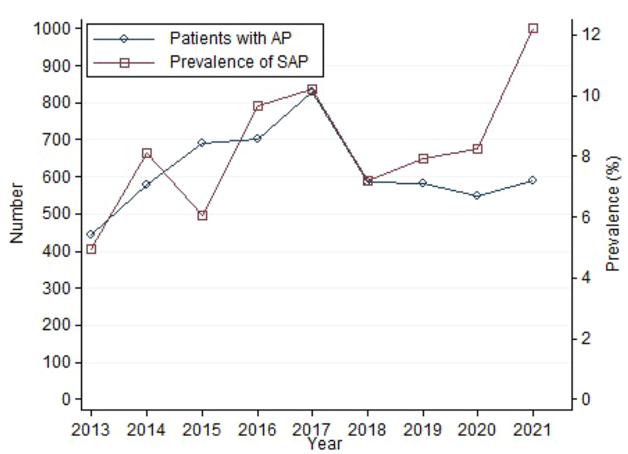

Figure 10. Number of patients with AP and prevalence of SAP in different survey years.

11,409–34,196) (YUAN) in 2013 to 12,845 (IQR 7715–24,803) (YUAN) in 2021 ($P_{trend} < 0.0001$). When stratified by severity of disease, subgroup analysis suggested that the MCH for patients with non-SAP decreased from 19,239 (IQR 11,206–32,056) YUAN in 2013 to 12,496 (IQR 7860–21,899) YUAN in 2021 ($P_{trend} < 0.0001$). At the same time, the MCH for patients with SAP decreased a little from 55290.5 (IQR 27,092–118,464) YUAN in 2013 to 46647.5 (IQR 17,857–98,518) YUAN in 2021, but this difference was not statistically significant (P_{trend} = 0.124).

3.5. Mortality

A total of 70 patients died during the study period, with a mortality of 1.28% (70/5459). Forty-two (60%) were male, with a mean age of 61.7 ± 18.6 years. There was no statistically significant temporal trend in mortality during 2013 and 2021 (Ptrend = 0.5873) (Figure 15). There were 4, 7, 6, 16, 10, 6, 6, 6 and 9 deaths in 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020 and 2021, respectively. Among all death, only 4 patients underwent open surgical necrosectomy before death.

4. Discussion

4.1. Prevalence of AP and gender difference

The prevalence of AP varies around the world. Iannuzzi et al. showed that the incidence was increased in North America (average annual percent change, 3.67%) and Europe (average annual percent change, 2.77%), while it was stable in Asia (average annual percent change, −0.28%) [1]. As reported by Brindise et al., the

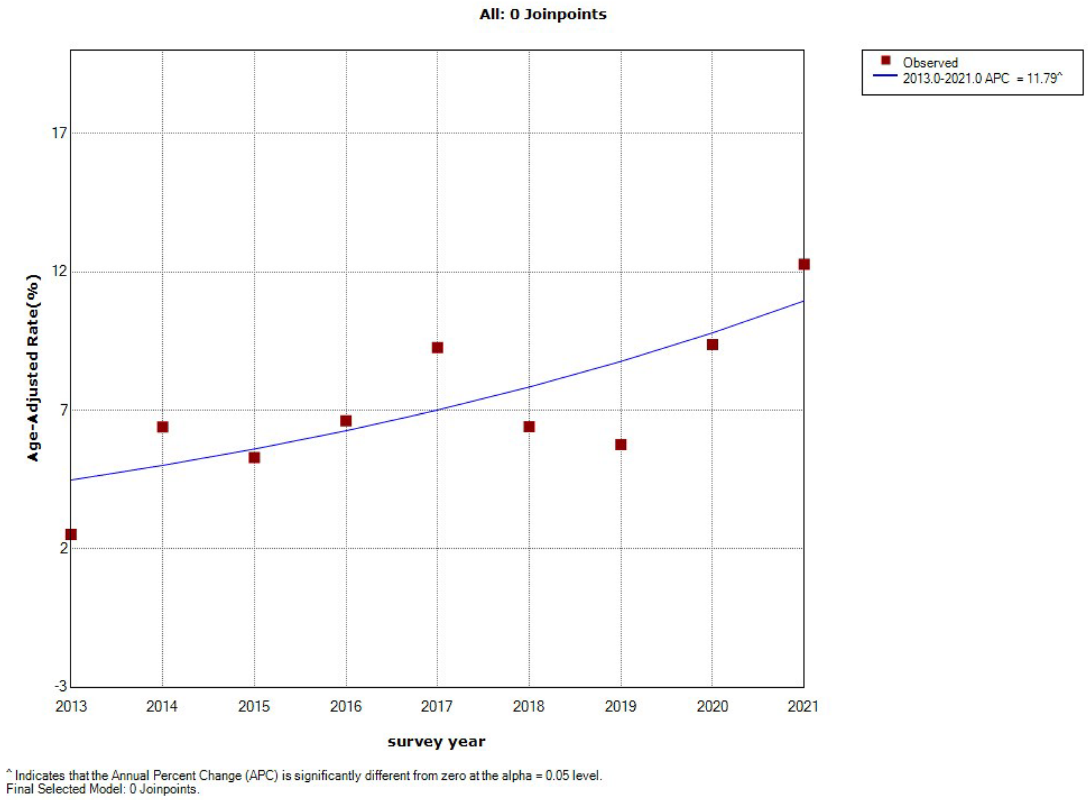

Figure 11. Relationship between survey year and the age-adjusted prevalence of SAP.

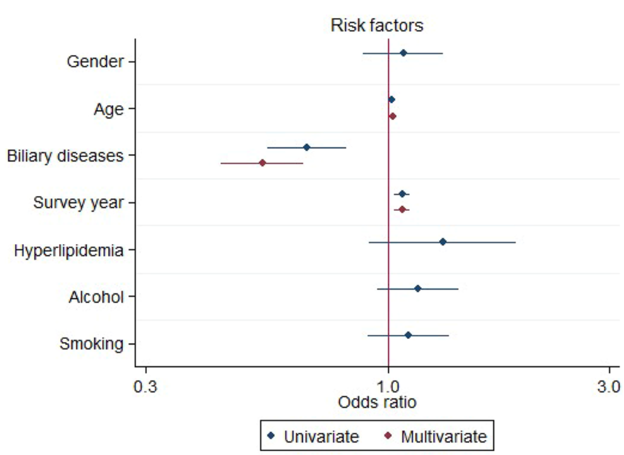

Figure 12. Univariate and multivariate logistic regression plot of odds ratios and 95% confidence intervals for evaluation of the risk factors of SAP.

