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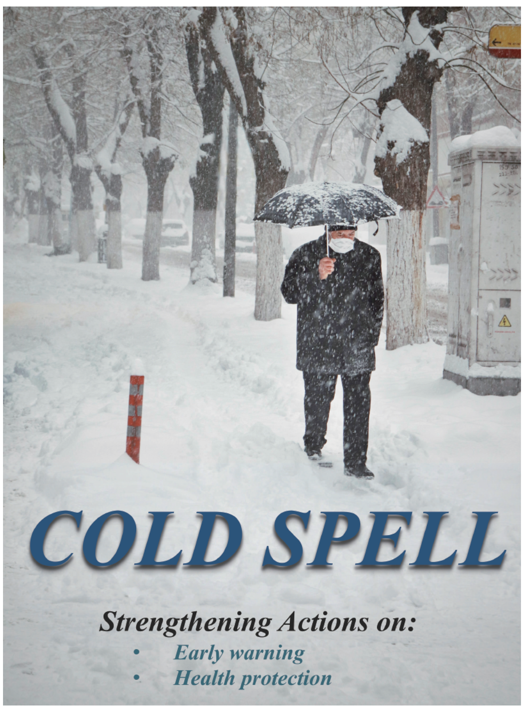


## COLD SPELL ISSUE



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Cover Photo: adapted from Pexels, https://www.pexels.com.
This week's issue was organized by Guest Editor Tiantian Li.

Preplanned Studies

# Acute Effects of Low Temperatures and Cold Waves on Elderly Infectious Pneumonia Mortality — Jinan City, Shandong Province, China, 2014–2022

Huiyun Chang[1,2]; Mingjun Li[1]; Ying Wang[1]; Liangliang Cui[1,#]; Tiantian Li[3]

**Summary**

**What is already known about this topic?**

The mortality rate due to pneumonia varies depending on the infectious agents present in a low- temperature environment.

**What is added by this report?**

This study aimed to examine the relationship between low temperatures and cold waves and the risk of mortality from infectious pneumonia in the elderly. The findings indicate a significant increase in the risk of infectious pneumonia, specifically bacterial pneumonia, during periods of low temperatures and cold waves.

**What are the implications for public health practice?**

This study presents compelling evidence that highlights the importance of proactive public responses to infectious pneumonia among the elderly population during periods of cold waves.

Infectious pneumonia is the leading cause of death among the elderly population (*1*–*2*). Previous studies have shown that low temperatures increase the risk of pneumonia-related deaths in the elderly (*3*). A study conducted in China (*4*) found that pneumonia patients have different demographic characteristics and varying risks of mortality related to infectious causes during non-optimal temperatures. However, there is a lack of research on the risk of elderly infectious pneumonia-related deaths during extremely low temperatures and cold waves. The National Health Commission of the People's Republic of China has reported an increase in elderly pneumonia cases since the winter of 2023 (*5*). Therefore, this study conducted a time-stratified case-crossover study in Jinan City to investigate the risk of mortality from infectious pneumonia in the elderly during the cold months from 2014 to 2022. Our findings showed an increased risk of mortality due to infectious pneumonia, particularly bacterial pneumonia, during low temperatures and cold waves, with a higher risk observed in males and rural populations. This highlights the need to prioritize public health interventions for infectious pneumonia-related deaths in the elderly during the cold season.

Death records of individuals aged 65 years and older who died from infectious pneumonia in China between 2014 and 2022 (November to March) were collected from the death registration system of the National Health Commission (NHC). The study extracted specific causes of infectious pneumonia based on the International Classification of Diseases, 10th revision (ICD-10) codes, including viral pneumonia (J10–J12), bacterial pneumonia (J13–J15), chlamydia pneumonia (J16), fungus pneumonia (J17), and other infectious pneumonia (J18). Additional data on the date of death, residential addresses, age, and gender were obtained. Information on daily minimum temperature, other air pollutants, and meteorological factors during the study period was also collected (Supplementary Material, available at https://weekly.chinacdc.cn).

The definition for low temperatures and cold waves can be found in the Supplementary Material. In our analysis, we conducted a three-stage process. First, we performed descriptive analysis on the collected data, using indicators such as minimum (Min), maximum (Max), median (M), first quartile ($P_{25}$), and third quartile ($P_{75}$). Second, we tested the Spearman correlation between air pollutants and meteorological factors. Third, we explored the relationship between low temperature and the risk of infectious pneumonia deaths using exposure-response relationship curves. To compare the differences in elderly infectious pneumonia deaths during low temperatures and cold waves with other days, we used *t*-tests after confirming normality and adherence to the normal distribution (*4*). We then conducted a time-stratified case-crossover study using a conditional logistic regression model to examine the association between infectious pneumonia deaths and low temperatures and cold waves. We also applied an exploratory analysis with an 8-day lag (Lag8) to estimate the pattern of pneumonia mortality in relation to lower temperatures and cold waves (*6*). The effect estimates were presented as odds ratios (*OR*s) with corresponding 95% confidence intervals (*CI*s). Furthermore, we investigated the specific causes of pneumonia (bacterial, viral, and other infectious pneumonia) and the vulnerability of sub-populations based on gender (male and female) and resident area type (urban and rural). Sensitivity analysis can be found in the Supplementary Materials. We performed the statistical analysis using R software (version 4.2.0; RStudio Inc; the USA). Statistical significance was considered at a *P*-value <0.05.

A total of 8,685 deaths due to infectious pneumonia occurred among elderly individuals from 2014 to 2022, with 4,284 (49.33%) of these deaths occurring during cold months. Table 1 provides details regarding the demographic characteristics of the deceased, as well as information on meteorological factors and air pollutants. Among the infectious pneumonia cases, 8.71% were caused by viral pneumonia, 23.74% were attributed to bacterial pneumonia, and 65.59% were classified as other types of infectious pneumonia. In terms of population composition, 54.27% were males and 75.84% lived in urban areas. The average daily minimum temperature was 1.10 ℃, ranging from −18.30 ℃ to 19.60 ℃. Temperature showed a negative association with pressure and a positive association with relative humidity, wind speed, $PM_{2.5}$, and $O_3$ (Supplementary Table S1, available at https://weekly.chinacdc.cn). A total of 47 episodes of cold wave events were observed during the study period, spanning 151 days and accounting for 9.93% of the total research period (Supplementary Table S2, available at https://weekly.chinacdc.cn).

Figure 1 illustrates exposure-response curves that depict the correlation between ambient temperature and pneumonia mortality. It shows an increased risk of

TABLE 1. Descriptive statistics of daily infectious pneumonia deaths in the elderly population, meteorological factors, and air pollutants in Jinan City from 2014 to 2022 (November to March).

| Variables | *n* (%) | Min | $P_{25}$ | M | $P_{75}$ | Max |
|---|---|---|---|---|---|---|
| Infectious pneumonia death counts | | | | | | |
| All pathogen | 4,284 (100.00) | 0 | 2 | 3 | 5 | 12 |
| Viral | 373 (8.71) | 0 | 0 | 0 | 0 | 4 |
| Bacterial | 1,017 (23.74) | 0 | 0 | 1 | 1 | 6 |
| Chlamydia | 7 (0.16) | 0 | 0 | 0 | 0 | 3 |
| Fungus | 77 (1.80) | 0 | 0 | 0 | 0 | 3 |
| Other infectious | 2,810 (65.59) | 0 | 1 | 2 | 3 | 11 |
| Death counts classified by gender | | | | | | |
| Male | 2,325 (54.27) | 0 | 1 | 2 | 3 | 8 |
| Female | 1,959 (45.73) | 0 | 0 | 1 | 2 | 8 |
| Death counts classified by area type | | | | | | |
| Urban | 3,249 (75.84) | 0 | 1 | 2 | 4 | 9 |
| Rural | 1,035 (24.16) | 0 | 0 | 1 | 1 | 6 |
| Meteorological factors | | | | | | |
| Min T. (℃) | 1,300 | −18.3 | -2.3 | 1.1 | 5.5 | 19.6 |
| Mean T. (℃) | 1,300 | −13.6 | 1.1 | 4.8 | 9.5 | 23.1 |
| WS (m/s) | 1,300 | 0.2 | 1.6 | 2.1 | 2.7 | 7.3 |
| RH (%) | 1,300 | 15 | 35 | 46 | 62 | 100 |
| Pressure (hPa) | 1,300 | 984 | 1,000 | 1,005 | 1,009 | 1,022 |
| Air pollution (μg/$m^3$) | | | | | | |
| $PM_{2.5}$ | 1,300 | 7 | 45 | 68 | 104 | 424 |
| $O_3$ | 1,300 | 5 | 46 | 63 | 87 | 243 |

Abbreviation: Min=minimum; $P_{25}$=first quartile; M=median; $P_{75}$=third quartile; Max=maximum; T.=temperature; WS=wind speed; RH=relative humidity; $PM_{2.5}$=fine particulate matter; $O_3$=ozone.

