

Preplanned Studies

Disease Burden of Pancreatic Cancer — China, 1990–2019

Yuan He^{1,2}; Xiaolong Zhou²; Xueqi Fan²; Bin Zhang^{2,3}; Li Ma⁴; Jing Wu^{2,5}; Xudong Li^{4,6}**Summary****What is already known about this topic?**

Pancreatic cancer is one of the most malignant tumors of the digestive tract, and the etiology is not clear. Pancreatic cancer has a poor prognosis and high mortality.

What is added by this report?

Compared with 1990, the burden of pancreatic cancer in China increased significantly in 2019. In 1990 and 2019, the disease burden indicator of male pancreatic cancer was higher than that of females, and pancreatic cancer became more common as age increased, especially above 50 years old.

What are the implications for public health practices?

This study mainly provided scientific data and references for the prevention and control of pancreatic cancer in people aged 50 and above.

Pancreatic cancer is prone to distant metastasis, has a high degree of malignancy, and an extremely poor prognosis, and statistics from the National Cancer Centre of China showed that its 5-year survival rate was only 7.2% (1). However, in recent years, the total number of pancreatic cancer cases in the world has been increasing, and in China, the disease burden caused by pancreatic cancer was also relatively high. Based on the Global Burden of Disease Study (GBD 2019) database in China, this research analyzed the burden of pancreatic cancer in China and its changes from 1990 to 2019. This study found that the burden of pancreatic cancer had increased in recent years and was mainly concentrated in the male population of the older age group. Therefore, it is recommended that attention should be paid to the prevention, control, and health management of pancreatic cancer in high-risk groups, and relevant health policies should be formulated as soon as possible.

All data in this study came from the Global Health Data Exchange database (<http://ghdx.healthdata.org/gbd-resultstool>). GBD 2019 estimated the burden of disease in China and utilized data from multiple

sources, primarily using data from the national census, population surveys, disease surveillance systems, and cause of death registration reporting information systems, and systematically reviewed studies on the incidence and prevalence of various diseases. Years of life lost (YLLs) were obtained by multiplying the number of age-specific deaths by the life expectancy corresponding to that age, years living with disability (YLDs) were obtained by multiplying the number of illnesses by the corresponding disability weights, and disability-adjusted life years (DALYs) were calculated as the sum of YLLs and YLDs (2). Table 1 shows the incidence, prevalence, mortality, and disease burden indicators of pancreatic cancer by gender in 1990, 2000, and 2019 from GBD 2019, and obtains their standardized rates, expressed as numbers and rates (1/100,000), respectively.

Compared with 1990, the incidence and mortality of pancreatic cancer in China increased in 2019 (Figure 1A, B). In 2019, pancreatic cancer was estimated to cause 117,374 deaths and 2,805,178 disability-adjusted life years. From 1990 to 2019, DALYs, YLLs, and YLDs in all age groups caused by pancreatic cancer showed an overall increasing trend, with the most significant increase in the age group of 70 years and older (Figure 1C, D, E).

In 2019, the number of pancreatic cancer cases in China was estimated to be 114,964, and the incidence was estimated to be 5.78/100,000, an increase of 329.40% and 82.11% compared with 1990, respectively. Among them, 69,635 were males and 45,329 were females. The incidence for males is greater than that for females. The prevalence of pancreatic cancer was estimated to be 4.46/100,000, an increase of 85.41% over 1990 (2.40/100,000). The number of deaths in 2019 was estimated to be 117,374, and the mortality was estimated to be 5.99/100,000, an increase of 333.05% and 79.46% compared with 1990, respectively. Among them, 70,218 were male deaths and 47,156 were female deaths. The mortality for males is greater than that for females, as shown in Table 1. The DALYs caused by pancreatic cancer in China were estimated to have increased from 749,415

TABLE 1. Overall incidence, prevalence, deaths, and burden indicators of pancreatic cancer for the years 1990, 2000, and 2019 in China.