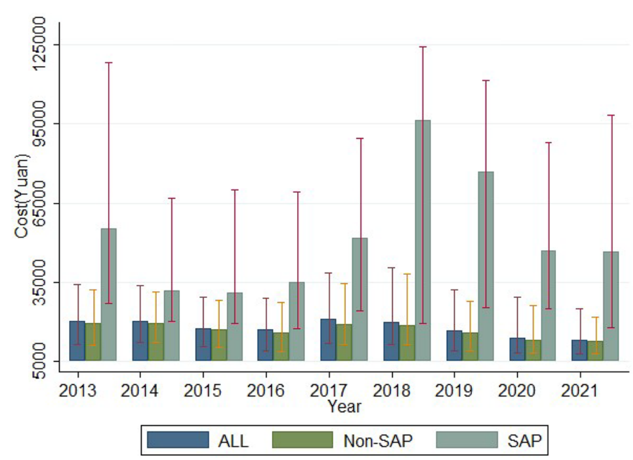

Figure 13. The median length of stay by survey year.

prevalence of AP increased by 2.71 admissions per 1000 hospitalizations in the United States [18]. A study from Sweden revealed that the prevalence of AP increased from 25.2 to 38.3 per 100,000 person-years during the period ranging from 1990–1994 to 2010–2013 [24]. On the other hand, the prevalence of AP has not changed statistically in our study (Figure 1) and this result was consistent with the observation by Iannuzzi et al. [1]. The difference in the prevalence of AP among different regions may be partially attributed to the dietary pattern, race and genetics [25,26]. The fibre-rich diet was negatively related to the prevalence of AP. In contrast, the dietary pattern which was rich in saturated fat and cholesterol (including red meat) was associated with a higher risk of developing AP [27].

From 2013 to 2021, the annual trends of the number of AP in Wenzhou City have not changed statistically (Figure 1). The likelihood of AP varied according to age and gender (Figures 2 and 3). Compared with

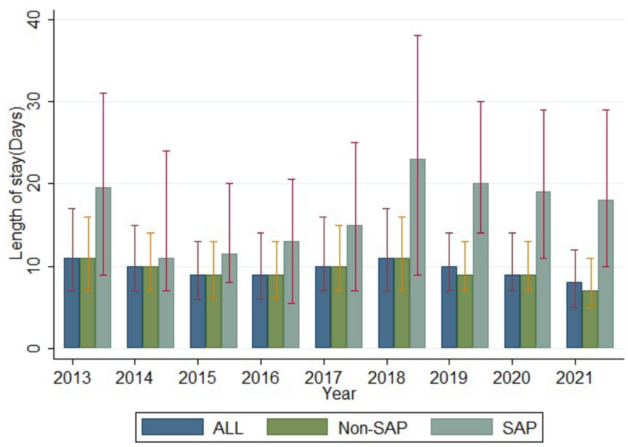

Figure 14. The median cost of hospitalization by survey year.

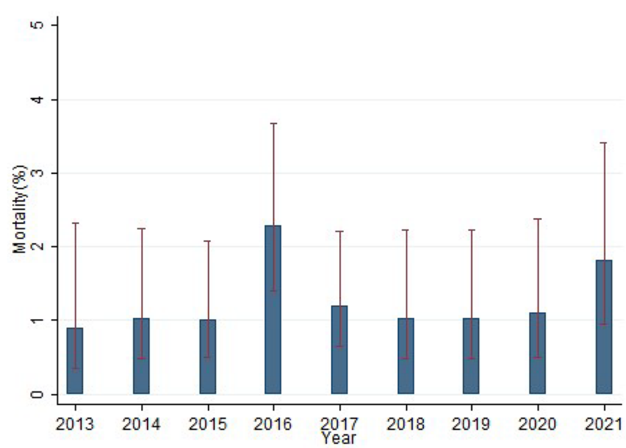

Figure 15. The in-hospital mortality of patients with AP and its time trend.

women, men had a higher prevalence of AP, which is consistent with the findings from Japan and other regions of China [4,6,28,29]. Pu et al. showed that among the 3028 patients with AP, 52.8% were men [29]. Similarly, Zheng et al. reported that among 2461 patients with AP, the male-to-female ratio was 1.59:1 [4]. In addition, the proportion of AP in male increased, while the proportion of different age groups remained over the course of the survey year (Figure 4). As expected, the age-standardized proportion of men increased significantly throughout the survey years (Figure 5). The difference in the prevalence of AP between male and female can be partly attributed to the higher prevalence of HTG, alcohol consumption and smoking in the male population [30,31].

Our study showed that the prevalence of HTG was higher in male population than in the female population (the male to female ratio was 2.8). Lin et al. found that in 371 HTG-AP patients, the male-to-female ratio was 2.0 [32]. Likewise, a retrospective observational study by Yang et al. revealed that among patients with HTG, 72.1% were men [31].

Previous studies have reported that alcohol intake is a risk factor for AP [33,34]. Alcohol consumption remains predominant in China, and the prevalence of alcohol use was higher in male compared with female [35]. Millwood et al. noted that 33% of men among 210,205 male subjects were frequent drinkers, compared with only 2% of women among 302,510 female subjects [30]. Zheng et al. demonstrated that the proportion of male patients with alcohol-related AP was 97.2% [4].

In our study, the rate of male versus female was 20.7 (95.4% vs. 4.6%) in alcohol induced AP. Although alcohol causes AP indirectly, it promotes the intracellular activation of digestive enzymes, leading to an inflammatory response and pancreatic injury [36].