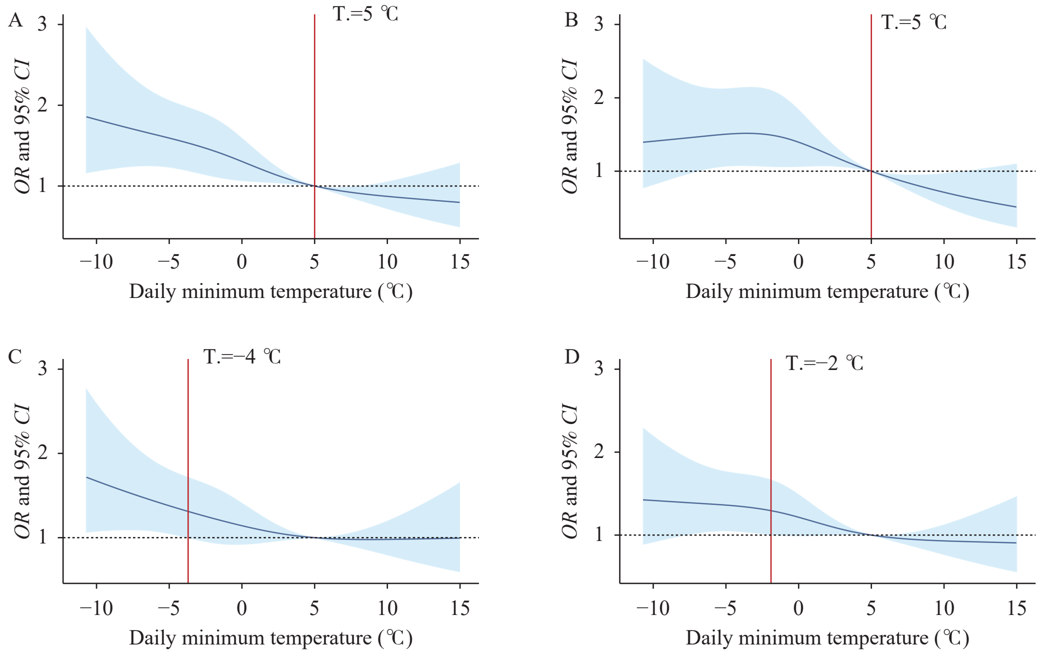


FIGURE 1. Exposure-response curves of daily minimum temperature in relation to infectious pneumonia in Jinan City from 2014 to 2022 (November to March). (A) All pathogen pneumonia; (B) Viral pneumonia; (C) Bacterial pneumonia; (D) Other infectious pneumonia.

Note: The blue solid lines represent the mean risk estimates, and the light blue areas represent their 95% *CI*s. The red vertical lines indicate the threshold temperatures (5 ℃, 5 ℃, −4 ℃, and −2 ℃) that showed the lowest statistically significant mortality risk.

Abbreviation: *OR*=odds ratio; *CI*=confidence interval; T.=temperature.

pneumonia mortality with decreasing temperature. Specifically, at the threshold temperature of 5 ℃, there is a significant increase in the risk of all pathogens and viral pneumonia. As the temperature declines to −2 ℃, there is a higher risk of other infectious pneumonia. Furthermore, at −4 ℃, the risk of bacterial pneumonia becomes statistically significant. The differences in elderly pneumonia deaths under different scenarios of low temperatures and cold waves are shown in Supplementary Table S3 (available at https://weekly.chinacdc.cn). The study found a higher risk of elderly infectious pneumonia deaths during low-temperature days and cold waves compared to other days.

Figure 2 shows the lag effects on mortality from infectious pneumonia in the elderly. There is a significant increase in the risk of mortality from all-pathogen pneumonia at Lag5 (*OR*=1.39, 95% *CI*: 1.04–1.87) and Lag5 (*OR*=1.67, 95% *CI:* 1.06–2.61) for temperatures of −7 ℃ and −10 ℃, respectively. Similarly, the risk of mortality from bacterial pneumonia follows the same pattern, with significant effects observed at Lag6 (*OR*=2.07, 95% *CI*: 1.17–3.37) and Lag6 (*OR*=2.53, 95% *CI*: 1.08–5.62) for temperatures of −7 ℃ and −10 ℃, respectively. The risk of mortality from other infectious pneumonia shows a significant effect at Lag4 (*OR*=1.48, 95% *CI*: 1.02–2.16) at −7 ℃. However, there was no significant effect observed for mortality from viral pneumonia.

Figure 3 presents the acute impacts of elderly pneumonia mortality under various demographic characteristics are presented. At −7 ℃, males showed a significant risk of mortality from Lag4 to Lag6, while elderly individuals living in urban areas experienced a significant risk from Lag5 to Lag6. At −10 ℃, there was an earlier and higher emerging pattern of lag effects for infectious pneumonia deaths observed in males (from Lag3 to Lag6), females (Lag2), urban elderly individuals (Lag6), and rural elderly individuals (Lag3 to Lag5). Sensitivity analysis of the effect on all pathogens, viruses, bacteria, and other infectious pneumonia among the elderly showed robust results (Supplementary Figure S1, available at https://weekly.chinacdc.cn).

## DISCUSSION

The study found that low temperatures and cold waves have a significant impact on the mortality rates of pneumonia caused by various pathogens in the