Gender	Year	Incidence		Prevalence		Deaths		DALYs		YLLs		YLDs	
		Number	P'	Number	P'	Number	P'	Number	P'	Number	P'	Number	P'
Male	1990	15,832	3.89	12,817	2.94	15,869	4.12	455,549	99.25	452,149	98.43	3,400	0.82
	2000	24,905	4.67	19,773	3.51	25,212	4.94	688,378	115.71	683,105	114.74	5,274	0.97
	2019	69,635	7.43	55,700	5.75	70,218	7.69	1,760,522	176.41	1,746,099	174.91	14,423	1.51
	2019 vs. 2000 (%) [*]	179.60	59.06	181.70	63.66	178.52	55.70	155.75	52.46	155.61	52.44	173.48	55.28
	2019 vs. 1990 (%) [*]	339.84	90.87	334.57	95.57	342.49	86.79	286.46	77.74	286.18	77.69	324.21	84.05
Female	1990	10,941	2.55	8,520	1.92	11,235	2.70	293,866	64.48	291,532	63.94	2,334	0.54
	2000	17,557	3.14	13,473	2.34	18,195	3.33	453,981	76.45	450,256	75.79	3,725	0.66
	2019	45,329	4.36	34,678	3.31	47,156	4.58	1,044,656	98.93	1,035,187	98.03	9,470	0.91
	2019 vs. 2000 (%) [*]	158.18	38.97	157.39	41.18	159.17	37.44	130.11	29.41	129.91	29.35	154.22	37.15
	2019 vs. 1990 (%) [*]	314.30	70.79	307.01	72.46	319.71	69.54	255.49	53.43	255.09	53.31	305.66	67.61
Both	1990	26,773	3.17	21,337	2.40	27,104	3.34	749,415	81.48	743,680	80.81	5,734	0.67
	2000	42,462	3.86	33,246	2.91	43,406	4.07	1,142,359	95.80	1,133,360	94.99	8,999	0.81
	2019	114,964	5.78	90,378	4.46	117,374	5.99	2,805,178	136.57	2,781,285	135.38	23,892	1.19
	2019 vs. 2000 (%) [*]	170.74	49.69	171.85	53.41	170.41	47.09	145.56	42.57	145.40	42.53	165.51	47.03
	2019 vs. 1990 (%) [*]	329.40	82.11	323.57	85.41	333.05	79.46	274.32	67.61	273.99	67.53	316.66	77.11

Note: P' was standardized rate calculated using the 2010 National Census as the standard population, expressed as 1/100,000.

Abbreviations: DALYs=disability-adjusted life years; YLLs=years of life lost; YLDs=years lived with disability.

* Percentage change (%) was calculated as the difference between 2019 and 2000 divided by the amount in 2000 and the difference between 2019 and 1990 divided by the amount in 1990.

person-years in 1990 to 2,805,178 person-years in 2019, an increase of 274.32%, and the DALYs rate was estimated to have increased from 81.48/100,000 to 136.57/100,000, a growth rate of 67.61%. The standardized rates of DALYs, YLLs, and YLDs due to pancreatic cancer all increased in 2019 compared with 2000, with YLDs showing the largest increase, more in men than in women; regardless of 1990, 2000, and 2019, men's disease burden indicators were higher than women's (Table 1).

Whether in 1990 or 2019, the incidence of pancreatic cancer was low before the age of 50, and it substantially increased with age, starting from the 50–54 age group, and reaching its peak in the 85-and-over age group. The pattern of changes in mortality was broadly the same among all age groups (Figure 2).

Compared with 1990, DALYs, YLLs, and YLDs of all age groups were estimated to have increased significantly in 2019. YLLs accounted for a larger proportion of DALYs in all age groups, indicating that the disease burden caused by pancreatic cancer was mainly the loss of life due to premature death in 2019. In 2019, DALYs were estimated to have reached a maximum of 457,701 person-years in the 15–49 age group, of which YLLs were estimated to 455,259 person-years, an increase of 273,219 person-years and

271,707 person-years, respectively, compared with 1990, and YLDs were estimated to have reached a maximum of 3,984 person-years in the 65–69 age group. In 2019, the DALYs rate of pancreatic cancer increased with age up to 75–79 years old. The largest increase was in the 75–79 age group. The DALYs rate and YLLs rate gradually increased and reached their peak rate in 70–74 age group (Table 2).