Smoking is considered as an independent risk for AP [33,37]. Yuhara et al. reported that both past and current smoking are related to AP [38]. Similarly, Pang et al. showed that current smokers had a 45% higher risk of AP compared to never smokers [34].

In our study, the male to female smoking rate was 75.41. Moreover, a study by Chen et al. showed that two-thirds of 210,222 males smoked, while 3.2% of 302,669 female subjects were smokers, meaning that males outnumbered females in China [39].

4.2. Etiology of AP

Gallstone disease is a common condition, and it is considered as the primary cause of AP [40,41]. In this investigation, biliary disease, which accounted for 47.7% of the aetiologies of AP, was still the dominant cause of AP in Wenzhou city. This observation was comparable to the result reported by Pu et al. in which the proportion of biliary AP was 42.6% among patients with AP [29]. Further, a multicentre study from Chile demonstrated that biliary disease was observed in 61.4% of 962 patients with AP [42]. The prevalence of gallstone disease varies from region to region. Previous studies have shown that the prevalence of gallstones is higher in Western countries (over 10%) than in Asian countries (about 3–15%) [40,43–45].

Regarding temporal trends in biliary etiology, as shown in Figures 6 and 7, there was no statistical change in the prevalence of biliary-induced AP during the survey year. In contrast, Zhu et al. noted that this last increased from 52.5% in 2005 to 62.2% in 2012 [21]. A Swedish study showed that biliary AP prevalence increased slightly between 1990 and 2013 [42]. Investigating this discrepancy in the future will be interesting.

Several studies from China reported that HTG is the second most common cause of AP and increased in recent years [4,21]. Pu et al. observed that the proportion of HTG-AP was 14.4% in 3028 patients [29]. Zhu et al. stated that the frequency of hyperlipidaemic AP accounted for 14.3% in 3260 patients [21]. A retrospective single-centre study by Lin et al. revealed that the prevalence of HTG-AP increased from 8.4% in 2012–2013 to 22.3% in 2020–2021 [32]. A population-based cohort study from Denmark observed an increase, from 0.7 to 1.7 per 100,000 person-years, in the mean prevalence rate of HTG-associated AP [46].

As illustrated in Figures 6 and 8, the prevalence of HTG induced AP increased gradually from 3.6% in 2013 to 5.4% in 2021. Nevertheless, it did not reach statistical significance in Joinpoint regression analysis. It may be partially explained by the low incidence of HTG (5.6% among all patients with AP) resulting in low statistical power in our study.

The prevalence of HTG in our cohort (increased from 3.6% in 2013 to 5.4% in 2021) was lower than that reported in other reported studies (reaching up to 10%)[4,29]. This may be explained that different criteria of HTG levels sufficient to account for causing pancreatitis were used in different studies. For instance, in the study by Pu et al. [29], HTG-AP was defined when serum triglycerides were higher than 5.3 mmol/L. Despite the impact of economic development and urbanization on dietary patterns in recent decades, Wenzhou residents still maintain a Jiangnan diet (high consumption of fresh vegetables and fruits and moderate intake of meat and salt) [47].

Alcohol consumption is one of the most common risk factors for AP [28,48]. In this study, alcohol accounted for 30.9% of the aetiologies of 5459 patients with AP. Hamada et al. showed that alcohol, which accounted for 46.2% among male patients with AP, was the most common cause of AP in male population in Japan [28]. Similarly, Zheng et al. revealed that the percentage of alcoholic AP among 2461 patients was 10%, and alcohol was the third most common cause of AP in Beijing [4]. Samokhvalov et al. showed a dose–response relationship between alcohol and AP in the male population [49].

Moreover, Figure 9 demonstrates that the prevalence of alcoholic AP increased gradual manner from 2013 to 2021. A study from Zhu et al. noted that alcoholic AP had an increase of 3.5% during study period (p < .001) [21]. By contrast, Jin et al. found no significant change in the prevalence of alcohol associated AP during survey years [50]. Although alcohol use does not directly induce AP, it may lead to pancreatic injury by lowering the threshold for activation of trypsin [36]. Moreover, the annual per capita consumption of alcohol increased by 22% in China from 2006 to 2016 [51]. The prevalence of alcohol drinking is growing in Chinese population, which may be partly due to the high prevalence of alcoholic AP in recent years [52].

4.3. Severity and risk factors of AP

As shown in Figure 1, the number of patients with AP did not statistically change between the survey years. Similarly, Wu et al. also reported that the prevalence of AP was stable in Shanghai among 2009 and 2014 [6]. The explanation for the stabilization is that healthcare delivery and health literacy level have both improved in past decades [1,53]. In contrast, several studies from other regions, including the United States and Europe, have reported a steady increase in the prevalence of AP from year to year [1,3,41]. The possible reasons for this difference included the different races, dietary patterns and genes.

Furthermore, Figures 10 and 11 indicated that there was an obvious rise in both the crude and age-adjusted prevalence of SAP from 2013 to 2021. Likewise, Brindise et al. showed that the prevalence of SAP in the United States increased from 9.79 to 21.63 per 100 discharges between 2002 and 2012 [18]. China has been promoting reform of its healthcare system since 2009 [54]. The graduated diagnosis and treatment (GDT) policy was an important part of the health reform [55]. The guidelines state that referral to a specialist centre is necessary for patients with SAP [56]. The First Affiliated Hospital of Wenzhou Medical University serves as a regional medical centre in Southern Zhejiang province, and the standard of medical care is greater than that of other general hospitals in this area. This may lead to an increase in the prevalence of SAP as a large number of critically ill patients are transferred to this hospital. Our multivariable analysis, age was positively associated with the prevalence of SAP this condition (Figure 12). The data were consistent with the result from Zhu et al. that the prevalence of SAP in the elderly patients compared to that in young and middle-aged patients was 1.6 [21]. Moran et al. reported that the age group (>85 years old) related to persistent organ failure in AP [57]. In He et al.'s retrospective study, patients with SAP were older than those with moderate SAP (mean 74 versus mean 69) [58]. The positive association between age and SAP may partially be due to the high degree of concomitant diseases in the elderly, which can have an adverse effect on organ functions [57,58]. As for other risk factors of SAP, there was a negative association between biliary disease and the prevalence of this degree of severity of disease. It may be in part explained by the fact that gallstone could can often be detected by imaging tests, such as CT scans, so that biliary disease can be treated in a timely manner, which may then help prevent progression from mild AP to SAP [59].