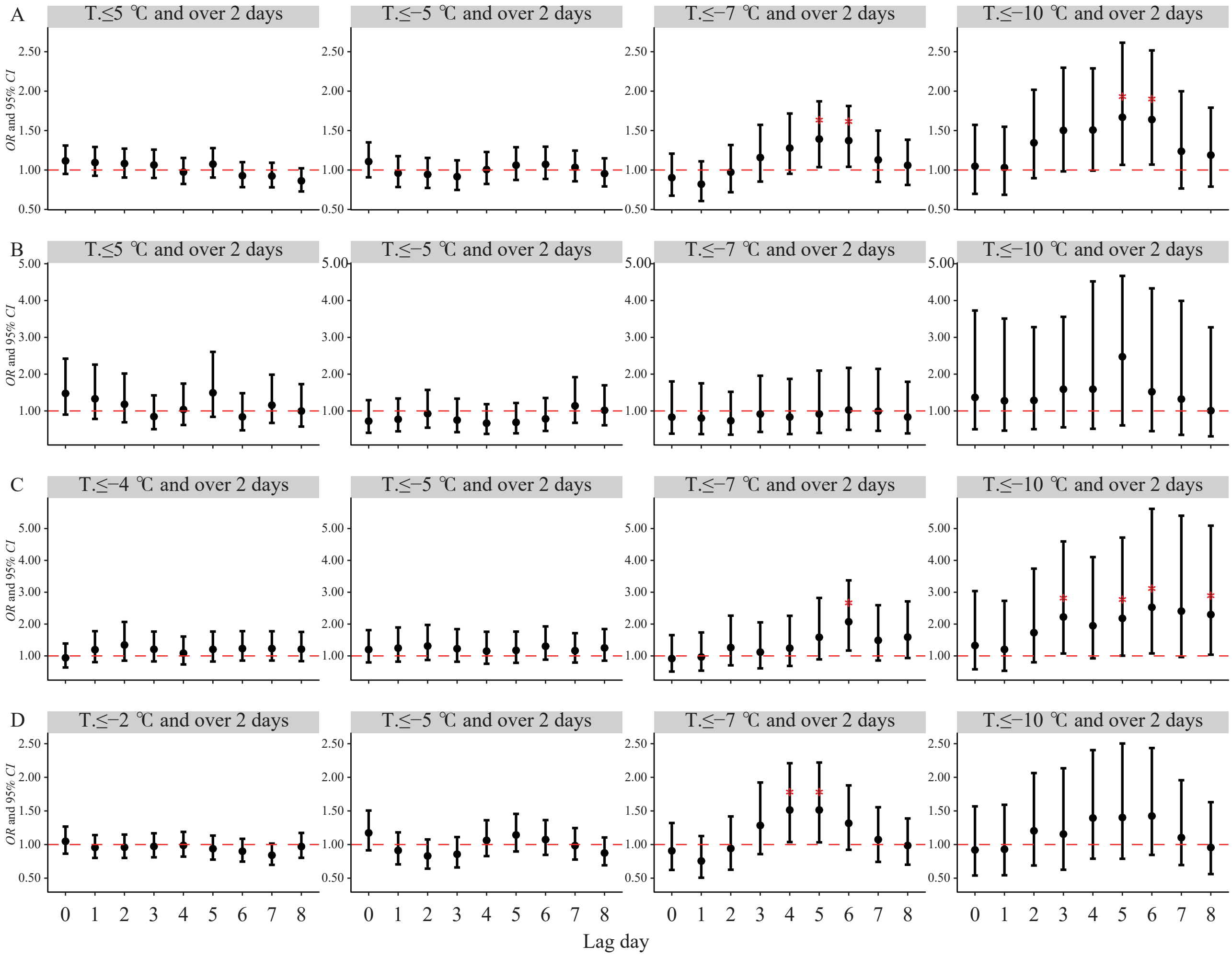


FIGURE 2. The lag effects of all pathogens, including viral, bacterial, and other infectious pneumonia deaths, on the elderly population under the scenario of low temperatures and cold waves in Jinan City from 2014 to 2022 (November to March). (A) All pathogen pneumonia; (B) Viral pneumonia; (C) Bacterial pneumonia; (D) Other infectious pneumonia.
Note: The red asterisk (*) indicates statistical significance.
Abbreviation: *OR*=odds ratio; *CI*=confidence interval; T.=temperature.

elderly population during cold months. The risk patterns of infectious pneumonia mortality in the elderly population in Jinan City varied depending on the specific pathogen, with increased severity observed during periods of low temperatures and cold waves. Furthermore, the study identified that males and individuals residing in rural areas were more vulnerable to mortality from infectious pneumonia in the elderly population.

In colder months, with temperatures dropping to 5 ℃, there is an increased risk of all-pathogen pneumonia. However, as the temperature continues to decrease, there is no threshold increase in the risk of elderly death from bacterial pneumonia. This finding is consistent with a nationwide study (*4*) and could be attributed to a negative correlation between ambient temperature and the incidence of bacterial infections (*7*). The National Disease Control and Prevention Administration has published the “Cold Wave Public Health Protection Guidelines”, emphasizing the vulnerability of the elderly during cold waves and the need for special attention (*8*). The higher risk of mortality from infectious pneumonia in elderly individuals residing in rural areas may be attributed to limited awareness of health risks, lack of heating facilities, and limited accessibility to medical resources (*9*).

Our study presents evidence that low temperatures and cold waves increase the mortality risk of infectious pneumonia among the elderly, with varying risks based on different status categories. However, there are several limitations to our study. First, we were unable

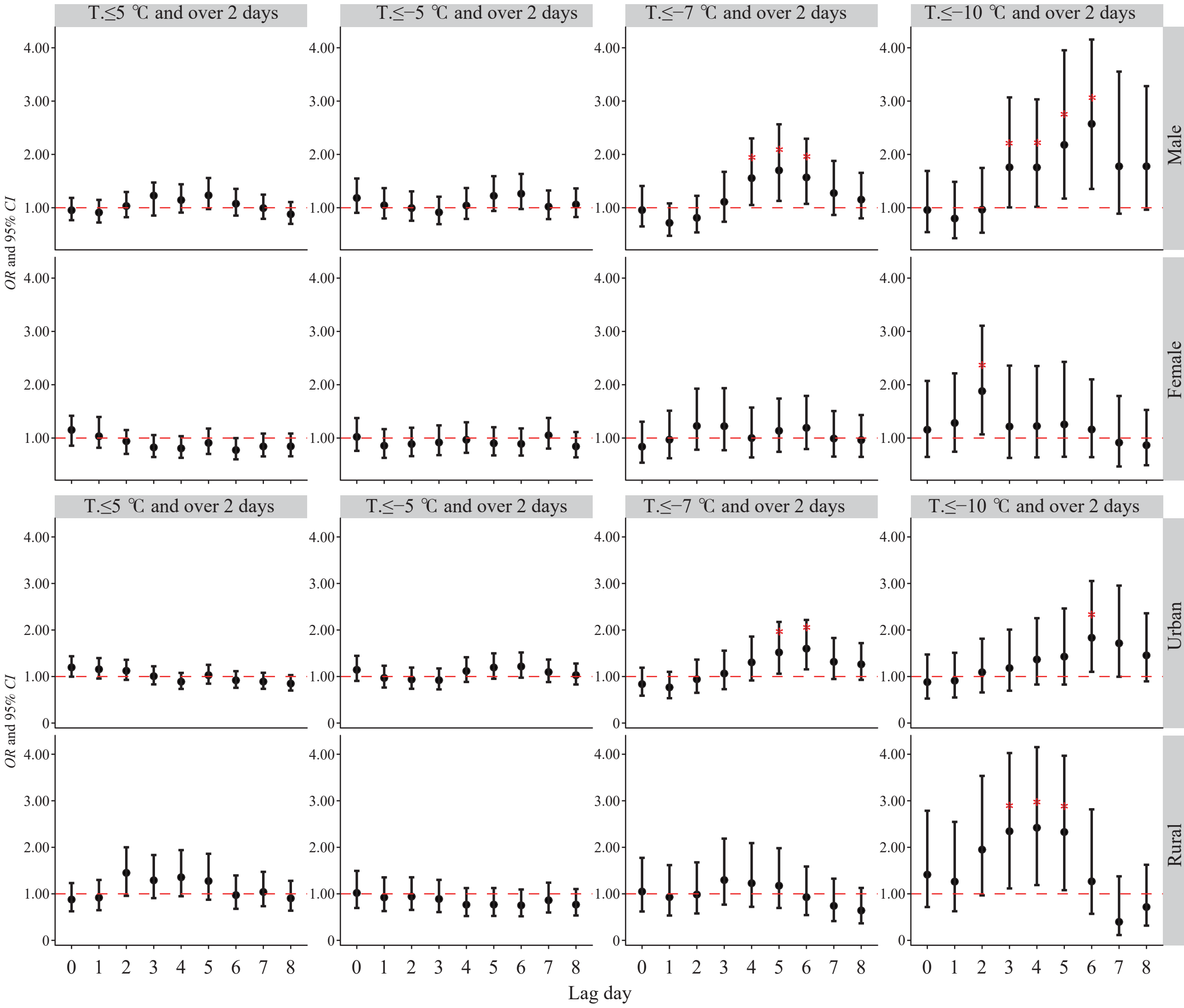


FIGURE 3. Subgroup analysis of the acute effects on mortality in the elderly population due to pneumonia during the period of low temperatures and cold waves in Jinan City from 2014 to 2022 (November to March).
Note: The red asterisk (*) indicates statistical significance.
Abbreviation: *OR*=odds ratio; *CI*=confidence interval; T.=temperature.

to obtain individual temperature exposure data as our study was conducted using a population-based case-crossover design. Second, due to the small sample size, we were unable to analyze pneumonia caused by chlamydia and fungus. Lastly, we grouped infectious pneumonia into three categories (bacterial, viral, and other) without further discussion on specific diseases. In summary, our study investigated the immediate impact of low temperatures and cold waves on the risk of mortality from infectious pneumonia in the elderly. Therefore, it is crucial to raise awareness among the elderly about infectious pneumonia and encourage pneumonia vaccination before the onset of colder months. Additionally, healthcare facilities should ensure sufficient resource reserves.

