Supplementary Methods S1:

Age-specific incidence rates and age-standardized incidence rates (ASIRs) were calculated for each stratum defined by county/district × sex × calendar year. Let $i = 1, \ldots, k$ index the age groups.

Age-specific incidence rate

For age group i, the age-specific incidence rate was computed as:

$$r_i = \frac{C_i}{P_i} \times 100000$$

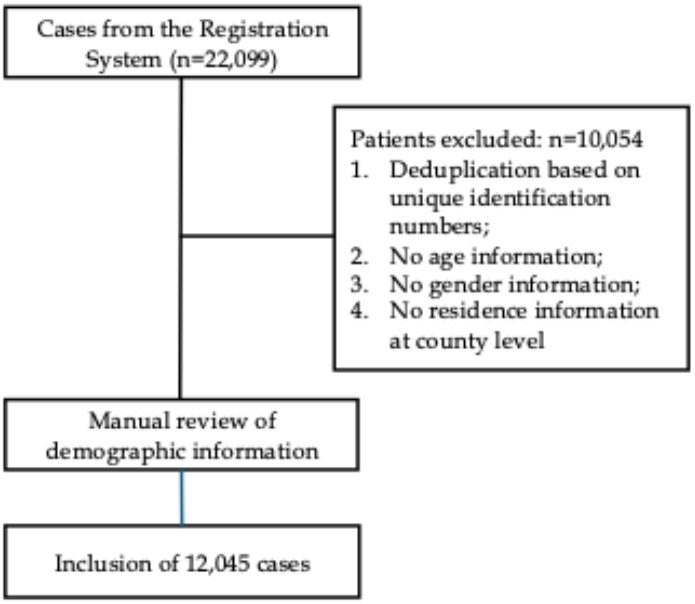
where C_i denotes the number of incident pancreatic cancer cases in age group i, and P_i denotes the corresponding population denominator in age group i. Population denominators were obtained from the Seventh National Population Census (2020) at the county level, stratified by sex and age group.

Age-standardized incidence rate (ASIR)

ASIRs were calculated using direct age standardization with the China 2010 standard population (derived from the Sixth National Population Census). The ASIR was computed as:

$$\text{ASIR} = \sum_{i=1}^{k} w_i \, r_i = \sum_{i=1}^{k} w_i \left(\frac{C_i}{P_i} \times 100000 \right)$$

where w_i is the proportion (weight) of age group i in the China 2010 standard population, satisfying $\sum_{i=1}^{k} w_i = 1$. Rate smoothing was not applied for county/district-level estimates.



Supplementary Figure 1 Procedure of data cleaning and case selection.

Supplementary Table 1 The Köppen-Geiger climate classification

Climate code	Description
BWk	Desert climate
BSk	Semi-arid grassland climate
Cwa	Subtropical humid climate
Dwa	Monsoon climate of medium latitudes
Dwb	Monsoon climate of medium latitudes
Dwc	Subarctic monsoon climate
ET	Tundra climate in the frigid zone

Supplementary Table 2 Descriptive statistics of county-level indicators

Variable	Unit	mean (SD)	Median (IQR)	Min-Max
ASIR	per 100,000	3.93 (1.88)	3.83 (2.72–4.74)	0.14–13.22
GDP per capita	CNY/capita/year	15588 (18257)	9329 (4764–16169)	2470–114269
GDP (total)	10,000 CNY	386609 (501369)	232357 (122563–371332)	31428–3305386
Hospital beds	beds per 10,000 population	699.84 (507.48)	648.45 (412.09–775.45)	70.73–3517.36
Primary industry output	10,000 CNY	54022 (44634)	49226 (23551–73759)	2088–316742
Secondary industry output	10,000 CNY	173904 (262797)	80937 (31146–156154)	4904–1500752
Tertiary industry output	10,000 CNY	143450 (291472)	72984 (39965–116134)	12111–2564997
Secondary-industry share (Second/Total)	proportion	0.395 (0.263)	0.340 (0.174–0.554)	0.004–0.950
Tertiary-industry share (Third/Total)	proportion	0.396 (0.263)	0.342 (0.180–0.581)	0.036–0.983

ASIR: age-standardized incidence rate; IQR: interquartile range. Secondary-/tertiary-industry share = secondary/tertiary output divided by (primary + secondary + tertiary output).