On the other hand, our study indicated that no relationship between alcohol, cigarettes and SAP was found. These results were consistent with previous reports [60,61]. Bertilsson et al. showed that there was no association between alcohol consumption and the prevalence of SAP [60]. Additionally, although smoking is an independent risk factor for AP, there was no significant association between SAP and smoking [61].

4.4. Median LOS and median cost of hospitalization

Brindise et al. have reported that the average LOS for AP in the United States decreased from 6.99 days in 2002 to 5.74 days in 2013, although the average cost of hospitalization did not decrease accordingly [18].

Similarly, a study from Wadhwa et al. showed that the mean LOS for AP decreased by about two days during the study period [62]. As shown in Figures 13 and 14, both the median LOS and MCH for AP decreased for all patients during all the survey years. The results of the decline in both median LOS and MCH may be due to the implementation of health reform and DRG payment system. The Chinese government launched health reform in 2009, with the aim of establishing an efficient and affordable health system [63]. Additionally, the Chinese government implemented diagnosis-related groups (DRGs) at the national level in 2017 [64]. A DRG-based hospital payment system means that patients classified into a particular DRG have a homogeneous resource consumption pattern [65]. This system is beneficial in controlling expenditures and improving efficiency by reducing unnecessary care, in contrast to the traditional fee-for-service (FFS) payment system [64,66]. For example, after the introduction of DRG payment in hospitals in Beijing, Jian et al. found that spending per admission decreased by 6.2% [67]. Payment reform reduced LOS by 17.7% in a study from Hunan Province [68]. Further, both medical service capacity and medical service efficiency have improved in the past decade. A report from the National Health Commission of the People's Republic of China showed that the average LOS in tertiary hospitals in mainland China decreased by 1.5 days between 2014 and 2019 [69].

In the subgroup analysis, patients with non-SAP had a greater decrease in the magnitude of the MLS when compared to patients with SAP. Similarly, when compared to SAP, patients with non-SAP had a greater decrease in the magnitude of the MCH. However, the decrease in the magnitude of the MCH for patients with SAP during the study year did not reach statistical significance (Figure 14). This means that SAP still burdens the economy for individuals, families and society due to its slow-moving recovery and the need for long-term medical treatment. Although many treatment options, including early intensive monitoring, fluid resuscitation, enteral nutrition and organ-supporting therapy, are available, the management of SAP is still challenging due to the lack of specific therapy. Thus, further surveys on mechanisms and drugs of SAP are necessary for better treatment in the future [70].

4.5. Mortality of AP

The overall in-hospital mortality rate for patients with AP in our study was 1.28%. And no statistically significant temporal trend in mortality was found during the study period. This result is comparable to data from a retrospective cohort study from Pu et al. which revealed that the overall mortality of AP in the hospital was 1% [29]. Similarly, Zhu et al. demonstrated that 40 out of 3260 patients diagnosed with AP died in the hospital during the study period, with an overall mortality rate of 1.2% [21].

The following reasons may explain the stability of the time trend in mortality rates observed in our study. Despite AP is one of the most common gastrointestinal diseases, the pathogenesis and natural course of the disease remains poorly understood [71,72]. The initial treatment of AP remains supportive, including adequate fluid resuscitation and pain management, while there are still no specific or effective medical treatments available able to significantly alter the course of AP [19,72–74]. Besides, approximately 20% of patients with AP progress to moderate or severe AP, which carries a significant mortality rate of 20–40% [75]. Therefore, identifying at-risk patients in terms of progression to SAP at an early stage is considered crucial to reduce mortality [76]. However, early risk stratification and timely detection of SAP remains a clinical challenge. Many scoring systems and predictive models, including Bedside Index for Severity in Acute Pancreatitis (BISAP), have been developed to predict the severity and clinical course of the disease [77]. However, the existing scoring systems and predictive models have low predictive value in individual clinical patients, thus accurate prediction the severity of the disease remains to a significant extent erratic [75]. Additionally, the existing scoring systems and predictive models have been developed and validated in specific patient groups, which may limit their generalizability in broader clinical settings [77].

Though there has been substantial evolution of strategies including minimally invasive surgical and endoscopic step-up approach interventions for pancreatic necrosis in recent years [78], there is an ongoing controversy as to which approach is best for which patient at which time. Although meanwhile prioritized in most Western pancreatic centres, a multicentre randomized trial suggested that in patients with infected pancreatic necrosis, the endoscopic step-up approach was not superior to the surgical step-up approach in reducing major complications or death [79]. Bang et al. reported that an endoscopic transluminal approach, compared to minimally invasive surgery, reduces complications and costs but not mortality for patients with necrotizing pancreatitis [80]. A meta-analysis did not show any significant differences in mortality between the endoscopic versus surgical treatment for infected pancreatic necrosis [81]. Luckhurst et al. suggested that adoption of a multidisciplinary minimally invasive step-up-based approach to necrotizing pancreatitis resulted in a fivefold decrease in mortality compared with open surgical necrosectomy [82]. Authoritative guidelines suggest that minimally invasive operative approaches to the debridement of acute necrotizing pancreatitis are preferred to open surgical necrosectomy whenever possible, while open operative debridement maintains a role in the management of acute necrotizing pancreatitis in cases with relentless sepsis and not amenable to less invasive endoscopic and/or surgical procedures [83]. The temporal trends and efficacy of minimally invasive operative approaches or open surgical necrosectomy of pancreatic necrosis were not analysed in the current study due to overall low sample sizes in these subgroups. It will be necessary and interesting to assess and compare the efficacy and safety of these different procedures in necrotizing pancreatitis in the future.

4.6. Strengths and limitations

To our best knowledge, this is the first study to evaluate the epidemiology of AP in a third-tier city in mainland China and rigorous statistical methods (e.g. joinpoint regression analysis) were used. The other strength of this study is the large sample size of the database, which allows for robust associations to be obtained.