**Conflicts of interest**: No conflicts of interest.

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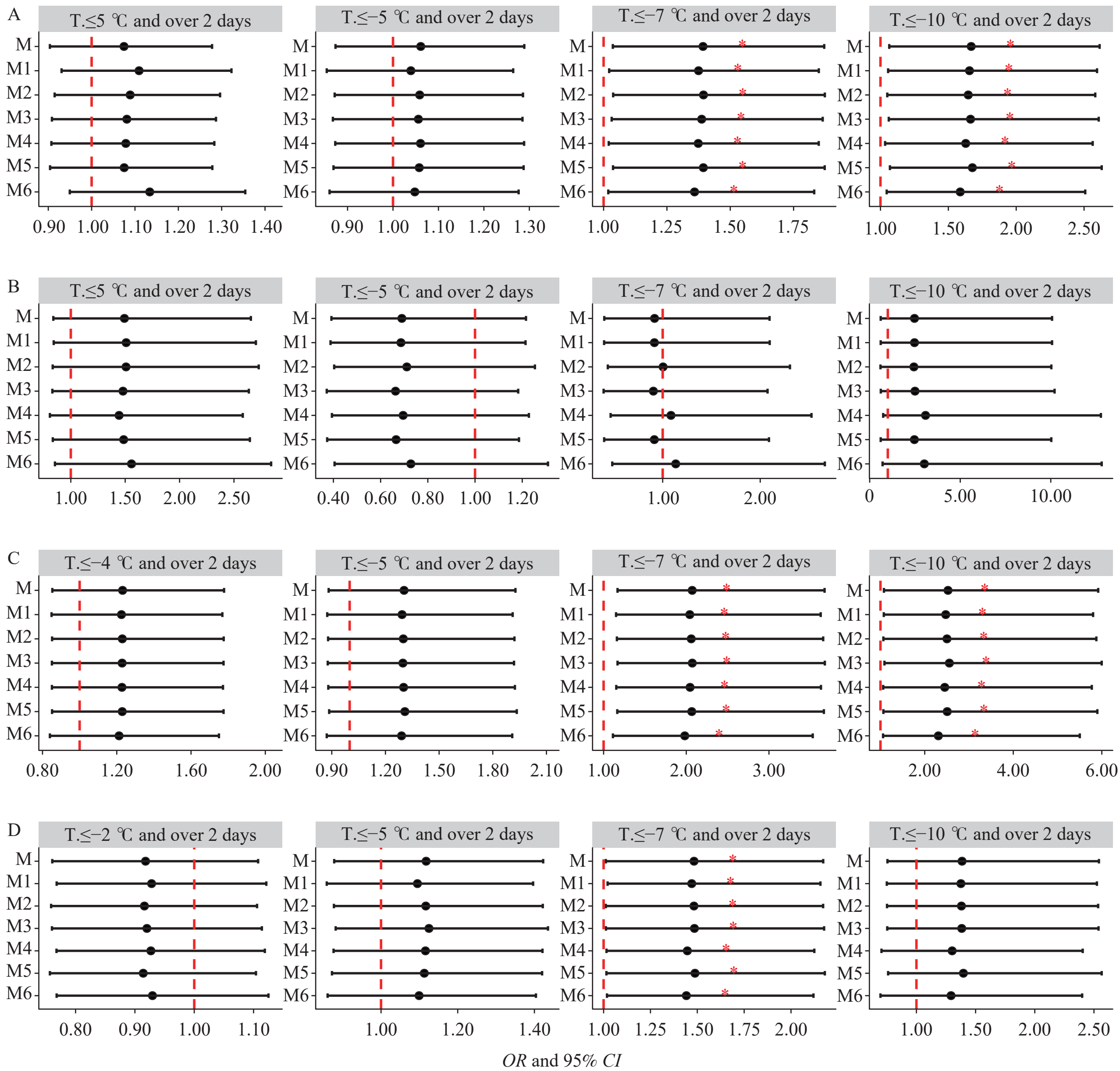
# SUPPLEMENTARY MATERIAL

## METHODS

### Data Collection

Daily measurements of fine particulate matter ($PM_{2.5}$) and 8-hour ozone ($O_3$-8h, referred to as $O_3$) levels were collected from the Jinan Ecological Environmental Protection Bureau (http://jnepb.jinan.gov.cn/). Meteorological data, including daily mean minimum temperature (℃), daily mean temperature (℃), relative humidity (%),




SUPPLEMENTARY FIGURE S1. Sensitivity analysis of the effect on elder pneumonia death for all pathogen, viral, bacterial and other infectious pneumonia in Jinan City from 2014 to 2022 (November to March). (A) All pathogen pneumonia; (B) Viral pneumonia; (C) Bacterial pneumonia; (D) Other infectious pneumonia.

Note: The red asterisk (*) indicates statistical significance; M for main model; M1 for adjustment of $PM_{2.5}$; M2 for adjustment of $O_3$; M3 for adjustment of daily mean temperature; M4 for adjustment of wind speed; M5 for adjustment of pressure; M6 for adjustment of $PM_{2.5}$, $O_3$, wind speed, daily mean temperature, and pressure.

Abbreviation: *OR*=odds ratio; *CI*=confidence interval; T.=temperature.

SUPPLEMENTARY TABLE S1. Spearman correlation coefficient ($r_s$ value) between meteorological factors and air pollutants in Jinan City from 2014 to 2022 (November to March).

| Variables | RH | Pressure | WS | $PM_{2.5}$ | $O_3$ |
|---|---|---|---|---|---|
| Min T. | 0.05* | −0.07* | 0.26* | 0.06* | 0.49* |
| RH | | −0.05* | −0.26* | 0.41* | −0.39* |
| Pressure | | | −0.28* | −0.12* | −0.41* |
| WS | | | | −0.26* | 0.41* |
| $PM_{2.5}$ | | | | | −0.30* |

Abbreviation: Min T.=minimum temperature; RH=relative humidity; WS=wind speed.
* Iindicates statistical significance.

SUPPLEMENTARY TABLE S2. The basic information of low temperature and cold wave definitions in Jinan City from 2014 to 2022 (November to March).

| Definitions | T. (℃) | Duration (d) | Frequency (times) | Days (d) |
|---|---|---|---|---|
| Low temperature* | ≤5 | ≥2 | 51 | 915 |
| | ≤−2 | ≥2 | 67 | 311 |
| | ≤−4 | ≥2 | 45 | 144 |
| Cold wave | ≤−5 | ≥2 | 29 | 97 |
| | ≤−7 | ≥2 | 14 | 41 |
| | ≤−10 | ≥2 | 4 | 13 |

Abbreviation: T.=temperature.
* Represents the threshold of significant low temperature for all pathogen, viral, bacterial and other infectious pneumonia, based on exposure-response relationship curve.

pressure (hPa), and wind speed (m/s), were obtained from the China Meteorological Data Service Centre (http://data.cma.gov.cn/).

## Definition of Low Temperatures and Cold Waves

Currently, there is no standard definition for low temperatures and cold waves in China. In this study, we used a combination of threshold temperature and duration to define low temperatures and cold waves. The study period was chosen as the cold season (November to March), and the daily minimum temperature during this period was used. Cold waves were defined as two or more consecutive days with daily minimum temperature equal to or below the 10th (−5 ℃), 5th (−7 ℃), and 1st (−10 ℃) percentiles (*1–2*). Threshold temperature was determined based on the exposure-response relationship between daily minimum temperature and pneumonia mortality, using statistically significant values. The duration used for the definition of low temperatures was consistent with the definition of cold waves.

## Study Design

We utilized a time-stratified case-crossover study design, combined with a conditional logistic regression model, to examine the association between pneumonia deaths caused by different infections from low temperatures and cold waves. The time-stratified case-crossover study design involves dividing the study period into time strata, with the case phase and control phase occurring within the same stratum. For instance, if a pneumonia death occurs on January 15, 2014 (a Wednesday), other Wednesdays in January 2014 would be selected as control days. Each event day was matched with 3 to 4 control days. To account for confounding factors, we included relative humidity (RH) and holidays as covariates in the regression model.

## Sensitivity Analyses

We performed multiple sensitivity analyses to evaluate the reliability of our primary results. We adjusted the primary model by incorporating specific air pollutants and additional meteorological factors individually, focusing on the periods when these factors had the greatest impact.

