



Supplementary Materials: The Association between Compound Hot Extremes and Mortality Risk in Shandong Province, China: A Time-Series Analysis

Table S1. Monthly averages of mean temperature, relative humidity, wind speed, and sunshine duration for the top ten most densely populated subdistricts of Shandong Province.

Subdistrict	Month	Mean Temperature (°C)	Relative Humidity (%)	Wind Speed (m/s)	Sunshine Duration (h)
Jinanshi Tianqiaoqu	June	26.58	55.28	1.16	224.40
Luokoujiedao	July	28.64	70.63	1.08	176.12
	August	27.34	71.41	0.95	199.60
	September	22.89	62.83	0.90	183.88
Jiningshi	June	25.98	63.00	1.04	222.45
Renchengqu	July	28.49	76.50	1.03	211.50
Fuqiaoqiedao	August	27.42	76.65	0.83	224.14
	September	22.63	72.11	0.74	186.36
Weihaishi Huancu- iqu Zhudaojiedao	June	22.10	69.41	2.02	221.47
	July	25.64	80.44	1.92	174.14
	August	26.08	77.99	1.86	233.92
	September	21.78	64.46	1.77	223.54
Qingdaoshi	June	21.31	80.32	1.79	203.96
Shinanqu Jin- menlujiedao	July	25.51	87.31	1.84	174.54
	August	26.57	79.81	1.81	217.80
	September	22.45	72.37	1.74	203.37
Qingdaoshi Si- fangqu Jiax- inglujiedao	June	21.31	80.32	1.79	203.96
	July	25.51	87.31	1.84	174.54
	August	26.57	79.81	1.81	217.80
	September	22.45	72.37	1.74	203.37
	June	26.52	54.68	1.22	224.40

Subdistrict	Month	Mean Temperature (°C)	Relative Humidity (%)	Wind Speed (m/s)	Sunshine Duration (h)
Jinanshi Shi-	July	28.50	70.56	1.11	176.12
zhongqu Shun-	August	27.24	71.89	0.99	199.60
yulujiedao	September	22.93	62.99	0.94	183.88
Jinanshi Tianqiaoqu	June	26.62	55.44	1.22	224.40
Dikoulujiedao	July	28.63	71.23	1.12	176.12
	August	27.31	72.77	0.99	199.60
	September	22.94	63.95	0.96	183.88
Hezeshi Mudanqu	June	26.47	60.55	1.19	206.20
Dongchengjiedao	July	28.32	76.49	1.15	202.32
	August	27.34	77.88	0.99	205.81
	September	22.80	71.74	0.96	167.19
Binzhoushi Bin-	June	25.28	62.01	1.44	230.10
chengqu Shi-	July	27.79	75.15	1.40	179.08
zhongjiedao	August	26.77	76.95	1.19	206.93
	September	22.04	68.60	1.18	195.92
Jiningshi	June	25.98	63.00	1.04	222.45
Renchengqu	July	28.49	76.50	1.03	211.50
Guhuaijiedao	August	27.42	76.65	0.83	224.14
	September	22.63	72.11	0.74	186.36

Note: Due to the lack of subdistrict-scale data for sunshine duration, we supplemented it using city-level data.

Table S2. Distribution of deaths during different types of hot extremes.

Hot extreme	Frequency (Proportion / %)	Number of deaths (Proportion / %)	Mean Temperature (°C)
Normal day	1022988 (84.49)	935544 (83.09)	24.59
Hot day	74024 (6.11)	76406 (6.79)	27.74
Hot night	72054 (5.95)	69869 (6.21)	27.77
Compound hot extreme	41662 (3.44)	44088 (3.92)	29.97
Total	1210728 (100.00)	1125907 (100.00)	25.16

Table S3. Sensitivity analysis of mortality risk associated with compound hot extremes by changing lag days, df of time, the relative humidity and adding PM_{2.5} or O₃.