The limitations of this study include the retrospective nature of the data collected, which means that only associations and not causality could be inferred, as well as reliance on potentially inaccurate ICD-10 coding. However, we attempted to mitigate these drawbacks by obtaining consecutive data using a standard approach and enrolling a large number of patients. Second, the disability-adjusted life-years (DALYs) of AP were not analysed in our study. DALYs represent a composite index of disease burden, evaluating the premature mortality and severity of diseases [84]. Han et al. demonstrated that the age-standardized DALY rate for pancreatitis decreased by 15.54 per 100,000 between 1990 and 2019 [85]. However, a stratified analysis of acute and chronic pancreatitis was not conducted in Han's research. Third, the correlation between sociodemographic index (SDI) and AP was not analysed in our epidemiological study. SDI is a composite indicator of development status, which is created according to total fertility rate, mean education for people over age 15 and country-level income per capita [86,87]. Li et al. found that the mortality of AP was more than twice as high in the low SDI region as in the high SDI region [86]. An analysis including DALYs and SDI of AP is an interesting and necessary research point for our future prospective study.

5. Conclusions

In conclusion, over the 9 years of observation, the annual proportion of male patients, etiology of HTG, and alcohol consumption of subjects suffering from AP, as well as the annual prevalence of SAP increased, while the etiology of biliary diseases-related etiology and mortality of AP was stable. On the other hand, the MLS and the MCH for all patients with AP decreased during examination period.

Authors contributions

Wandong Hong was involved in the conception and design; Yining Huang, Minhao Qiu, Shuang Pan, Yan Zhou, Xiaoyi Huang and Yinglu Jin were contributed to collecting and collating data; Yining Huang and Wandong Hong participated in analysis and interpretation of the data; Yining Huang, Wandong Hong and Maddalena Zippi. Sirio Fiorino and Vincent Zimmer took part in the drafting of the paper and revising it critically for intellectual content; Wandong Hong was responsible for the final approval of the version to be published; and that all authors agree to be accountable for all aspects of the work.

Ethics statement

We confirm that our study adheres to the Declaration of Helsinki. This study protocol was approved by the Ethics Committee of the First Affiliated Hospital of Wenzhou Medical University (Number: KY2023-R270). The data were collected and analysed retrospectively and anonymously. Thus, the requirement for written informed consent was waived by the ethics committee in this article.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by Zhejiang Medical and Health Science and Technology Plan Project (Grant Number: 2022KY886) and Wenzhou Science and Technology Bureau (Grant Numbers: Y2020010 and Y20220317).

ORCID

Wandong Hong http://orcid.org/0000-0001-6857-4252

Data availability statement

The datasets used and/or analysed during the current study are available from the corresponding author upon request.

References

[1] Iannuzzi JP, King JA, Leong JH, et al. Global incidence of acute pancreatitis is increasing over time: a systematic review and meta-analysis. Gastroenterology. 2022;162(1):122–134. doi: 10.1053/j.gastro.2021.09.043.

[2] Garg PK, Singh VP. Organ failure due to systemic injury in acute pancreatitis. Gastroenterology. 2019;156(7):2008–2023. doi: 10.1053/j.gastro.2018.12.041.

[3] Gapp J, Hall AG, Walters RW, et al. Trends and outcomes of hospitalizations related to acute pancreatitis: epidemiology from 2001 to 2014 in the United States. Pancreas. 2019;48(4):548–554. doi: 10.1097/MPA.0000000000001275.

[4] Zheng Y, Zhou Z, Li H, et al. A multicenter study on etiology of acute pancreatitis in Beijing during 5 years. Pancreas. 2015;44(3):409–414. doi: 10.1097/MPA.0000000000000273.

[5] Fan J, Ding L, Lu Y, et al. Epidemiology and etiology of acute pancreatitis in urban and suburban areas in Shanghai: a retrospective study. Gastroenterol Res Pract. 2018;2018:1420590. doi: 10.1155/2018/1420590.

[6] Wu D, Tang M, Zhao Y, et al. Impact of seasons and festivals on the onset of acute pancreatitis in Shanghai, China. Pancreas. 2017;46(4):496–503. doi: 10.1097/MPA.0000000000000795.

[7] Xiong X, Zhang L, Hao Y, et al. Urban dietary changes and linked carbon footprint in China: a case study of Beijing. J Environ Manage. 2020;255:109877. doi: 10.1016/j.jenvman.2019.109877.

[8] Wan S, Chen Y, Xiao Y, et al. Spatial analysis and evaluation of medical resource allocation in China based on geographic big data. BMC Health Serv Res. 2021;21(1):1084. doi: 10.1186/s12913-021-07119-3.

[9] Yuan L, Cao J, Wang D, et al. Regional disparities and influencing factors of high quality medical resources distribution in China. Int J Equity Health. 2023;22(1):8. doi: 10.1186/s12939-023-01825-6.

[10] Lin S, Gaubatz P. New Wenzhou: migration, metropolitan spatial development and modernity in a third-tier Chinese model city. Habitat Int. 2015;50:214–225. doi: 10.1016/j.habitatint.2015.08.040.

[11] Main Data Bulletin of Wenzhou population in 2018; 2018. Available from: http://wztjj.wenzhou.gov.cn/art/2019/2/12/art_1243860_30198045.html

[12] Xu G, Dong H, Shi X. China's economic development quality grows faster than economic quantity. PLOS One. 2023;18(7):e0289399. doi: 10.1371/journal.pone.0289399.

[13] GBD 2019 Hepatitis B Collaborators. Global, regional, and national burden of hepatitis B, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Gastroenterol Hepatol. 2022;7(9):796–829.

[14] Jiang H, Liu M, Zhang Y, et al. Changes in incidence and epidemiological characteristics of pulmonary tuberculosis in Mainland China, 2005–2016. JAMA Netw Open. 2021;4(4):e215302. doi: 10.1001/jamanetworkopen.2021.5302.