SUPPLEMENTARY TABLE S3. The daily average numbers of elder pneumonia death under different scenarios of low temperatures and cold waves in Jinan City from 2014 to 2022 (November to March) (mean±SD).

| Death counts | T.≤5 ℃ and ≥2 days | | T.≤−2 ℃ and ≥2 days | | T.≤−4 ℃ and ≥2 days | | T.≤−5 ℃ and ≥2 days | | T.≤−7 ℃ and ≥2 days | | T.≤−10 ℃ and ≥2 days | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** |
| Infectious pneumonia | | | | | | | | | | | | |
| All pathogen | 3.51±2.16* | 2.82±1.88 | 3.68±2.23* | 3.19±2.05 | 3.88±2.34* | 3.23±2.06 | 3.85±2.19* | 3.26±2.09 | 3.63±2.30* | 3.29±2.10 | 3.23±1.54 | 3.31±2.11 |
| Viral | 0.33±0.60 | 0.18±0.46 | 0.35±0.60 | 0.27±0.55 | 0.34±0.60* | 0.28±0.56 | 0.35±0.60 | 0.28±0.56 | 0.32±0.65* | 0.29±0.56 | 0.46±0.78* | 0.29±0.56 |
| Bacterial | 0.83±0.93* | 0.67±0.90 | 0.89±0.98* | 0.75±0.90 | 0.92±0.96 | 0.77±0.92 | 0.91±0.91 | 0.77±0.92 | 0.88±0.78* | 0.78±0.93 | 0.85±0.80* | 0.78±0.92 |
| Other infectious | 2.27±1.73* | 1.89±1.49 | 2.37±1.78* | 2.10±1.63 | 2.56±1.91* | 2.11±1.63 | 2.55±1.86* | 2.13±1.65 | 2.39±1.88* | 2.15±1.67 | 1.92±1.19 | 2.16±1.68 |
| Gender | | | | | | | | | | | | |
| Male | 1.89±1.47* | 1.57±1.35 | 2.05±1.56* | 1.72±1.39 | 2.16±1.63* | 1.75±1.41 | 2.15±1.52* | 1.77±1.43 | 2.17±1.51* | 1.78±1.44 | 1.92±1.26* | 1.79±1.44 |
| Female | 1.62±1.41* | 1.25±1.18 | 1.64±1.43 | 1.47±1.33 | 1.72±1.49 | 1.48±1.34 | 1.69±1.51 | 1.50±1.34 | 1.46±1.52 | 1.51±1.35 | 1.31±1.80 | 1.51±1.35* |
| Residential area | | | | | | | | | | | | |
| Urban | 2.64±1.77* | 2.18±1.64 | 2.74±1.86 | 2.43±1.70 | 2.89±1.97 | 2.46±1.71 | 2.91±1.98* | 2.47±1.72 | 2.80±2.17* | 2.50±1.73 | 2.15±1.41 | 2.51±1.75* |
| Rural | 0.87±0.98* | 0.63±0.82 | 0.94±0.98 | 0.75±0.93 | 0.99±1.03 | 0.77±0.93 | 0.94±0.99 | 0.79±0.94 | 0.83±1.02* | 0.80±0.94 | 1.08±1.19* | 0.80±0.94 |

Abbreviation: T.=temperature.

* Represents that the daily number of deaths in the group is significantly higher than in the other group.

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Review

# Community-Level Practice Checklists for Health Protection During Cold Spells in China

Jing Shang[1]; Mengzhen Zhao[2]; Zhao Liu[3]; Xiya Zhang[1]; Shiguang Miao[1,#]; Ishaq D. Sulaymon[5,6]; Wenjia Cai[4,#]

## ABSTRACT

Communities play a crucial role in protecting the health of vulnerable populations such as the elderly, low-income groups, and high-risk individuals during cold spells. However, current strategies for responding to cold spells primarily consist of programmatic policies that lack practicality, specificity, and detailed implementation guidelines for community workers. Therefore, this study aims to identify and analyze the challenges faced by communities in responding to cold spells, review international experiences, and develop a set of practical checklists for community-level health protection. These checklists will assist community workers and volunteers in effectively preparing for, responding to, and recovering from cold spells.

## DIFFICULTIES AND CHALLENGES IN COMMUNITY RESPONSE TO COLD SPELLS EMERGENCIES

A significant decrease in temperature can elicit a physiological stress response in the human body, which poses risks to vulnerable populations in communities. According to the Global Burden of Disease Study 2019, an estimated 580.8 [95% uncertainty intervals (UI): 485.7, 690.1] thousand deaths in China were attributed to cold temperatures (*1*). In response to this, the China Meteorological Administration issued a national emergency plan for meteorological disasters in 2010. The plan outlined the primary responsibilities of various departments during cold spells. The civil affairs departments were tasked with implementing cold relief measures, opening cold shelters, and implementing emergency cold protection measures, specifically targeting poor households and homeless individuals. Since the residents' committees (villagers' committees) have the responsibility for executing specific tasks at the grassroots level, community-level cooperation is often necessary for the successful completion of these tasks (*2*–*3*).

Chinese communities have taken steps to address the health risks associated with cold spells, such as having designated personnel responsible for weather forecasting and early warning dissemination, as well as maintaining lists of vulnerable individuals. However, there are still challenges in fully utilizing the community's potential in responding to cold spells. The lack of practice checklists for health protection at the community level and a lack of recognition and supportive regulations hinder communities' ability to cope with these emergencies. Additionally, some residents and villagers do not support or understand the work of community workers, and there is insufficient funding and timely replenishment of emergency supplies. Moreover, low salaries and limited career opportunities for community workers lead to talent shortages, high turnover rates, and a lack of manpower resources for cold spell emergencies. These factors negatively impact the motivation and proactive approach of community workers.

## INTERNATIONAL EXPERIENCES IN COMMUNITY RESPONSE TO COLD SPELLS

In Europe and the United States of America (USA), there is significant attention given to the emergency response for cold spells (*4*–*6*). Organizations like the Red Cross and Red Crescent Societies, as well as various cities in the USA, Canada, and the United Kingdom (UK), have established community-level plans and guidelines for addressing cold spells (*7*). Currently, the primary focus of community-scale response in these regions is on assisting displaced individuals or those experiencing homelessness by providing warming shelters (*8*). Local official websites also disseminate information on the location and operating hours of these shelters, along with emergency contact numbers such as medical helplines. In the UK, the Health Security Agency not only concentrates on actions during cold spells, but also implements measures throughout the year to support vulnerable individuals in England who sleep rough (*9*). The UK government provides strategies to prevent cold-related incidents, including the use of risk registers and identification of at-risk groups. They also prioritize improving access to quality healthcare and enhancing supervision of services and amenities in public warming shelters. During cold spells, the emphasis is on general guidance for staying warm, promoting flu vaccinations, and conducting screenings for diseases such as tuberculosis and blood-borne viruses in warming shelters. Health response teams should prioritize providing prompt medical assistance and helping individuals affected by carbon monoxide poisoning. To address the shortage of personnel, the public can register as volunteers for warming shelters through online platforms.

## PREVENTIVE MEASURES AND PREPAREDNESS FOR COLD SPELLS

### Increasing Awareness of Health Risks During Cold Spells

Communities can enhance public awareness of the health risks associated with cold spells by organizing informative activities and displaying educational boards. These initiatives are designed to educate residents about the heightened risks of respiratory, cardiovascular, and cerebrovascular diseases resulting from cold spells and abrupt temperature fluctuations.

### Identification and Support for Vulnerable Individuals

Communities should regularly update their list of priority populations to include the elderly and individuals with cardiovascular, cerebrovascular, and respiratory conditions. These populations are particularly vulnerable to health risks during cold spells. It is recommended to proactively conduct follow-up visits with these individuals prior to the occurrence of cold spells in order to understand their needs and provide timely assistance. Additionally, communities should be attentive to the challenges faced by families who struggle to obtain cold relief supplies. Efforts should be made to purchase and distribute these items to support those in need.

### Development of A Contingency Plan for Cold Spells

The cold spell contingency plan should include various crucial components. These components comprise early warning communication channels, a comprehensive list of emergency teams with clearly defined roles and responsibilities, contact information of key units, the locations of emergency shelters, and the implementation of emergency measures. The emergency response team will consist of a meteorological disaster supervisor, community staff members, and volunteers. Communities should also actively establish suitable channels to distribute meteorological early warning information to different population groups in advance. Moreover, communities should organize and regularly update a directory of essential contacts, including community hospitals, fire departments, local rescue agencies, community police officers, property management teams, and key institutions such as schools and hospitals.

### Inspection of Warming Shelters and Emergency Relief Supplies

Local authorities and communities have a responsibility to ensure the availability of safe public spaces for individuals seeking refuge from cold temperatures and to prevent cold-related illnesses. Prior to the onset of cold weather, it is crucial to perform comprehensive inspections and maintenance of warming shelters. Moreover, communities, property management centers, and emergency shelters should be adequately equipped with essential emergency relief supplies, such as snow removal tools, ice melters, anti-slip materials, straw mats, sandbags, industrial salt, shovels, tents, quilts, and blankets.