DISCUSSION

In this paper, pancreatic cancer's estimated disease burden and its changes in China were analyzed in detail. The results of this study showed that the incidence and mortality of pancreatic cancer in China in 2019 increased significantly compared with 1990. In 1990, the death toll from pancreatic cancer in China only accounted for 1.88% of all malignant tumor deaths, but it rose to 4.33% in 2019, and it continuously increased. The incidence of pancreatic cancer in China in 2019 was 5.78/100,000, which is lower than the global level (6.57/100,000), but the incidence and mortality have increased significantly, increasing by 82.11% and 79.46% in recent 30 years, respectively. The speed was much higher than the global level (25.86% and 27.90%).

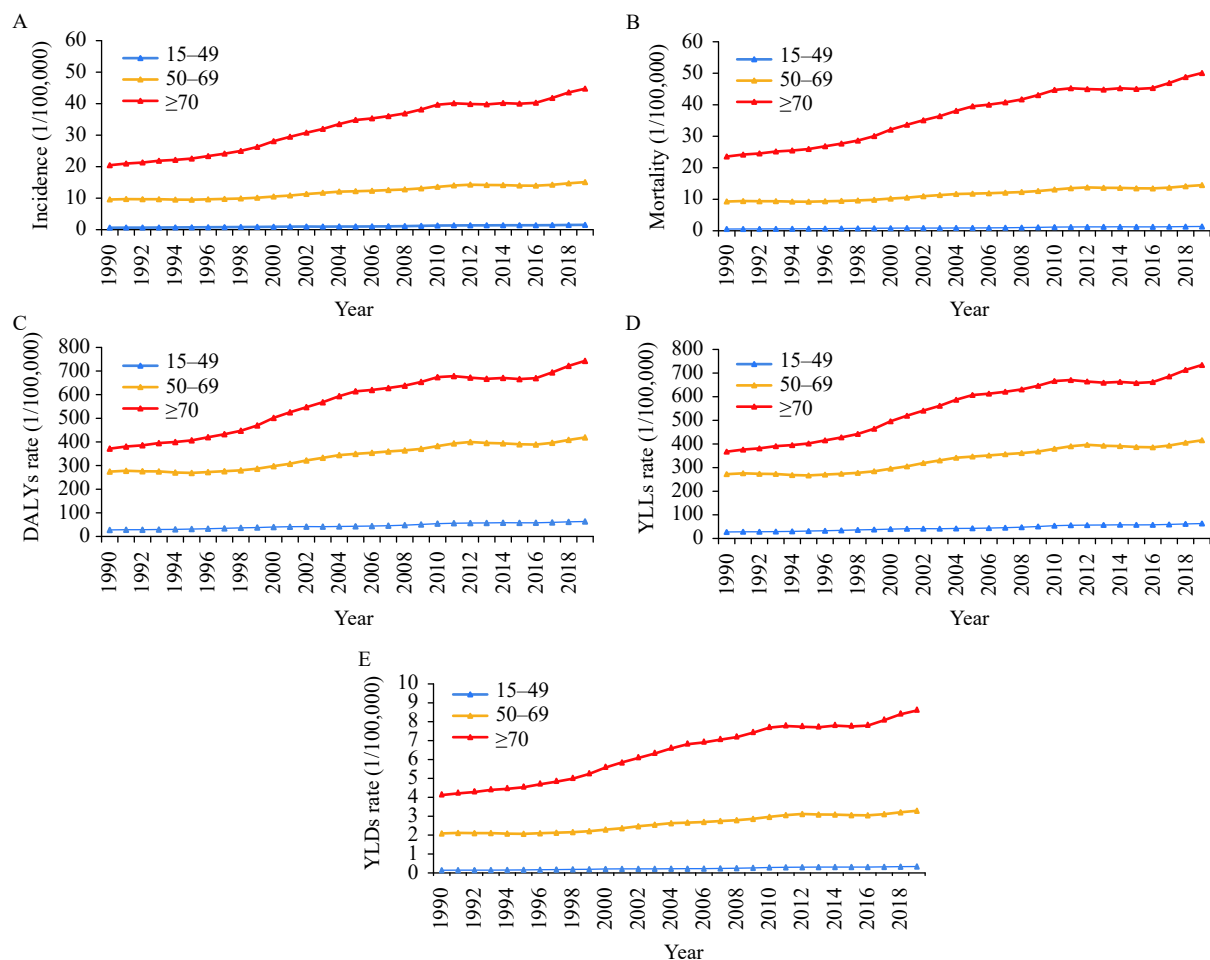


FIGURE 1. Trends of disease burden in pancreatic cancer in 3 age groups, China, 1990–2019. (A) Trends of incidence (1/100,000); (B) Trends of mortality (1/100,000); (C) Trends of DALYs rate (1/100,000); (D) Trends of YLLs rate (1/100,000); (E) Trends of YLDs rate (1/100,000).