[15] Li S, Chen H, Man J, et al. Changing trends in the disease burden of esophageal cancer in China from 1990 to 2017 and its predicted level in 25 years. Cancer Med. 2021;10(5):1889–1899. doi: 10.1002/cam4.3775.

[16] Wang C, Yang X, Zhang H, et al. Temporal trends in mortality of tuberculosis attributable to high fasting plasma glucose in China from 1990 to 2019: a joinpoint regression and age-period-cohort analysis. Front Public Health. 2023;11:1225931. doi: 10.3389/fpubh.2023.1225931.

[17] Jiang W, Du Y, Xiang C, et al. Age-period-cohort analysis of pancreatitis epidemiological trends from 1990 to 2019 and forecasts for 2044: a systematic analysis from the Global Burden of Disease Study 2019. Front Public Health. 2023;11:1118888. doi: 10.3389/fpubh.2023.1118888.

[18] Brindise E, Elkhatib I, Kuruvilla A, et al. Temporal trends in incidence and outcomes of acute pancreatitis in hospitalized patients in the United States from 2002 to 2013. Pancreas. 2019;48(2):169–175. doi: 10.1097/MPA.0000000000001228.

[19] Szatmary P, Grammatikopoulos T, Cai W, et al. Acute pancreatitis: diagnosis and treatment. Drugs. 2022;82(12):1251–1276. doi: 10.1007/s40265-022-01766-4.

[20] Pezzilli R, Zerbi A, Campra D, et al. Consensus guidelines on severe acute pancreatitis. Dig Liver Dis. 2015;47(7):532–543. doi: 10.1016/j.dld.2015.03.022.

[21] Zhu Y, Pan X, Zeng H, et al. A study on the etiology, severity, and mortality of 3260 patients with acute pancreatitis according to the Revised Atlanta Classification in Jiangxi, China over an 8-year period. Pancreas. 2017;46(4):504–509. doi: 10.1097/MPA.0000000000000776.

[22] Hong W, Dong L, Stock S, et al. Prevalence and characteristics of colonic adenoma in Mainland China. Cancer Manag Res. 2018;10:2743–2755. doi: 10.2147/CMAR.S166186.

[23] Kim HJ, Fay MP, Feuer EJ, et al. Permutation tests for joinpoint regression with applications to cancer rates. Statist Med. 2000;19(3):335–351. doi: 10.1002/(SICI)1097-0258(20000215)19:3<335::AID-SIM336>3.3.CO;2-Q.

[24] Oskarsson V, Hosseini S, Discacciati A, et al. Rising incidence of acute pancreatitis in Sweden: national estimates and trends between 1990 and 2013. United European Gastroenterol J. 2020;8(4):472–480. doi: 10.1177/2050640620913737.

[25] Tsirouki T, Dastiridou A, Symeonidis C, et al. A focus on the epidemiology of uveitis. Ocul Immunol Inflamm. 2018;26(1):2–16. doi: 10.1080/09273948.2016.1196713.

[26] Tavakkoli A, Singal AG, Waljee AK, et al. Racial disparities and trends in pancreatic cancer incidence and mor-