Supplementary Table 3 Sensitivity analysis of SaTScan high-risk space–time clusters under different maximum spatial window sizes (overall population)

Max spatial window (%)	Reported high-risk cluster	Counties (*n*)	Time frame	Core area	RR	LLR	Monte Carlo *P* value
10	High-risk cluster 1 (most significant)	1	2013–2017	Baiyin (Pingchuan District)	4.92	158.34	≤0.001
10	High-risk cluster 2 (second most significant)	7	2019–2021	Baiyin–Lanzhou (Pingchuan-centered)	2.01	104.64	≤0.001
20	Most likely high-risk cluster	13	2017–2021	Lanzhou–Baiyin and eastern Wuwei	1.76	204.58	≤0.001
30	Most likely high-risk cluster	15	2017–2021	Lanzhou–Baiyin extending to Dingxi; Wuwei	1.74	238.84	≤0.001
50 (baseline)	Most likely high-risk cluster	39	2017–2021	Hexi Corridor and central Gansu	1.63	292.20	≤0.001

RR: relative risk; LLR: log likelihood ratio.

Supplementary Table 4 Comparison of baseline vs age-adjusted SaTScan results in the overall population (most likely high-risk space–time cluster)

Analysis (overall)	Time frame	Counties (*n*)	Core area	Cases	Expected	O/E	RR	LLR	Monte Carlo *P* value
Baseline (unadjusted)	2017–2021	39	Hexi Corridor and central Gansu	3899	2739.27	1.42	1.63	292.20	≤0.001
Age-adjusted (18 age groups)	2017–2021	37	Hexi Corridor and central Gansu	3705	2673.27	1.39	1.56	236.51	≤0.001

O/E: Observed-to-expected ratio; RR: Relative risk; LLR: Log likelihood ratio.

Supplementary Table 5 The AAPC of pancreatic cancer ASIR in counties of Gansu Province

code_shp	AAPC	95%CI lower	95%CI upper	Statistically significant (0 = No, 1 = Yes)	*P* value
620102	2.6862	-2.9363	8.2713	0	0.3962
620103	7.3195	-0.6297	15.3447	0	0.071
620104	-1.0205	-8.4576	6.5425	0	0.731
620105	-2.5444	-7.9772	3.2562	0	0.3582
620111	11.0805	-21.4843	54.2086	0	0.3186
620121	6.1004	-2.0797	15.1692	0	0.1336
620122	7.8972	-8.4672	27.8071	0	0.3672
620123	2.404	-7.8729	13.9067	0	0.6138
620200	-20.0464	-37.5986	11.0866	0	0.156
620302	-7.7	-11.9481	-2.9439	1	0.001
620321	1.0603	-12.0293	16.7017	0	0.8258
620402	-12.0067	-20.9692	-1.6099	1	0.0248
620403	-22.9128	-34.7235	-8.6567	1	0.0014
620421	8.1505	-3.973	18.6408	0	0.124
620422	-4.2527	-12.3503	7.6481	0	0.4236
620423	-0.7851	-10.0832	9.5183	0	0.8468

620502	3.7696	-8.0212	17.1585	0	0.416
620503	-1.2333	-6.9153	5.283	0	0.7404
620521	14.1372	3.7367	26.5089	1	0.0246
620522	6.1216	-1.9447	15.2407	0	0.1508
620523	8.9367	0.5811	18.0626	1	0.0354
620524	21.0472	-13.8229	56.9894	0	0.1408
620525	7.1345	-4.5887	20.0573	0	0.1974
620602	-7.2235	-15.501	1.9253	0	0.117
620621	-9.9146	-20.6569	2.6629	0	0.1102
620622	-2.93	-12.8902	8.4134	0	0.5906
620623	14.1588	-2.7597	34.5547	0	0.098
620702	16.6603	4.2542	35.8617	1	0.0104
620722	21.8957	1.487	45.3632	1	0.0354
620723	13.3071	7.4638	20.8542	1	0
620724	-5.7342	-30.5838	28.5683	0	0.6496
620725	13.4485	-9.742	43.3052	0	0.2386
620802	-7.5716	-17.1493	0.4616	0	0.0624
620821	-10.8152	-19.1664	1.7888	0	0.0774

620822	5.0954	-4.9136	16.1512	0	0.2824
620823	6.7762	-2.1967	16.73	0	0.1354
620825	0.7203	-13.2638	17.253	0	0.8938
620826	3.4197	-8.2228	15.6759	0	0.6212
620881	-7.0807	-17.6727	5.2423	0	0.2372
620902	3.9728	-2.7224	10.4011	0	0.1876
620922	1.8343	-15.2425	22.8718	0	0.829
620981	13.9829	-9.4737	42.2351	0	0.197
621002	7.9039	-11.6197	37.156	0	0.246
621021	8.3352	-1.6375	19.6429	0	0.097
621023	13.1318	-0.3326	28.4163	0	0.0542
621025	12.2338	-7.5394	37.0167	0	0.232
621026	29.0367	19.3518	41.1078	1	0
621027	11.5481	-7.7229	35.1813	0	0.2116
621102	2.8154	-3.0042	8.896	0	0.2926
621121	-4.8206	-12.3321	3.5322	0	0.2434
621122	10.5464	3.6234	18.0691	1	0.0036
621123	-3.518	-13.429	7.5952	0	0.481