Abbreviations: DALYs=disability-adjusted life years; YLLs=years of life lost; YLDs=years lived with disability.

The increased number of cases in China could possibly be associated with better diagnostic technology and the aging of the population, but also possibly associated with some risk factors for pancreatic cancer, such as unhealthy living habits, *Helicobacter pylori* infection, obesity, etc. (3). And a meta-analysis (4) confirmed that folic acid was a protective factor for pancreatic cancer, and people with higher levels of folic acid in the body have a lower risk of disease. Therefore, it is recommended to pay attention to the level of folic acid in the body and take folic acid supplements when levels are low. The YLLs and YLDs of elderly patients with pancreatic cancer increased. The latest census results show that the population aging degree in China is further deepened, and the proportion of the population aged 60 and above is more than 18.70% (5). As the population ages, the disease burden of pancreatic cancer will continue to

increase. The reasons for increased deaths could be limitations in diagnostic and treatment methods as the recurrence rate after surgical resection is high and the prognosis is poor. The 5-year survival rate of patients after surgery is only 7% to 25% (6).

In 2019, the incidence and mortality of pancreatic cancer in China for males (7.43/100,000 and 7.69/100,000) were higher than for females (4.36/100,000 and 4.58/100,000). This result may be due to differences in lifestyle behaviors between men and women. Among the differences in lifestyle, the effects of smoking and drinking were more obvious. According to the latest “Report on Nutrition and Chronic Disease Status of Chinese Residents (2020)” (7), the smoking and drinking rates of Chinese men were as high as 50.5% and 46.2%, which were much higher than women (2.1% and 10.2%). Smoking is the most common risk factor for pancreatic cancer. A