tality in the United States. Clin Gastroenterol Hepatol. 2020;18(1):171–178.e110. doi: 10.1016/j.cgh.2019.05.059.
[27] Setiawan VW, Pandol SJ, Porcel J, et al. Dietary factors reduce risk of acute pancreatitis in a large multiethnic cohort. Clin Gastroenterol Hepatol. 2017;15(2):257–265.e3. doi: 10.1016/j.cgh.2016.08.038.
[28] Hamada S, Masamune A, Kikuta K, et al. Nationwide epidemiological survey of acute pancreatitis in Japan. Pancreas. 2014;43(8):1244–1248. doi: 10.1097/MPA.0000000000000200.
[29] Pu W, Luo G, Chen T, et al. A 5-year retrospective cohort study: epidemiology, etiology, severity, and outcomes of acute pancreatitis. Pancreas. 2020;49(9):1161–1167. doi: 10.1097/MPA.0000000000001637.
[30] Millwood IY, Walters RG, Mei XW, et al. Conventional and genetic evidence on alcohol and vascular disease aetiology: a prospective study of 500 000 men and women in China. Lancet. 2019;393(10183):1831–1842. doi: 10.1016/S0140-6736(18)31772-0.
[31] Yang X, He J, Ma S, et al. The role of comorbid hypertriglyceridemia and abdominal obesity in the severity of acute pancreatitis: a retrospective study. Lipids Health Dis. 2021;20(1):171. doi: 10.1186/s12944-021-01597-4.
[32] Lin XY, Zeng Y, Zhang ZC, et al. Incidence and clinical characteristics of hypertriglyceridemic acute pancreatitis: a retrospective single-center study. World J Gastroenterol. 2022;28(29):3946–3959. doi: 10.3748/wjg.v28.i29.3946.
[33] Walkowska J, Zielinska N, Karauda P, et al. The pancreas and known factors of acute pancreatitis. J Clin Med. 2022;11(19):5565. doi: 10.3390/jcm11195565.
[34] Pang Y, Kartsonaki C, Turnbull I, et al. Metabolic and lifestyle risk factors for acute pancreatitis in Chinese adults: a prospective cohort study of 0.5 million people. PLoS Med. 2018;15(8):e1002618. doi: 10.1371/journal.pmed.1002618.
[35] Zhang L, Huang L, Weiger C, et al. Prevalence, correlates, and behavioral outcomes of alcohol gifting in China. BMC Public Health. 2022;22(1):1653. doi: 10.1186/s12889-022-13946-8.
[36] Yadav D, Whitcomb DC. The role of alcohol and smoking in pancreatitis. Nat Rev Gastroenterol Hepatol. 2010;7(3):131–145. doi: 10.1038/nrgastro.2010.6.
[37] Tolstrup JS, Kristiansen L, Becker U, et al. Smoking and risk of acute and chronic pancreatitis among women and men: a population-based cohort study. Arch Intern Med. 2009;169(6):603–609. doi: 10.1001/archinternmed.2008.601.
[38] Yuhara H, Ogawa M, Kawaguchi Y, et al. Smoking and risk for acute pancreatitis: a systematic review and meta-analysis. Pancreas. 2014;43(8):1201–1207. doi: 10.1097/MPA.0000000000000176.
[39] Chen Z, Peto R, Zhou M, et al. Contrasting male and female trends in tobacco-attributed mortality in China: evidence from successive nationwide prospective cohort studies. Lancet. 2015;386(10002):1447–1456. doi: 10.1016/S0140-6736(15)00340-2.
[40] Cucher D, Kulvatunyou N, Green DJ, et al. Gallstone pancreatitis: a review. Surg Clin North Am. 2014;94(2):257–280. doi: 10.1016/j.suc.2014.01.006.
[41] Roberts SE, Morrison-Rees S, John A, et al. The incidence and aetiology of acute pancreatitis across Europe. Pancreatology. 2017;17(2):155–165. doi: 10.1016/j.pan.2017.01.005.
[42] Berger Z, Mancilla C, Tobar E, et al. Acute pancreatitis in Chile: a multicenter study on epidemiology, etiology and clinical outcome. Retrospective analysis of clinical files. Pancreatology. 2020;20(4):637–643. doi: 10.1016/j.pan.2020.04.016.
[43] Gurusamy KS, Davidson BR. Gallstones. BMJ. 2014;348(16):g2669. doi: 10.1136/bmj.g2669.
[44] Wang J, Shen S, Wang B, et al. Serum lipid levels are the risk factors of gallbladder stones: a population-based study in China. Lipids Health Dis. 2020;19(1):50. doi: 10.1186/s12944-019-1184-3.
[45] Nie C, Yang T, Wang Z, et al. Dietary patterns and gallstone risks in Chinese adults: a cross-sectional analysis of China Multi-Ethnic Cohort Study. J Epidemiol. 2023;33(9):471–477. doi: 10.2188/jea.JE20220039.
[46] Olesen SS, Harakow A, Krogh K, et al. Hypertriglyceridemia is often under recognized as an aetiologic risk factor for acute pancreatitis: a population-based cohort study. Pancreatology. 2021;21(2):334–341. doi: 10.1016/j.pan.2021.02.005.
[47] Wang J, Lin X, Bloomgarden ZT, et al. The Jiangnan diet, a healthy diet pattern for Chinese. J Diabetes. 2020;12(5):365–371. doi: 10.1111/1753-0407.13015.
[48] Klöppel G, Zamboni G. Acute and chronic alcoholic pancreatitis, including paraduodenal pancreatitis. Arch Pathol Lab Med. 2023;147(3):294–303. doi: 10.5858/arpa.2022-0202-RA.
[49] Samokhvalov AV, Rehm J, Roerecke M. Alcohol consumption as a risk factor for acute and chronic pancreatitis: a systematic review and a series of meta-analyses. EBioMedicine. 2015;2(12):1996–2002. doi: 10.1016/j.ebiom.2015.11.023.
[50] Jin M, Bai X, Chen X, et al. A 16-year trend of etiology in acute pancreatitis: the increasing proportion of hypertriglyceridemia-associated acute pancreatitis and its adverse effect on prognosis. J Clin Lipidol. 2019;13(6):947–953.e1. doi: 10.1016/j.jacl.2019.09.005.
[51] Zheng Q, Chan GCK, Wang Z, et al. Assessing alcohol consumption in a Chinese urban population and a university town using high temporal resolution wastewater-based epidemiology. Drug Alcohol Depend. 2022;230:109178. doi: 10.1016/j.drugalcdep.2021.109178.
[52] Piao WZL, Fang HY, Ju LH, et al. Status of drinking behaviors in adults aged 18 years old and over in China. Food Nutr China. 2021;27(10):15–19.
[53] Li Y, Lv X, Liang J, et al. The development and progress of health literacy in China. Front Public Health. 2022;10:1034907. doi: 10.3389/fpubh.2022.1034907.
[54] Yip W, Fu H, Chen AT, et al. 10 years of health-care reform in China: progress and gaps in universal health coverage. Lancet. 2019;394(10204):1192–1204. doi: 10.1016/S0140-6736(19)32136-1.
[55] Tao W, Chen X, Gan S. How to promote grass roots medical treatment under China's graded diagnosis and treatment policy? From the perspective of customer value theory. Front Public Health. 2022;10:994644. doi: 10.3389/fpubh.2022.994644.
[56] Working Group IAP/APA Acute Pancreatitis Guidelines. IAP/APA evidence-based guidelines for the management of acute pancreatitis. Pancreatology. 2013;13(4 Suppl. 2):e1–e15.
[57] Moran RA, García-Rayado G, de la Iglesia-García D, et al. Influence of age, body mass index and comorbidity on