### Safety Inspections and Anti-Freeze Measures in Public Areas

Communities and property management centers should conduct inspections and enhancements of anti-freezing measures for fire pipelines, public area pipelines, and water supply pipelines to ensure uninterrupted domestic water supply during cold weather conditions. In the event of heavy snowfall during these times, safety checks should be carried out in public places such as elderly care centers, cultural halls, activity rooms for the elderly, construction sites, farmers' markets, religious sites, gyms, and areas susceptible to geological disasters. These safety checks are essential in preventing accidents such as collapses due to the accumulation of snow.

### Establishing A Supplies Delivery Network

Cold spells or blizzards can potentially result in road blockages, making it imperative to establish a pre-existing material delivery network. This network will ensure the prompt provision of essential daily necessities and emergency supplies, with special attention given to vulnerable populations.

## COMMUNITY EMERGENCY RESPONSE DURING COLD SPELLS WARNINGS

### Widespread Dissemination of Cold Spell Warnings

During cold spell warnings, it is essential for community workers to actively monitor weather changes and promptly communicate warning information through various channels. Effective strategies include updating public screens, displaying signs at entrances and exits of residential areas and prominent locations in buildings. In rural areas, village loudspeakers can be utilized to broadcast cold spell warnings. Additionally, online platforms such as WeChat groups, WeChat moments, official accounts, Weibo, and other social media platforms can be leveraged to effectively disseminate early warnings.

### Opening Public Warming Shelters

Communities should establish warming shelters and designate specific public places, such as libraries, shopping malls, restaurants, and hotels, as “warming centers” to provide warmth and protection for individuals who are in need. It is important to direct community members to these locations, where they can seek refuge from the cold. Special attention should be given to prioritizing vulnerable groups within the community, such as homeless individuals, beggars, and those experiencing economic hardship.

### Special Assistance for Vulnerable Groups

Communities should organize visits to specific households, such as “shidu” families (families who have lost their only child), elderly individuals living alone, families with serious illnesses, and residents in need (*10*). The purpose of these visits is to assess their living conditions, identify their needs and challenges, and provide necessary assistance and measures to prevent freezing. Moreover, they should be advised to take precautions against cold weather and limit unnecessary outdoor activities.

### Evacuation of Affected Individuals

In the event of house collapses and road obstructions caused by cold spells and blizzards, it is recommended that communities promptly contact local rescue agencies for assistance. These agencies should be responsible for transferring affected individuals and those facing difficulties to emergency shelters. It is crucial to ensure a consistent supply of food and drinking water in the shelters, maintain order, and provide support to calm the affected individuals.

### Ensuring Safety Measures in Place

Communities and property management centers should conduct regular inspections in order to identify and address potential hazards in their areas. This includes addressing issues such as heavy snow accumulation on roofs and icy roads. In areas with high risk, communities should utilize salt to melt snow and ice, along with laying down grass mats to prevent slips and falls. Additionally, warning signs should be strategically placed in areas with dangerous icy slopes to ensure residents are alerted to the potential dangers.

### Timely Reporting of Disaster Situations

In the event of major disasters caused by cold spells and heavy snowfall, it is essential for communities to collect meteorological disaster information promptly, maintain comprehensive records, and report the situation to the local health department, meteorological authorities, and other relevant government agencies. Timely reporting ensures that all stakeholders are informed about the disaster’s extent and enables them to take appropriate actions to mitigate its impact on public health and safety.

## DISASTER RECOVERY

### Gathering Disaster Statistics

Following the occurrence of cold spells, it is crucial for communities to conduct a comprehensive disaster assessment to evaluate the extent of damage and identify the specific needs of residents. Thorough field investigations and documentation of findings can reveal any deficiencies in current prevention and response measures.

### Focusing on the Needs of Vulnerable Populations After Disasters

Cold spells can have a significant and long-lasting impact on the health of high-risk populations, with effects lasting up to 27 days (*11*). Therefore, it is imperative for communities to actively follow up and monitor the health status of vulnerable individuals, particularly those with cardiovascular, cerebrovascular, and respiratory diseases. This proactive approach is essential to safeguard their well-being and promptly address any potential health issues that may arise following a cold spell.

### Resuming Normalcy in Residents' Lives after Disasters

Communities should mobilize personnel to remove snow and ice after cold spells, conduct safety inspections on water, electricity, gas, and traffic within the community, and expedite the restoration of normalcy in residents' lives.

### Preventing Secondary Disasters from Occurring

There is a possibility of severe freezing or frost phenomena occurring after cold spells, which can pose risks to fisheries, transportation, forestry, and agriculture. Therefore, it is necessary to mobilize personnel to carry out targeted inspections in order to prevent the occurrence of secondary disasters.

## MOBILIZE VOLUNTEERS TO PARTICIPATE IN COLD SPELLS EMERGEMNCY WORK

Communities can leverage volunteer teams to help alleviate the workload of community staff during cold weather emergencies. Volunteers play a crucial role by offering personalized support to vulnerable populations, promoting awareness about the health risks associated with cold spells, sharing cold weather warnings, and inspecting potentially hazardous areas within the community. Furthermore, volunteer teams with expertise in public health response or affiliated with organizations like the Red Cross can be mobilized to assist in cold weather relief efforts. These teams can provide vital medical services including emergency vaccinations, treatment for carbon monoxide poisoning incidents, and medical support in cold shelters (*12*).

## CONCLUSIONS

This study has presented community-level practice checklists for health protection during cold spells in China as shown in Table 1. However, it is important to consider that each community has its own unique climate, population vulnerability level, and economic situation. Therefore, there is no universal advice that can be universally applied to all communities. The checklists should be customized based on each community's specific service scope, available resources, and local context. In rural areas, the presence of a significant elderly population and the need to prioritize agricultural production present additional challenges in dealing with cold waves. Active cooperation between communities and agricultural departments is crucial for effectively managing the impacts of cold spells.

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TABLE 1. The community-level practice checklists for health protection during cold spells.

| Disaster stage | Practice checklist |
|---|---|
| Preventive measures and preparedness | 1. Increasing awareness of health risks during cold spells.<br>2. Identification and support for vulnerable individuals.<br>3. Development of a contingency plan for cold spells.<br>4. Inspection of warming shelters and emergency relief supplies.<br>5. Safety inspections and anti-freeze measures in public areas.<br>6. Establishing a supplies delivery network. |
| Community emergency response | 1. Widespread dissemination of cold spell warnings.<br>2. Opening public warming shelters.<br>3. Special assistance for vulnerable groups.<br>4. Evacuation for affected individuals.<br>5. Ensuring safety measures in place.<br>6. Timely reporting of disaster situations. |
| Disaster recovery | 1. Gathering disaster statistics.<br>2. Focusing on the needs of vulnerable populations after disasters.<br>3. Resuming normalcy in residents' lives after disasters.<br>4. Preventing secondary disasters from occurring. |

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Recollection

# A Brief of Cold Spell Warning Actions of the National Meteorological Center of China Meteorological Administration

Taiyuan Zhang[1]; Mengxue Zhang[2]; Qiutong Li[2]; Yu Lan[3,#]

The "Outline for High-Quality Development of Meteorology (2022–2035)" was published by the State Council of the People's Republic of China in April 2022 (*1*). This publication highlights the essential role of meteorological disaster warnings, particularly cold spell warnings, in preventing and mitigating disasters. The outline also sets forth stricter expectations for enhancing the overall capacity of society in terms of meteorological disaster preparedness and response.

The characteristics of a cold spell are characterized by significant drops in temperature and a wide-ranging impact that can lead to serious disasters (*2–3*). Cold spells may be accompanied by or trigger intense cooling, gales, rain, snow, ice, etc. These events not only result in considerable losses in the national economy, particularly in agriculture, forestry, and animal husbandry production, but also pose significant impacts and hazards to the lives and health of the public.

The history of meteorological disaster warning actions in China can be traced back to 1951 when the China Meteorological Administration (CMA) first began implementing such actions. However, it was in June 2007 that the well-known modern meteorological disaster warning system was established through the issuance of the "Measures for the Issuance and Dissemination of Meteorological Disaster Warning Signals" (*4*), which regulated the issuance and dissemination of warning signals for 13 types of meteorological disasters by meteorological departments at all levels. In the same year, the National Meteorological Center established the mechanism for issuing weather warnings for meteorological disasters, including cold spell warnings. The latest version of the "Measures for Issuance of Meteorological Disaster Early Warnings of the National Meteorological Center" (*5*) was revised and issued by the CMA in March 2023. This updated version optimizes the types of disaster warnings, expanding it to 14 categories, improves the warning responsibilities authorized by the CMA, and implements normalized actional standards for cold spell warnings. Additionally, it provides national-level defense guidelines for meteorological disasters.

