

1 **Method**

2 Sensitivity analyses:

3 *Statistical Analysis* -DLNM model

4 To assess the robustness of the primary model, we used the Distributed Lag
5 Non-linear Model (DLNM) to identify non-linear and delayed effects of cold spells.
6 We applied a quasi-Poisson regression model combined with DLNM to determine the
7 influence of p1day2 cold spells. The lag–response curve was modeled with a natural
8 spline with 4 degrees of freedom (*df*) and 2 internal knots (plus an intercept) placed at
9 equally spaced values in the log scale. The model is given as follows:

$$\begin{aligned} \text{Log}[E(Yt)] = & \alpha + \beta \times cb(CS_t, lag) + ns(\text{Time}, 4 \times \text{year}) + ns(\text{Tmean}, 2) \\ & + ns(\text{RH}, 2) + \text{Holiday} + \text{DOW} \end{aligned}$$

10 where $E(Yt)$ represents the conditional expectation of the daily count of hospital
11 admissions for a specific outcome on day t in district i ; α is the intercept. CS_t is an
12 indicator for whether a day at the lag day from day t belongs to the cold spell or was a
13 day without cold spell; β is a vector of coefficients for CS_t , and lag is the lag days (lag
14 0–14 was used in this study); ns indicates the natural spline (ns) with the degree of
15 freedom consistent with the main model; $Holiday$ is an indicator variable for public
16 holidays, and DOW is an indicator variable for the day of the week. Relative risks (RR ,
17 95% CI) were calculated as follows:

$$RR_t = \exp(\beta_t)$$

18 A random-effects meta-analysis was applied to estimate the cumulative RR s by
19 pooling hospital admissions of genitourinary system diseases at the city level.

20

21 *Data Collection* - ECMWF

22 Meteorological data used for verification, including ambient temperature and relative
23 humidity, were sourced from the European Centre for Medium-Range Weather
24 Forecasts (ECMWF) ERA-Interim (www.ecmwf.int/en). The spatial resolution of this
25 data set was $0.1^\circ \times 0.1^\circ$, with daily temperature and relative humidity values
26 calculated from hourly readings. District-specific meteorological data were generated
27 by spatially averaging meteorological data across all grid cells within each of
28 Beijing's 16 districts.

Supplementary Table S1. Definition of cold spells

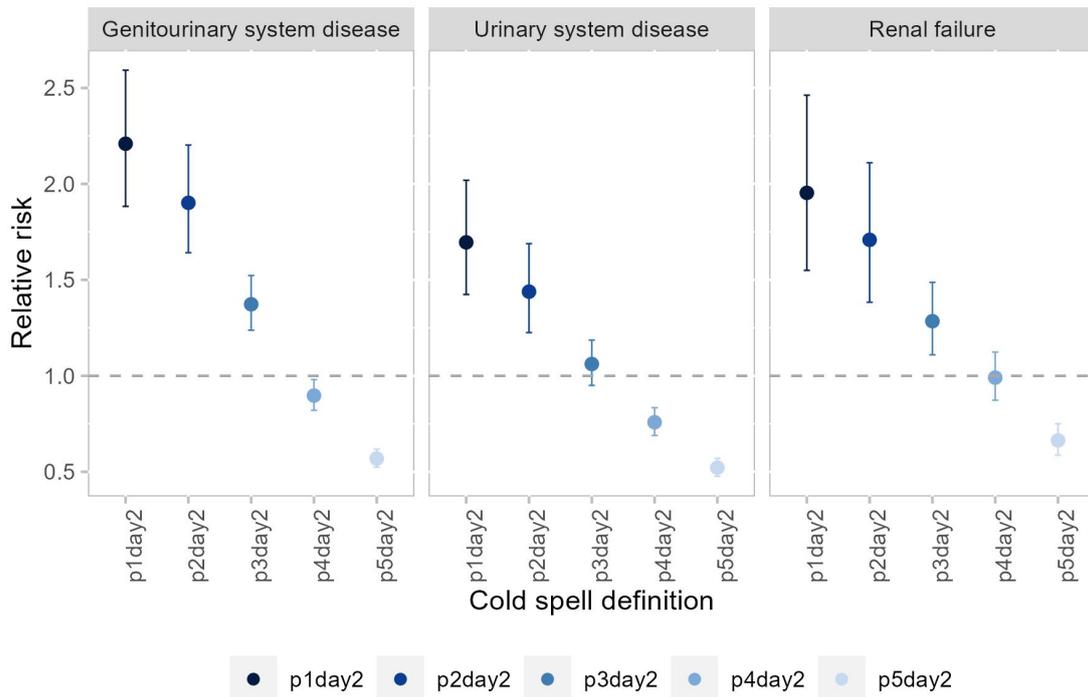
Definition	Threshold*	Number of days of duration
p1day2	P_1	≥ 2
p2day2	P_2	≥ 2
p3day2	P_3	≥ 2
p4day2	P_4	≥ 2
p5day2	P_5	≥ 2

Note. *Percentiles are based on average daily temperatures for the whole year 2013 to 2018.