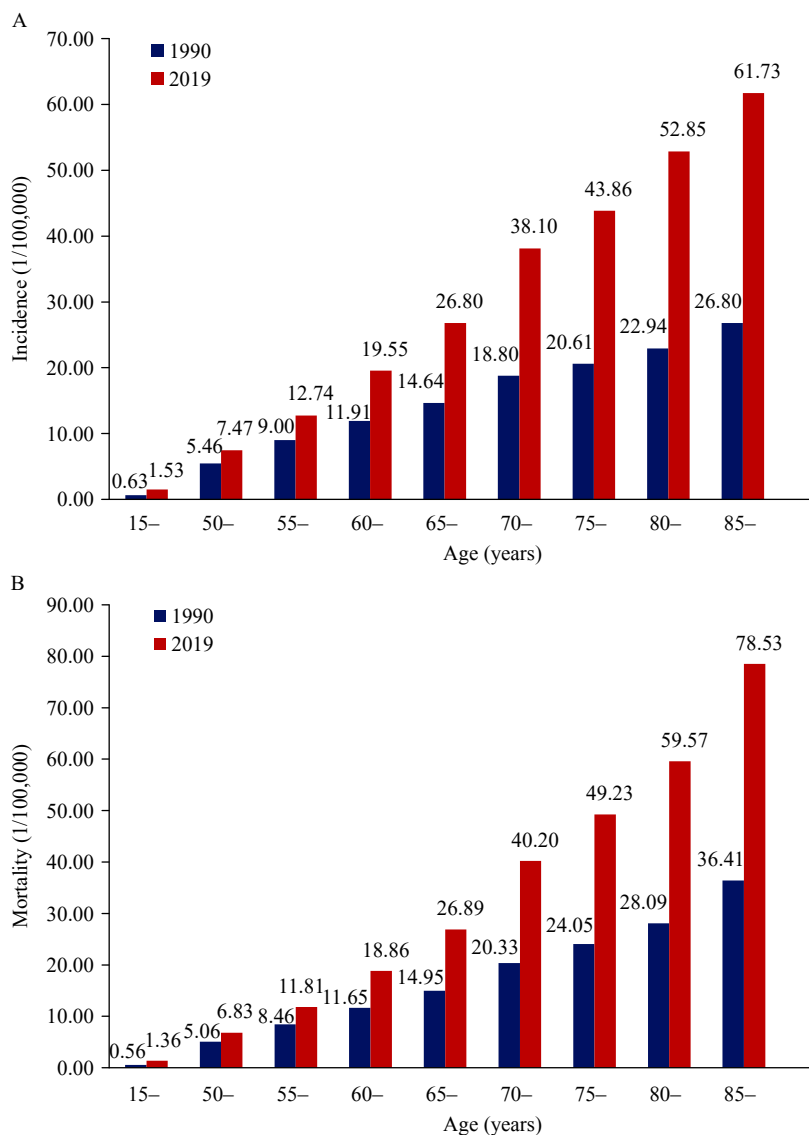


FIGURE 2. Incidence and mortality of pancreatic cancer by age group in China in 1990 and 2019. (A) Incidence of pancreatic cancer; (B) Mortality of pancreatic cancer.

TABLE 2. Disease burden of pancreatic cancer by age group in China, 1990 vs. 2019.

Age (years)	DALYs (person years)		DALYs rate (1/100,000)		YLLs (person years)		YLLs rate (1/100,000)		YLDs (person years)		YLDs rate (1/100,000)	
	1990	2019	1990	2019	1990	2019	1990	2019	1990	2019	1990	2019
15-	184,482	457,701	27.60	63.51	183,552	455,259	27.46	63.17	930	2,442	0.14	0.34
50-	90,383	319,059	189.08	255.04	89,808	316,981	187.87	253.38	576	2,079	1.20	1.66
55-	120,140	365,891	276.42	385.80	119,272	363,193	274.43	382.96	868	2,698	2.00	2.84
60-	115,848	415,592	327.06	529.04	114,931	412,229	324.47	524.76	918	3,363	2.59	4.28
65-	96,386	444,960	352.19	632.19	95,533	440,976	349.07	626.53	853	3,984	3.12	5.66
70-	74,005	370,395	392.47	773.98	73,269	366,724	388.56	766.31	736	3,671	3.90	7.67
75-	42,034	223,896	368.38	750.16	41,556	221,352	364.19	741.64	478	2,544	4.19	8.52
80-	26,136	207,684	327.06	686.28	25,760	204,572	322.35	675.99	376	3,112	4.71	10.28
Total	749,415	2,805,178	63.31	197.22	743,680	2,781,285	62.83	195.54	5,734	23,892	0.48	1.68

Abbreviations: DALYs=disability-adjusted life years; YLLs=years of life lost; YLDs=years lived with disability.

meta-analysis study (8) on pancreatic cancer risk factors showed that the risk of pancreatic cancer in smokers was as high as 1.74 times (95% CI: 1.61–1.87) compared with non-smokers. Previous studies have found that alcohol intake also had an impact on the incidence of pancreatic cancer. Long-term alcohol consumption may increase the risk of pancreatitis and diabetes, thereby increasing the risk of pancreatic cancer, and alcohol was associated with increased risk of pancreatic cancer in men, especially in heavy drinkers, but there was no significant correlation with the risk of pancreatic cancer in women (9).

The study was subject to at least two limitations. The first is that the GBD results are mainly estimates obtained through the calculation of a system dynamics model combined with a statistical model and are not real observations, so it is difficult to avoid the possibility of distortion of the estimates. Second, we did not have access to provincial data on the disease burden of pancreatic cancer in China, so we could only analyze at the national level and could not analyze the differences in the disease burden of pancreatic cancer between regions.

This research found that the disease burden of pancreatic cancer in China has increased in the past 30 years, and it was the most obvious in the population aged 70 and above. DALYs, YLLs, YLDs, and their standardized rates all increased. The disease burden of pancreatic cancer in men was higher than that in women, and the incidence of pancreatic cancer was more common in the older age group and lower in the 15–49 age group, which was consistent with findings of a study in China that analyzed trends in pancreatic cancer incidence and mortality from 2005–2015 (10). Therefore, strengthening the implementation of smoking and alcohol control policies and focusing on high-risk groups such as middle-aged and elderly men are important early preventive measures for the prevention and control of pancreatic cancer. In addition, we found that from the results obtained in this study, it appears that there may be an interactive effect of pancreatic cancer incidence and mortality with the three factors of year, age, and sex, which is well worthy of continued in-depth study. So this study not only analyzes the development trends of pancreatic cancer in China from 1990–2019, but also provides us with ideas for the next step of research.