## EXPERIENCES AND ACHIEVEMENTS

### Technical Research And Development

Building upon the advanced integrated three-dimensional meteorological observation system encompassing land, sea, air, and space, and grounded in a firm understanding of meteorological principles and the dynamics of standard weather models, meteorological agencies have honed forecasting and warning services for cold spells over many decades (*6–7*). The advent of increased automation and the perpetual evolution of technologies, such as numerical modeling and AI, have revolutionized cold spell warnings, transitioning from manual observations and synoptic chart analysis to automated data acquisition and sophisticated numerical weather prediction techniques. Consequently, scientific and technological advancements have become the cornerstone for enhancing the precision of forecasting and warning systems for cold spells and other extreme weather events.

### Service Actions

**Analysis and prediction of weather forecasts.** The National Meteorological Center diligently monitors, analyzes, and predicts cold spells in advance, specifically focusing on the movement of cold air and examining the underlying atmospheric circulation patterns and their future changes. This enables forecasts of cold spells with an extended lead time of more than 10 days.

Meteorological forecasters use a comprehensive analysis of integrated data from ground, air, and satellite observations, as well as numerical models, to predict the cold spell's timing, intensity variations, and affected areas. They also assess whether future weather conditions such as low temperatures, rain, and snow will meet the criteria for issuing cold spell warnings. Additionally, forecasters evaluate the potential economic and social impacts and risks associated with the cold spell. (*8*)

**Expert consultation for joint decision-making.** As the forecast time approaches, the predictability and accuracy of cold spell disaster weather forecasting also improve. Prior to the official release of a cold spell warning (usually more than three days in advance), the National Meteorological Center (NMC) convenes experts from provincial meteorological departments for a daily morning national consultation. During this session, the experts study the upcoming cold spell process and collectively decide on the subsequent progressive warnings and follow-up service strategies.

**Disaster warning production and dissemination.** In accordance with the Measures for Issuance and Dissemination of Meteorological Disaster Warnings of the National Meteorological Center, cold spell warnings are typically issued by the NMC 24 hours in advance. These warnings undergo review, issuance, and rechecking by the relevant departments. Additionally, the CMA collaborates with other relevant departments to establish an early warning information release mechanism for emergencies, ensuring the timely dissemination of information to the public. The issued warning information is continuously monitored and evaluated throughout the cold spell and will be updated or lifted as appropriate based on the actual situation.

The NMC classifies the cold spell early warning standard into three grades (blue, yellow, and orange), which align with the national standard for cold spell intensity levels (cold spell, extreme cold spell, and super cold spell). However, the specific details of provincial cold spell warnings may vary, such as the warning level, issuing standards, and regional coverage. The NMC issues a national-level warning that applies to the entire country and is required when a cold spell impacts more than four provincial-level administrative divisions (PLADs). On the other hand, PLAD's Meteorological Bureau issues warnings based on the specific conditions and service requirements of each PLAD. The release standards may vary to account for the PLAD's unique climatic characteristics and disaster prevention needs. Some PLADs still maintain four cold spell warning levels (blue, yellow, orange, and red). Despite the differences in warning levels and methods, the primary objective remains the same — to inform the public in advance and enable them to take precautionary measures to minimize the impact of cold spells.

**Intersectoral Joint Emergency Response.** Given the potentially severe impacts of cold spell events, meteorological agencies, in conjunction with emergency management departments, are diligently enhancing the integration of meteorological warning systems and emergency response activation criteria. Additionally, meteorological departments and government bodies at various levels are collaboratively developing and refining a suite of mechanisms, including rapid decision-making and dispatch, sector-specific emergency responses, and public engagement strategies. With meteorological forecasts serving as a vanguard, these initiatives aim to advance disaster prevention and reduction efforts, thereby significantly improving our overall capacity to defend against and manage meteorological disasters with precision and effectiveness.

**Follow-up assessment and services.** Meteorological departments establish and enhance comprehensive review systems to address cold spells and other weather-related disasters. This system encompasses meteorological forecast and warning technology service inspection, standardized assessment of the warning information release process, and evaluation of disaster reduction efforts and socio-economic benefits. The insights gained from these reviews directly contribute to the enhancement of weather warning services and associated operational systems. Simultaneously, meteorological departments prioritize the improvement of public awareness regarding meteorological warnings. This involves strengthening education and trainings for emergency response personnel and refining the mechanism for disseminating meteorological warnings.

## Overall Situation

**Early warning business layouts have been gradually improved.** National and provincial levels have established early warning actions focused on meteorological disasters, including early warnings and warning signals. Furthermore, a "progressive forecasting, progressive warning, and follow-up services" system has been developed, allowing for extended-release of outlooks for critical weather processes, forecasts for critical weather processes within 3–7 days, and information on disaster weather warnings and decision-making services 1–2 days in advance. Additionally, short-range prediction products and warning signals are released in a timely manner, achieving the desired effect of early notification and early warning.

**Increasing public coverage of early warning information.** The China Meteorological Administration has coordinated the establishment of a national platform for releasing early warning information on emergencies. Initially, a service system called "one vertical and four horizontal" has been formed to facilitate the real-time sharing of platforms and information between meteorological departments at various levels and warning issuing agencies and government emergency management departments. Currently, early warning information, including cold spell warnings, can be released in real time through multiple channels such as radio, television, and the Internet. As of 2021, the public coverage rate has reached 96.9%.

**Establishment of the emergency response mechanism.** These mechanisms have been crucial in dealing with meteorological disasters. Local meteorological departments have been actively advocating for the establishment and enhancement of meteorological early warning and emergency response linkage mechanisms among local governments and relevant departments. Currently, a total of 25 PLADs have the capability to make informed decisions regarding the initiation of an emergency response based on meteorological disaster warnings. Additionally, 26 PLADs have developed specific standards for implementing measures such as school closures or business suspensions to different extents. Some PLADs have even implemented rapid emergency response linkage mechanisms that automatically trigger school closures once a defined level of warning is reached.

## CHALLENGES

The cold spell weather will have significant and extensive impacts on both the general public and industries. China's economy and society are currently in a phase of high-quality development. With the increasing sensitivity of the social system to meteorological impacts, there is a growing demand for accurate forecasting and effective prevention of major risks, including meteorological disasters (*9–10*).

While China has developed a relatively comprehensive operational system for predicting and issuing early warnings for cold spells, there are still several challenges ahead in achieving high-quality development. Improving forecast accuracy involves strengthening the ability to provide more precise forecasts for the intensity, region, and impact of extreme strong cold spells and super cold spells. Enhancing service quality and efficiency requires continuous innovation and exploration of the "soft power" of modern meteorological early warning capabilities. The social benefits of cold spell forecasting and early warning, particularly their impacts on human health, need further exploration. Additionally, there is a need to address the lack of unified emergency response coordination between meteorological departments and local government departments at all levels. To achieve this, there is a need for an improved, legally binding, multi-departmental emergency response mechanism led by cold spell early warning.

## PROSPECTS

### Continuously Improving the Accuracy of Cold Spell Disaster Weather Prediction Models

Enhancing the accuracy and timeliness of cold spell forecasting is crucial for effectively preventing and mitigating meteorological disasters, as well as ensuring the safety and security of individuals and their properties. In order to achieve this, it is essential to continuously improve the forecasting capability of cold spell disaster weather. Given the current information revolution, there is a need to enhance the application of intelligent and digital technologies, deepen our understanding of the mechanisms and patterns of cold spell weather, and strengthen our ability to forecast such weather accurately. This will serve as the foundation for establishing a robust first line of defense against meteorological disasters.

### Continuously Maximizing the Effectiveness of Cold Spell Forecasting and Alert Systems

It is important to recognize the advantages of cold spell forecasting and warning in various sectors such as agriculture, transportation, energy, and high-risk groups. To cater to the specific needs of these sectors and groups, it is crucial to enhance collaboration between industries and social sectors. This includes conducting objective and quantitative risk assessment and zoning for the potential impacts of cold spells. Furthermore, targeted risk forecasting and service strategies should be researched and implemented to fully utilize the benefits of meteorology in preventing harm.