Supplementary Table S2. Sensitivity analysis for the association between hospital admission for genitourinary system diseases and p1day2 cold spell exposure (lag10)

Model	RR (95% CI)	
Main model	Controlling ns (temperature, $df=2$) + ns (relative humidity, $df=2$) + ns (time, 4 $df/year$) + dow	1.43 (95% CI: 1.32, 1.56)
df of temperature = 3	Controlling ns (temperature, $df=3$) + ns (relative humidity, $df=2$) + ns (time, 4 $df/year$) + dow	1.75 (95% CI: 1.58, 1.95)
df of temperature = 4	Controlling ns (temperature, $df=4$) + ns (relative humidity, $df=2$) + ns (time, 4 $df/year$) + dow	1.76 (95% CI: 1.56, 1.98)
df of temperature = 5	Controlling ns (temperature, $df=5$) + ns (relative humidity, $df=2$) + ns (time, 4 $df/year$) + dow	1.65 (95% CI: 1.46, 1.87)
df of time = 3	Controlling ns (temperature, $df=2$) + ns (relative humidity, $df=2$) + ns (time, 3 $df/year$) + dow	1.45 (95% CI: 1.34, 1.57)
df of time = 5	Controlling ns (temperature, $df=2$) + ns (relative humidity, $df=2$) + ns (time, 5 $df/year$) + dow	1.51 (95% CI: 1.38, 1.64)
without relative humidity	Controlling ns (temperature, $df=2$) + ns (time, 4 $df/year$) + dow	1.44 (95% CI: 1.33, 1.56)
df of relative humidity = 3	Controlling ns (temperature, $df=2$) + ns (relative humidity, $df=3$) + ns (time, 4 $df/year$) + dow	1.43 (95% CI: 1.33, 1.56)
df of relative humidity = 4	Controlling ns (temperature, $df=2$) + ns (relative humidity, $df=4$) + ns (time, 4 $df/year$) + dow	1.44 (95% CI: 1.33, 1.56)
df of relative humidity = 5	Controlling ns (temperature, $df=2$) + ns (relative humidity, $df=5$) + ns (time, 4 $df/year$) + dow	1.44 (95% CI: 1.33, 1.56)
With PM _{2.5}	Controlling ns (temperature, $df=2$) + ns (relative humidity, $df=2$) + ns (time, 4 $df/year$) + PM _{2.5} + dow	1.43 (95% CI: 1.32, 1.55)

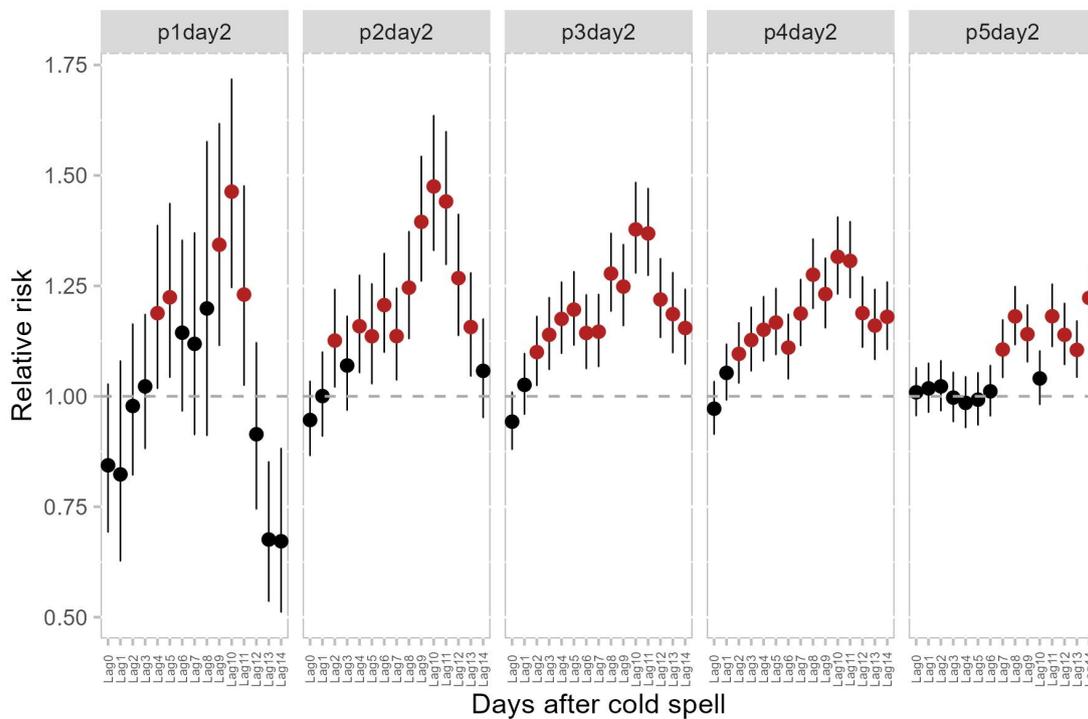
1



2

3 **Supplementary Figure S1.** Cumulative relative risks and 95% confidence intervals for three
4 cause-specific diseases associated with intensity-specific cold spells over 0-14 lag days.

5



6

7 **Supplementary Figure S2.** Relative risks and 95% confidence intervals for genitourinary system
8 diseases hospital admissions associated with intensity-specific cold spells on different lag days using
9 meteorological data from the European Centre for Medium-Range Weather Forecasts (ECMWF).