	Relative Risk (95%CI)		
	Hot day	Hot night	Compound hot extreme
Lag days			
12	1.039 (0.982, 1.099)	1.409 (1.324, 1.500)	1.789 (1.672, 1.914)
13	1.023 (0.965, 1.084)	1.436 (1.347, 1.532)	1.785 (1.659, 1.920)
15	1.045 (0.977, 1.119)	1.485 (1.382, 1.596)	1.729 (1.593, 1.876)
df of time			
3	1.025 (0.965, 1.095)	1.456 (1.364, 1.555)	1.755 (1.622, 1.899)
5	1.033 (0.992, 1.091)	1.370 (1.298, 1.445)	1.773 (1.680, 1.871)
Add PM _{2.5}	1.031 (0.966, 1.099)	1.447 (1.355, 1.545)	1.754 (1.623, 1.897)
Add O ₃	1.036 (0.971, 1.106)	1.453 (1.361, 1.552)	1.755 (1.622, 1.898)
4 df of relative humidity	1.040 (0.965, 1.084)	1.436 (1.347, 1.532)	1.785 (1.659, 1.920)
Delete the relative humidity	1.036 (0.971, 1.106)	1.431 (1.341, 1.527)	1.759 (1.624, 1.904)

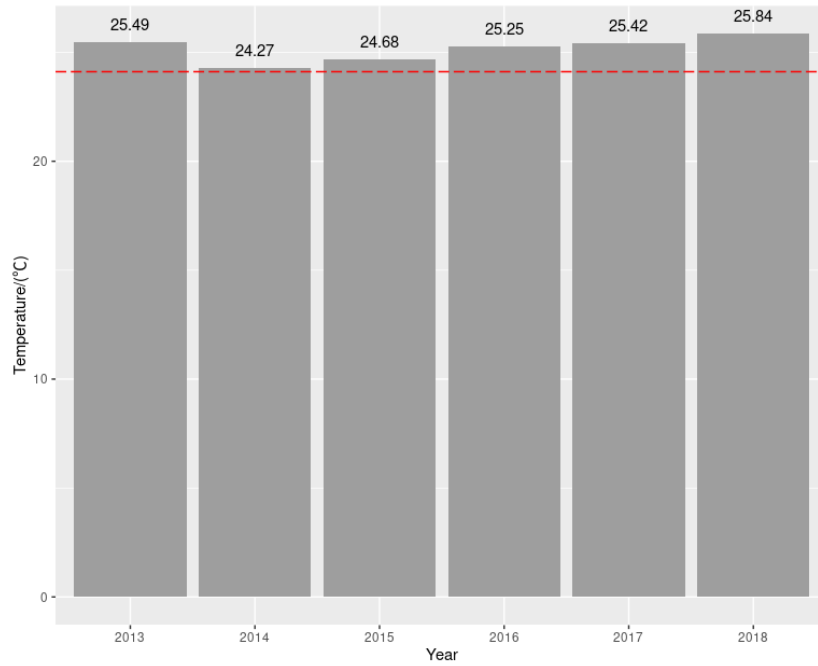


Figure S1. Distribution of average daily temperatures in summer in Shandong Province from 2013-2018. The red dotted line in the figure shows the average temperature from 2005 to 2020 (24.11°C).