major outcomes in acute pancreatitis, a prospective nation-wide multicentre study. United European Gastroenterol J. 2018;6(10):1508–1518. doi: 10.1177/2050640618798155.
[58] He F, Zhu HM, Li BY, et al. Factors predicting the severity of acute pancreatitis in elderly patients. Aging Clin Exp Res. 2021;33(1):183–192. doi: 10.1007/s40520-020-01523-1.
[59] Cho JH, Kim TN, Kim SB. Comparison of clinical course and outcome of acute pancreatitis according to the two main etiologies: alcohol and gallstone. BMC Gastroenterol. 2015;15(1):87. doi: 10.1186/s12876-015-0323-1.
[60] Bertilsson S, Håkansson A, Kalaitzakis E. Acute pancreatitis: impact of alcohol consumption and seasonal factors. Alcohol Alcohol. 2017;52(3):383–389. doi: 10.1093/alcalc/agx005.
[61] Chen JH, Zhang MF, Du WC, et al. Risk factors and their interactive effects on severe acute pancreatitis complicated with acute gastrointestinal injury. World J Gastrointest Surg. 2023;15(8):1712–1718. doi: 10.4240/wjgs.v15.i8.1712.
[62] Wadhwa V, Patwardhan S, Garg SK, et al. Health care utilization and costs associated with acute pancreatitis. Pancreas. 2017;46(3):410–415. doi: 10.1097/MPA.0000000000000755.
[63] The Lancet Public Health. China's health reform: 10 years on. Lancet Public Health. 2019;4(9):e431.
[64] Zhao C, Wang C, Shen C, et al. Diagnosis-related group (DRG)-based case-mix funding system, a promising alternative for fee for service payment in China. Biosci Trends. 2018;12(2):109–115. doi: 10.5582/bst.2017.01289.
[65] Mathauer I, Wittenbecher F. Hospital payment systems based on diagnosis-related groups: experiences in low- and middle-income countries. Bull World Health Organ. 2013;91(10):746–756A. doi: 10.2471/BLT.12.115931.
[66] Zou K, Li HY, Zhou D, et al. The effects of diagnosis-related groups payment on hospital healthcare in China: a systematic review. BMC Health Serv Res. 2020;20(1):112. doi: 10.1186/s12913-020-4957-5.
[67] Jian W, Lu M, Chan KY, et al. Payment reform pilot in Beijing hospitals reduced expenditures and out-of-pocket payments per admission. Health Aff. 2015;34(10):1745–1752. doi: 10.1377/hlthaff.2015.0074.
[68] Gao C, Xu F, Liu GG. Payment reform and changes in health care in China. Soc Sci Med. 2014;111:10–16. doi: 10.1016/j.socscimed.2014.03.035.
[69] China's medical services and medical quality and safety in 2019; Available from: https://www.gov.cn/xinwen/2020-10/17/content_5551942.htm.
[70] Hines OJ, Pandol SJ. Management of severe acute pancreatitis. BMJ. 2019;367:l6227. doi: 10.1136/bmj.l6227.
[71] Søreide K, Barreto SG, Pandanaboyana S. Severe acute pancreatitis. Br J Surg. 2024;111(8):znae170. doi: 10.1093/bjs/znae170.
[72] Gukovskaya AS, Gukovsky I, Algül H, et al. Autophagy, inflammation, and immune dysfunction in the pathogenesis of pancreatitis. Gastroenterology. 2017;153(5):1212–1226. doi: 10.1053/j.gastro.2017.08.071.
[73] Habtezion A, Gukovskaya AS, Pandol SJ. Acute pancreatitis: a multifaceted set of organelle and cellular interactions. Gastroenterology. 2019;156(7):1941–1950. doi: 10.1053/j.gastro.2018.11.082.
[74] van Dijk SM, Hallensleben NDL, van Santvoort HC, et al. Acute pancreatitis: recent advances through randomised trials. Gut. 2017;66(11):2024–2032. doi: 10.1136/gutjnl-2016-313595.
[75] Boxhoorn L, Voermans RP, Bouwense SA, et al. Acute pancreatitis. Lancet. 2020;396(10252):726–734. doi: 10.1016/S0140-6736(20)31310-6.
[76] Kui B, Pintér J, Molontay R, et al. EASY-APP: an artificial intelligence model and application for early and easy prediction of severity in acute pancreatitis. Clin Transl Med. 2022;12(6):e842. doi: 10.1002/ctm2.842.
[77] Capurso G, Ponz de Leon Pisani R, Lauri G, et al. Clinical usefulness of scoring systems to predict severe acute pancreatitis: a systematic review and meta-analysis with pre and post-test probability assessment. United European Gastroenterol J. 2023;11(9):825–836. doi: 10.1002/ueg2.12464.
[78] Trikudanathan G, Wolbrink DRJ, van Santvoort HC, et al. Current concepts in severe acute and necrotizing pancreatitis: an evidence-based approach. Gastroenterology. 2019;156(7):1994–2007.e. doi: 10.1053/j.gastro.2019.01.269.
[79] van Brunschot S, van Grinsven J, van Santvoort HC, et al. Endoscopic or surgical step-up approach for infected necrotising pancreatitis: a multicentre randomised trial. Lancet. 2018;391(10115):51–58. doi: 10.1016/S0140-6736(17)32404-2.
[80] Bang JY, Arnoletti JP, Holt BA, et al. An endoscopic transluminal approach, compared with minimally invasive surgery, reduces complications and costs for patients with necrotizing pancreatitis. Gastroenterology. 2019;156(4):1027–1040.e3. doi: 10.1053/j.gastro.2018.11.031.
[81] Haney CM, Kowalewski KF, Schmidt MW, et al. Endoscopic versus surgical treatment for infected necrotizing pancreatitis: a systematic review and meta-analysis of randomized controlled trials. Surg Endosc. 2020;34(6):2429–2444. doi: 10.1007/s00464-020-07469-9.
[82] Luckhurst CM, El Hechi M, Elsharkawy AE, et al. Improved mortality in necrotizing pancreatitis with a multidisciplinary minimally invasive step-up approach: comparison with a modern open necrosectomy cohort. J Am Coll Surg. 2020;230(6):873–883. doi: 10.1016/j.jamcollsurg.2020.01.038.
[83] Baron TH, DiMaio CJ, Wang AY, et al. American gastroenterological association clinical practice update: management of pancreatic necrosis. Gastroenterology. 2020;158(1):67–75.e1. doi: 10.1053/j.gastro.2019.07.064.
[84] GBD 2017 DALYs and HALE Collaborators. Global, regional, and national disability-adjusted life-years (DALYs) for 359 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2018;392(10159):1859–1922.
[85] Han K, Chen S, Song Y, et al. Burden of pancreatitis and associated risk factors in China, 1990 to 2019: a systematic analysis for the Global Burden of Disease Study 2019. Chin Med J. 2022;135(11):1340–1347. doi: 10.1097/CM9.0000000000002164.
[86] Li CL, Jiang M, Pan CQ, et al. The global, regional, and national burden of acute pancreatitis in 204 countries and territories, 1990–2019. BMC Gastroenterol. 2021;21(1):332. doi: 10.1186/s12876-021-01906-2.
[87] Feigin VL, Nguyen G, Cercy K, et al. Global, regional, and country-specific lifetime risks of stroke, 1990 and 2016. N Engl J Med. 2018;379(25):2429–2437. doi: 10.1056/NEJMoa1804492.