Conflicts of interest: No conflicts of interest reported.

Acknowledgements: The team of the GBD 2019 and the National Center for Chronic and

Noncommunicable Disease Control and Prevention, CDC China.

Funding: Supported by National Key Research and Development Program “Research on key technologies for monitoring and controlling major malignant tumor risk factors based on big data, guided by precise prevention and control” (2016YFC1302600).

doi: 10.46234/ccdcw2022.056

Corresponding authors: Jing Wu, wujingcdc@163.com; Xudong Li, lixd@chinacdc.cn.

¹ Baotou Medical College, Baotou, Inner Mongolia Autonomous Region, China; ² National Center for Chronic and Noncommunicable Disease Control and Prevention, Chinese Center for Disease Control and Prevention, Beijing, China; ³ Inner Mongolia Medical University, Huhehot, Inner Mongolia Autonomous Region, China; ⁴ Office of Epidemiology, Chinese Center for Disease Control and Prevention, Beijing, China.

Submitted: June 28, 2021; Accepted: October 18, 2021

REFERENCES

- Zeng HM, Chen WQ, Zheng RS, Zhang SW, Ji JS, Zou XN, et al. Changing cancer survival in China during 2003–15: a pooled analysis of 17 population-based cancer registries. *Lancet Glob Health* 2018;6(5):E555 – 67. [http://dx.doi.org/10.1016/S2214-109X\(18\)30127-X](http://dx.doi.org/10.1016/S2214-109X(18)30127-X).
- Vos T, Lim SS, Abbafati C, Abbas KM, Abbasi M, Abbasifard M, et al. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020;396(10258):1204 – 22. [http://dx.doi.org/10.1016/S0140-6736\(20\)30925-9](http://dx.doi.org/10.1016/S0140-6736(20)30925-9).
- Wu WR, He XK, Yang LY, Wang Q, Bian XY, Ye JZ, et al. Rising trends in pancreatic cancer incidence and mortality in 2000–2014. *Clin Epidemiol* 2018;10:789 – 97. <http://dx.doi.org/10.2147/CLEP.S160018>.
- Yang M, Deng SX, Fu XX, Zhang HG, Zhu W, Cai QC. Folate intake and risk of pancreatic cancer: a meta-analysis. *Acad J Second Mil Med Univ* 2011;32(5):510 – 6. <http://dx.doi.org/10.3724/SP.J.1008.2011.00510>. (In Chinese).
- National Bureau of Statistics. Bulletin of the Seventh National Population Census (No.4). 2021. http://www.stats.gov.cn/tzj/c/zdtjgz/zgrkpc/dqcrkpc/ggl/202105/t20210519_1817697.html. [2021-5-11]. (In Chinese).
- Salman B, Zhou DE, Jaffee EM, Edil BH, Zheng L. Vaccine therapy for pancreatic cancer. *Oncoimmunology* 2013;2(12):e26662. <http://dx.doi.org/10.4161/onci.26662>.
- State Council Press Office. Transcript of the press conference on December 23, 2020. 2020. <http://www.nhc.gov.cn/xcs/s3574/202012/bc4379ddf4324ef86f05d31cc1c4982.shtml>. [2021-1-13]. (In Chinese).
- Iodice S, Gandini S, Maisonneuve P, Lowenfels AB. Tobacco and the risk of pancreatic cancer: a review and meta-analysis. *Langenbeck's Arch Surg* 2008;393(4):535 – 45. <http://dx.doi.org/10.1007/s00423-007-0266-2>.
- Naudin S, Li KR, Jaouen T, Assi N, Kyrø C, Tjønneland A, et al. Lifetime and baseline alcohol intakes and risk of pancreatic cancer in the European Prospective Investigation into Cancer and Nutrition study. *Int J Cancer* 2018;143(4):801 – 12. <http://dx.doi.org/10.1002/ijc.31367>.
- Cai J, Chen HD, Lu M, Zhang YH, Lu B, You L, et al. Trend analysis on morbidity and mortality of pancreatic cancer in China, 2005–2015. *Chin J Epidemiol* 2021;42(5):794 – 800. <http://dx.doi.org/10.3760/cma.j.cn112338-20201115-01328>. (In Chinese).