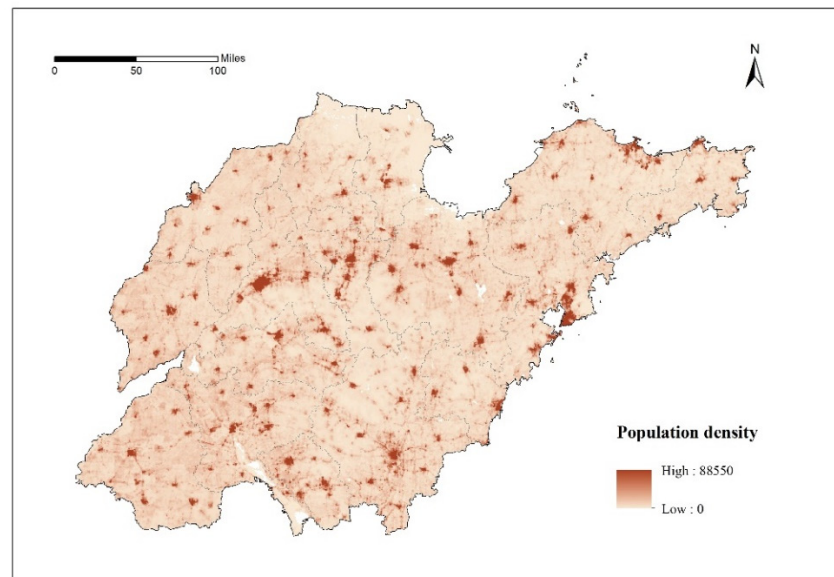


Figure S2. Population density distribution map of Shandong Province. The unit of population density is population/square kilometer. Population density data with a spatial resolution of approximately 1 km were obtained from WorldPop (<https://www.worldpop.org/>; accessed on 15 September 2023).

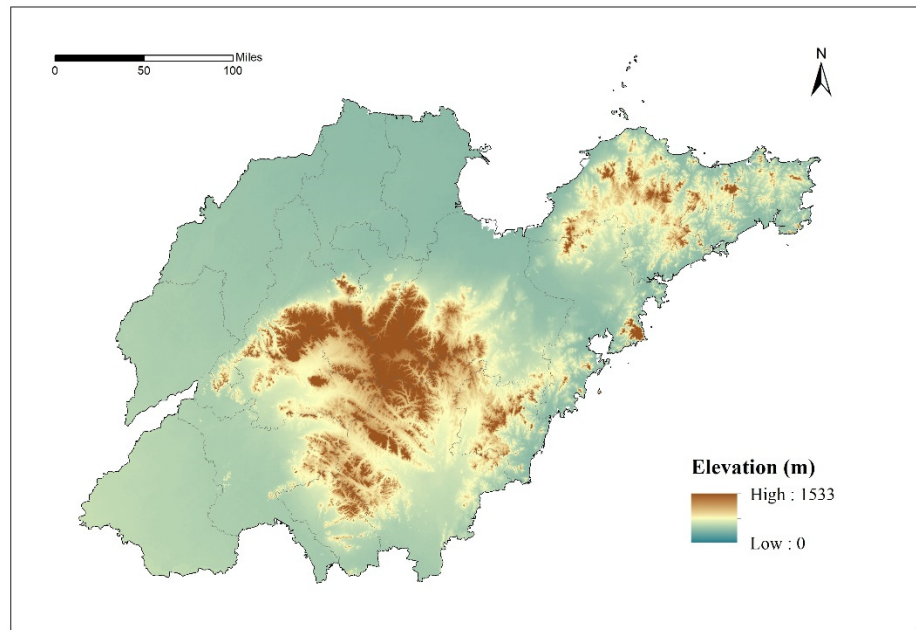


Figure S3. Elevation map of Shandong Province. Elevation data with a spatial resolution of approximately 1 km were obtained from SRTM (<http://srtm.csi.cgiar.org>; accessed on 15 September 2023).