## Continuously Improving the Timeliness and Efficacy of Government-Led Disaster Prevention and Response Mechanisms

Efforts must be made to enhance the effectiveness of the early warning system and strengthen government-led disaster prevention and mitigation mechanisms. Meteorological agencies and governmental bodies at all levels should strive to enhance the emergency management system, taking a proactive role in guiding and coordinating efforts. By prioritizing early warning as a proactive measure, it is essential to organize scientifically and efficiently the defense against cold spells during disaster emergencies, ensuring the safety of the public and minimizing socio-economic losses.

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Policy Notes

# Statement on Establishment of Public Health Protection Guideline for Cold Spells — China

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Cold spells are extreme weather events characterized by the invasion of cold air from high latitudes into the middle and low latitudes, resulting in significant cooling. Cold spells have various adverse health effects, including epidermal damage, respiratory tract spasms, respiratory immune abnormalities, acute cardiopulmonary diseases, and exacerbation of urinary and endocrine disorders. In response to the frequent cold spells in recent years, the National Disease Control and Prevention Administration has issued the "Public Health Protection Guideline for Cold Spells" on December 13, 2023 (*1*). The Guideline aims to provide guidance to the public on how to cope with cold spells effectively, enhance self-protection awareness, and minimize health damage caused by cold spells. The Guideline consists of five parts, covering the basic concept of cold spells, the main health risks associated with them, the vulnerable groups, warning signals, and graded protection recommendations for different population groups. It emphasizes the definition of cold spells, their multi-system health effects (respiratory, cardiovascular, urological, etc.), prioritizes the groups that require comprehensive protection, provides scientific information on cold spell forecasts and warnings, and proposes targeted health protection recommendations for major sensitive groups.

## BACKGROUND

The Global Burden of Disease, Injuries and Risk Factors Study (GBD) 2019 revealed that non-optimal temperatures ranked among the top 10 causes of death globally (*2*). A relevant study reported that there were 4,594,098 cold-related deaths per year worldwide between 2000 and 2019 (*3*). Cold spell, an extreme weather event resulting from climate change, have detrimental effects on public health. China, impacted by the Siberian cold stream, experiences frequent high-intensity cold spells during the cold season (*4*). From 2013 to 2019, China witnessed 57,783 excess deaths related to cold spells, with a 17.4% increase in the risk of non-accidental deaths on cold spell days in the south compared to non-cold spell days, and a 13.0% increase in the risk of non-accidental deaths on cold spell days in the north (*5*). Given this context, it is imperative to develop the "Public Health Protection Guideline for Cold Spells" to enhance the public's ability to cope with cold spells, increase awareness of the associated risks, and maximize protection of population health while reducing the health hazards associated with cold spells.

## METHODS

The Guideline is a public health guideline aimed at providing protection during extreme weather events, specifically focusing on cold spells. Its primary objective is to scientifically guide the public in coping with cold spells. The core principles of the Guideline are universality, scientificity, and practicability. The main contents of the Guideline encompass basic knowledge, cold spell warning signals, health risks associated with cold spells, and protective measures.

The definition of cold spells in the Guideline is based on the "Grade of cold air" as defined in GB/T 20484-2017. Cold spell warning signals are categorized into four grades, as specified in the "Cold Spells Warning Signals and Defense Guideline" (*6*). The identification of the main health risks associated with cold spells, such as respiratory, cardiovascular, urinary, and endocrine system-related morbidity and mortality, is based on previous epidemiological evidence (*5,7–12*). Additionally, vulnerable groups during cold spells, including individuals sensitive to cold spells, patients with chronic diseases, and outdoor workers, were identified. The Guideline also provides graded recommendations for different groups to minimize the adverse health effects of cold spells.

## RATIONALE AND EVIDENCE

This Guideline stands out for its ability to provide more precise protection strategies for key populations, based on the general protection recommendations applicable to populations categorized under the four levels of cold spell warning signals.

Previous epidemiological studies have identified populations that are vulnerable to cold spells. For example, Chen et al. (*7*) found that cold spells significantly increased the risk of cardiovascular, respiratory, and diabetes mortality in 31 Chinese capital cities. The pooled relative risks for these conditions were 1.37, 1.44, and 1.48, respectively. Additionally, the study found that the elderly aged ≥75 years were more vulnerable to cold spells than those aged 0–64 years, with pooled relative risks of 1.62 and 1.33, respectively. Based on epidemiological evidence (*5*,*7*,*9*–*11*,*13*–*14*), the Guideline has identified specific population groups that require priority protection during cold spells. These groups include sensitive populations such as infants, children, pregnant women, and the elderly, as well as individuals with chronic diseases and outdoor workers.

After conducting an extensive review of international guidelines (*6*,*15*–*17*), we developed a Graded Protective Recommendations Guideline for general and key populations during cold spells. This guideline offers specific guidance for outdoor activities, appropriate clothing, identification of discomfort or related illnesses, and necessary provisions such as materials and medications, based on the severity levels of cold spells.

The guideline provides graded protective recommendations for different groups of people:

### General Populations

According to the guideline, it is recommended that the general population selects warmer hours for outdoor activities, avoids engaging in long-duration and high-intensity activities as much as possible during cold spell days, and places emphasis on maintaining warmth. This is particularly important during red-warning days, when it is advised that the general population refrains from participating in outdoor physical activities.

### Sensitive Groups And Individuals With Chronic Diseases

According to the Guideline, it is recommended that individuals who are sensitive (eg. infants, children, pregnant women, and the elderly) or have chronic diseases should be mindful of the duration and intensity of outdoor activities. They should also take measures to stay warm during cold spells. Particularly on days with yellow, orange, and red warnings, individuals in these groups should limit outdoor activities to different degrees and prioritize their health.

### Outdoor Workers

According to the Guideline, it is recommended that outdoor workers should appropriately schedule their working hours and select appropriate cold-weather or warm clothing based on scientific principles. This is particularly important during days with orange or red weather warnings. During such days, it is advised to minimize prolonged outdoor work and take necessary measures to keep warm.

## PRESENTATION

On December 13, 2023, the Public Health Protection Guideline for Cold Spells (*1*) was officially released. The Guideline is applicable to individuals in the four grades of the cold spell warning signals, which are categorized as blue, yellow, orange, and red based on the “Cold Spells Warning Signals and Defense Guideline” (*6*). The Guideline not only applies to the general population but also address the health protection needs of three specific groups vulnerable to cold spells: sensitive groups (such as infants, children, pregnant women, and the elderly), individuals with chronic diseases (such as those with cardiovascular and cerebrovascular diseases, respiratory diseases, etc.), and outdoor workers (including traffic police, sanitation workers, construction workers, couriers, delivery workers, etc.).

The Guideline highlights the health risks associated with cold spells, as well as the vulnerable diseases and populations. It provides comprehensive recommendations for protective measures in various aspects such as environment, behavior, and individual health management. Building on these universal recommendations, the Guideline offers practical and effective health protection strategies specifically tailored for key populations. The recommendations cover preparation for cold weather (e.g., anti-skidding and anti-fall equipment, medicines, and vaccinations), measures to reduce cold exposure (e.g., selecting appropriate outdoor activity time, duration, and intensity, wearing cold-protective clothing), and guidelines for personal health management and emergency treatments (e.g., addressing hypothermia, discomfort symptoms, and relevant diseases). These guidelines provide systematic and detailed recommendations to ensure the health and safety of individuals during cold spells.

## DISCUSSION

The issuance of the Public Health Protection Guideline for Cold Spell demonstrates the Chinese government's commitment to addressing the challenges posed by climate change and safeguarding public health. This Guideline takes into account the specific needs of the Chinese public and considers the differences in health risks and protection requirements for various groups of people under different warning levels with respect to achievability, feasible implementation, and controllable costs. It provides both general protective recommendations and differentiated recommendations for sensitive individuals, those with chronic diseases, and outdoor workers, ensuring the effectiveness, applicability, and comprehensiveness of individual protective measures.

It is important for CDC agencies and healthcare institutions to actively promote the content of the Guideline on daily work and strengthen preparedness before a cold spell. This can be achieved through community health promotion and new media health promotion. Additionally, organizing and implementing public health protection measures during a cold spell is crucial. These efforts will help the public understand the cold spell warning signals issued by the Meteorological Bureau, guide them in responding to the cold spell correctly, increase their awareness of protection measures, assist them in selecting appropriate protective strategies, enhance their adaptive capacity to climate change, and alleviate the burden on healthcare facilities.

**Conflicts of interest**: No conflicts of interest.

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