621124	13.9175	6.484	21.2215	1	0.0006
621125	15.2235	-1.9858	33.295	0	0.075
621126	-0.4483	-6.08	5.4892	0	0.8616
621223	5.8952	-1.4178	13.9156	0	0.1184
621225	3.3011	-4.8089	12.4417	0	0.331
621226	15.6238	-6.1843	42.9954	0	0.147
622901	7.4624	-5.9485	23.0114	0	0.246
622921	15.2796	8.9388	22.5163	1	0
622922	3.1759	-7.8477	20.2625	0	0.5532
622923	15.6832	5.8747	26.6096	1	0.0006
622925	3.6692	-8.5004	17.8197	0	0.5646
622927	0.5341	-12.7088	16.0983	0	0.9254
623022	2.4789	-11.9682	16.9616	0	0.817
623023	6.4206	-10.2375	26.7109	0	0.4806
623024	-5.6332	-14.1656	3.9278	0	0.2284

Supplementary Table 6 The AAPC of male pancreatic cancer ASIR in counties of Gansu Province

Code_shp	AAPC	95%CI lower	95%CI upper	Statistically significant (0 = No, 1 = Yes)	*P* value
620102	-4.4769	-13.3047	5.2499	0	0.313116
620103	10.774	-1.2469	24.2582	0	0.074717
620104	0.8378	-6.3684	8.5986	0	0.80479
620105	-7.9332	-15.1191	-0.1389	1	0.046934
620121	7.8706	-0.8434	17.3504	0	0.072383
620122	9.6439	-3.1035	24.0684	0	0.126249
620123	1.7188	-5.6705	9.687	0	0.621538
620302	-4.6079	-9.1816	0.1962	0	0.059866
620321	0.8296	-11.1208	14.3868	0	0.88549
620402	-16.2749	-44.9063	27.2357	0	0.405467
620403	-21.7835	-32.5878	-9.2475	1	0.004634
620421	4.3785	-5.6812	15.5111	0	0.363778
620422	0.9656	-7.1648	9.8081	0	0.801505
620423	-7.4866	-14.7681	0.417	0	0.060299
620502	1.4256	-8.5987	12.5492	0	0.765308

620503	-0.193	-13.9271	15.7326	0	0.979594
620521	7.6237	-5.5559	22.6424	0	0.270319
620522	2.9932	-6.5344	13.492	0	0.509208
620523	12.3855	-8.8307	38.539	0	0.238491
620525	20.4196	0.3372	44.5213	1	0.04592
620602	-6.8567	-13.6271	0.4444	0	0.062099
620621	-10.4423	-20.5476	0.9483	0	0.066849
620622	-3.9429	-13.5586	6.7426	0	0.410678
620623	16.2784	6.8276	26.5654	1	0.002997
620702	21.3761	10.2081	33.6758	1	0.001406
620725	19.6135	2.2098	39.9807	1	0.029862
620802	-12.0329	-18.4679	-5.09	1	0.004104
620821	-9.0426	-18.3823	1.3659	0	0.079199
620822	3.5335	-7.9468	16.4455	0	0.520667
620823	7.1853	-7.8814	24.7163	0	0.327136
620825	0.8804	-9.5484	12.5117	0	0.859829
620826	-4.6726	-18.0357	10.8692	0	0.491719

620881	-8.169	-16.5984	1.1124	0	0.076276
620902	1.8327	-6.6832	11.1258	0	0.649237
621002	5.1824	-25.1778	47.8618	0	0.771231
621021	10.9021	-2.0969	25.6269	0	0.093158
621025	9.7228	-4.6158	26.2169	0	0.168155
621027	12.8937	3.1437	23.5655	1	0.014078
621102	3.5473	-5.0661	12.9422	0	0.387559
621121	-7.642	-15.5363	0.9901	0	0.075
621122	9.6349	2.8649	16.8504	1	0.009766
621123	-6.2113	-18.3535	7.7367	0	0.322718
621124	10.3173	0.0066	21.6909	1	0.049875
621125	13.1567	5.9236	20.8837	1	0.002197
621126	-4.1533	-7.244	-0.9596	1	0.011196
621225	3.1893	-4.1032	11.0363	0	0.357864
621226	11.3009	-2.108	26.5464	0	0.091815
622901	9.2629	-5.0374	25.7168	0	0.186887
622921	13.0843	5.9103	20.7443	1	0.002161