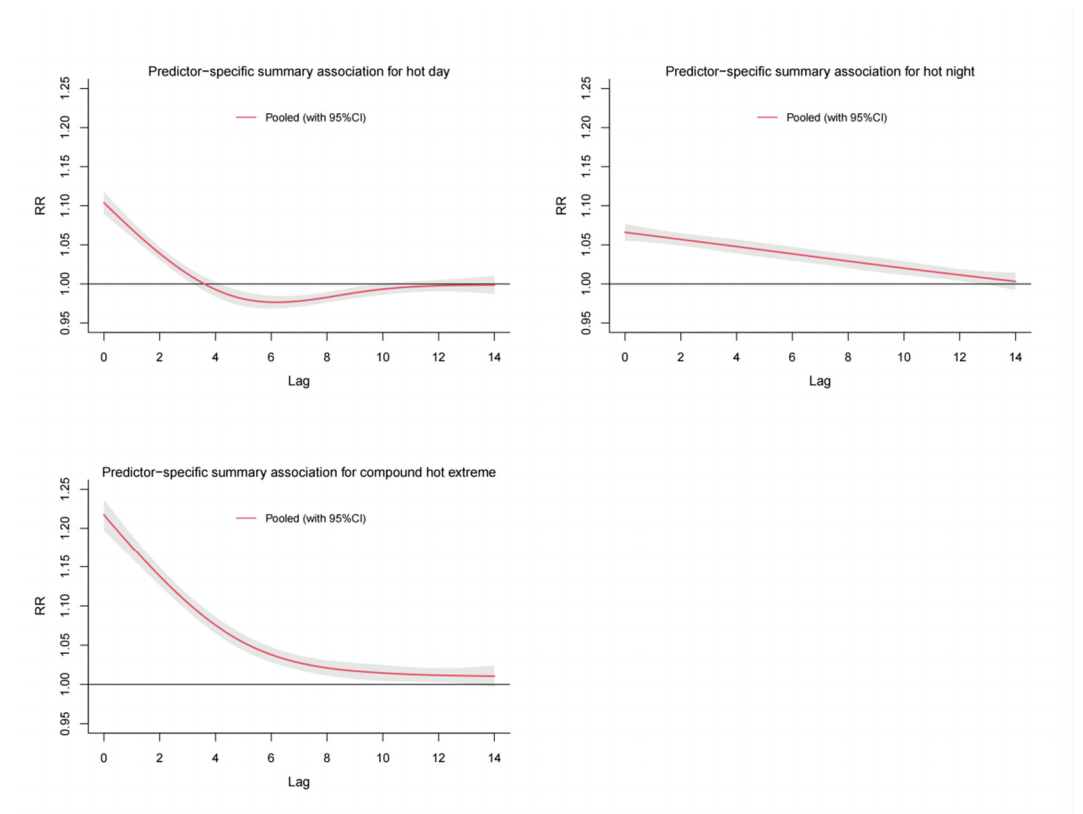


Figure S4. Overall lag structure in effects of hot extremes on daily mortality from cardiovascular diseases in Shandong Province, 2013–2018.

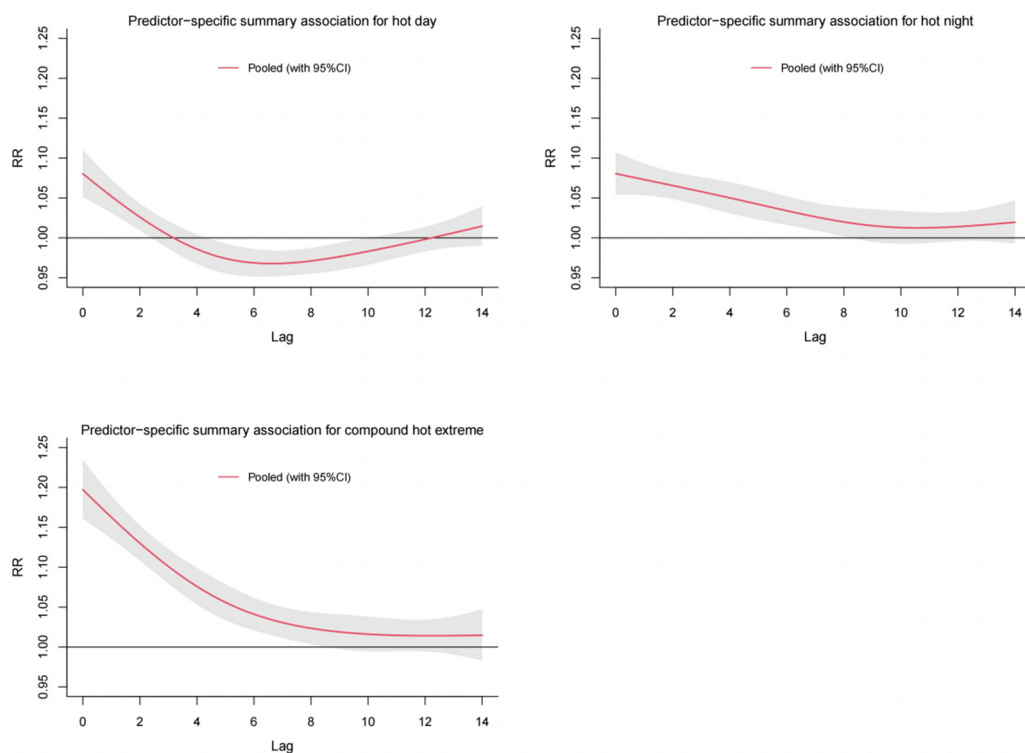


Figure S5. Overall lag structure in effects of hot extremes on daily mortality from respiratory diseases in Shandong Province, 2013–2018.