622922	-3.2373	-25.5472	25.7578	0	0.805613
622923	18.0371	4.8889	32.8335	1	0.011249
622925	-0.5383	-10.571	10.62	0	0.911102
622927	3.5523	-6.5919	14.7982	0	0.463346

Supplementary Table 7 The AAPC of female pancreatic cancer ASIR in counties of Gansu Province

code_shp	AAPC	95%CI lower	95%CI upper	Statistically significant (0 = No, 1 = Yes)	*P* value
620102	8.361	-5.095	23.7248	0	0.235245
620103	3.0658	-7.7224	15.1152	0	0.551998
620104	-4.5807	-17.7317	10.6725	0	0.535439
620121	2.1697	-9.5356	15.3895	0	0.699155
620123	10.9378	-13.9199	42.9736	0	0.422592
620200	-13.9087	-30.9307	7.3084	0	0.158468
620302	-13.3733	-26.0025	1.4113	0	0.069371
620321	2.0142	-14.0018	21.013	0	0.797616
620402	-9.1876	-32.099	21.4547	0	0.515902
620421	5.3563	-4.3635	16.0639	0	0.25367
620422	-3.7431	-18.7104	13.98	0	0.621885
620423	9.8394	-3.4386	24.9431	0	0.133799
620502	7.0598	-17.4965	38.925	0	0.607837
620503	-2.7359	-12.6855	8.3474	0	0.575168
620523	8.8953	-1.7702	20.7189	0	0.094271
620602	-7.2179	-14.4283	0.6002	0	0.065666

620621	-6.6238	-24.6238	15.6747	0	0.487478
620622	-5.6793	-19.8669	11.0203	0	0.438073
620702	23.1443	9.7683	38.1502	1	0.002694
620723	10.1221	-5.1124	27.8026	0	0.176991
620802	-5.2751	-19.4457	11.3882	0	0.468662
620821	-0.0598	-16.5478	19.6858	0	0.994177
620822	8.1966	-5.3054	23.6238	0	0.214031
620825	0.3425	-10.2728	12.2138	0	0.946359
620826	-4.6598	-19.9421	13.5397	0	0.551956
620881	-6.1774	-21.6105	12.2942	0	0.442869
620902	9.2944	-6.8986	28.3039	0	0.241512
621027	12.1729	-7.0384	35.3544	0	0.199925
621102	3.4207	-1.1624	8.2163	0	0.127528
621121	0.0633	-14.0569	16.5035	0	0.992692
621122	13.1383	4.3797	22.6318	1	0.007098
621123	-0.515	-10.4886	10.5699	0	0.914392
621124	16.0738	-1.5962	36.9167	0	0.076895
621126	3.6936	-9.8293	19.2445	0	0.571525

621223	9.5201	-0.4788	20.5236	0	0.060159
622921	16.1334	3.4501	30.3717	1	0.011251
622923	15.3875	2.55	29.832	1	0.022657
622927	-6.2278	-19.6018	9.3708	0	0.369182
623022	-0.8079	-11.9114	11.6952	0	0.880568

Supplementary Table 8 Spatial error model

Variable	**β (95%CI)**	**SE**	**z**	***P* value**
Intercept	-0.497 (-2.385, 1.392)	0.964	-0.515	0.606
log(GDP per capita)	0.207 (0.052, 0.362)	0.079	2.622	0.009
log(Hospital beds per 10,000)	-0.015 (-0.178, 0.148)	0.083	-0.179	0.858
Tertiary-industry share	-0.381 (-0.834, 0.071)	0.231	-1.654	0.098

SEM spatial parameter: $\lambda = 0.681$ (SE = 0.085), LR test = 28.905, $P = 7.60\times10^{-8}$; AIC = 122.68 (OLS AIC = 149.59).

Supplementary Table 9 Spatial lag model (sensitivity analysis)

Variable	β (95%CI)	SE	z	*P* value
Intercept	-0.522 (-2.357, 1.313)	0.936	-0.558	0.577
log(GDP per capita)	0.082 (-0.041, 0.206)	0.063	1.304	0.192
log(Hospital beds per 10,000)	0.054 (-0.113, 0.221)	0.085	0.634	0.526
Tertiary-industry share	-0.250 (-0.710, 0.210)	0.235	-1.065	0.287

SLM spatial parameter: $\rho = 0.592$ (SE = 0.096), LR test = 22.683, $P = 1.91\times10^{-6}$; AIC = 128.91 (OLS AIC = 149.59).