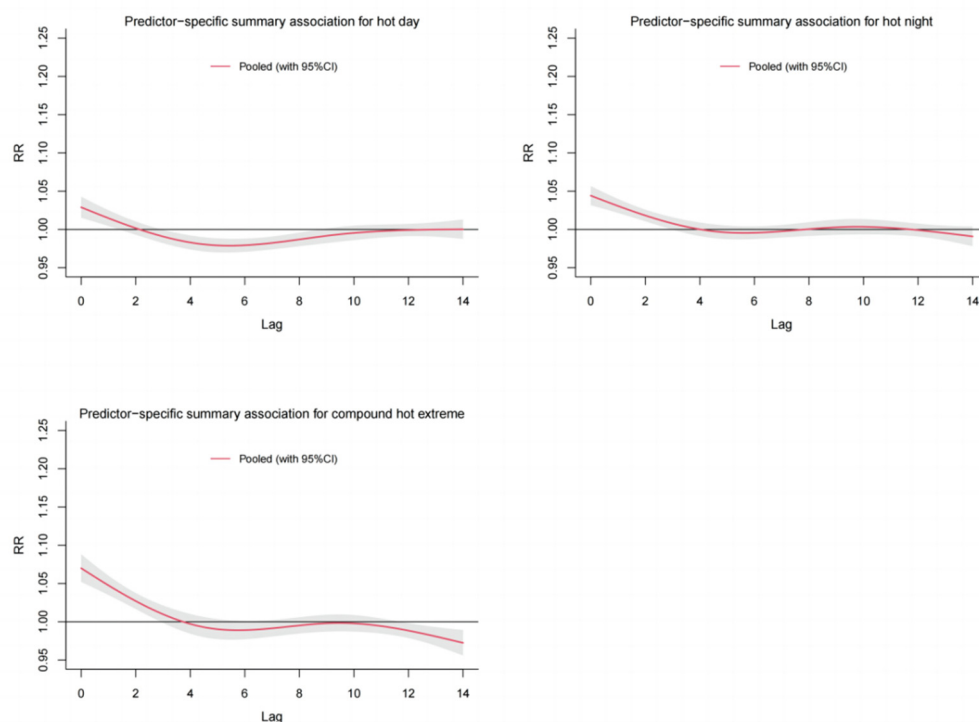


Figure S6. Overall lag structure in effects of hot extremes on daily mortality from tumor in Shandong Province, 2013–2018.

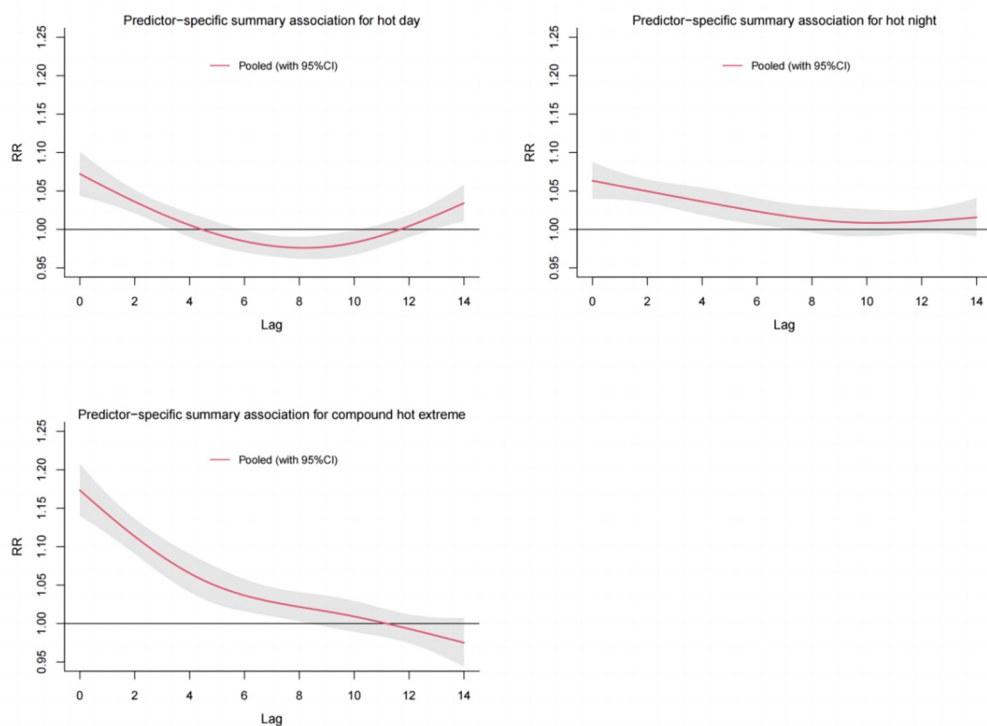


Figure S7. Overall lag structure in effects of hot extremes on daily mortality from other non-accidental deaths in Shandong Province, 2013–2018.

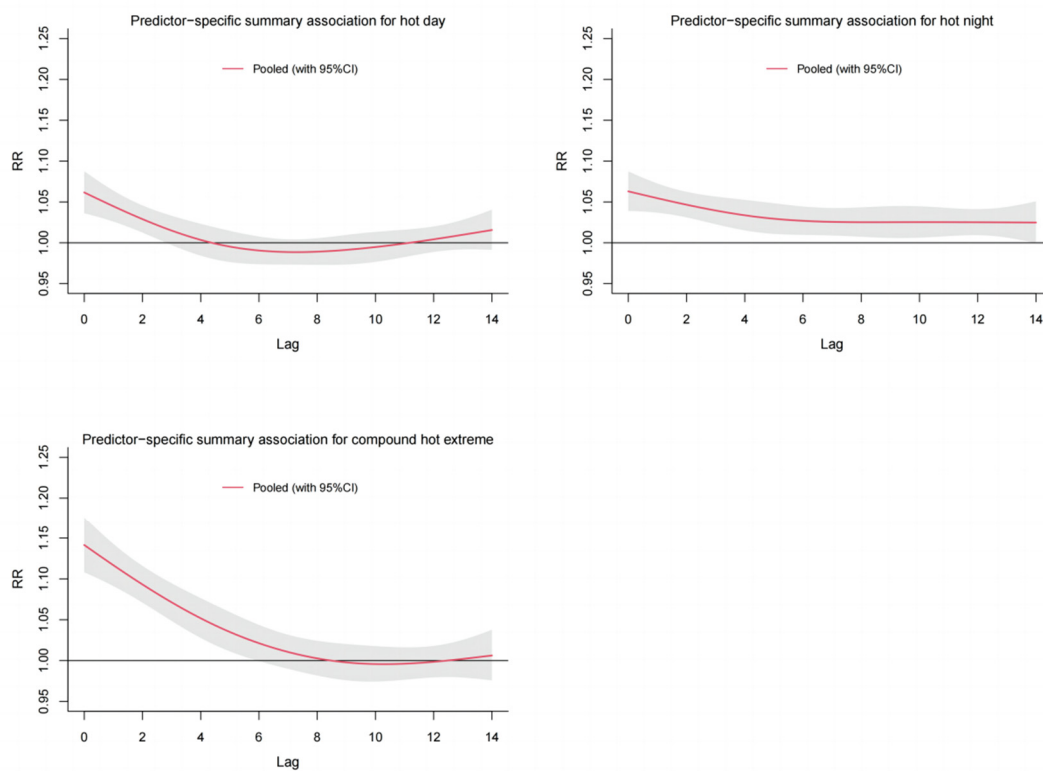


Figure S8. Overall lag structure in effects of hot extremes on daily mortality from accidental deaths in Shandong Province, 2013–2018.