Upper Respiratory Tract Infection Determination using the Distributed Lag Model

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ABSTRACT:

The primary focus of the research was on determining whether or not there was a correlation between temperature and the prevalence of upper respiratory tract infections (URI). from 2010 till 2015, URI data as well as weather data will be collected on the daily basis. A non- distributed lag has been used in the non-linear model where it was used to investigate the association among various temperatures, here the morbidity of upper respiratory infections (URI), as well as the possible implications of these variables. According to the findings, the morbidity of URI was significantly related to the meteorological factors, and the peak of the onset of the disease typically occurred between November and February of the following year. This coincided with the time period in which the disease was most likely to spread. The correlation study that was carried out between meteorological parameters and URI cases yielded the finding that the daily morbidity of URI in Lanzhou was connected to air temperature, air pressure, and wind speed. This was discovered by looking at the outcome of the analysis. In Lanzhou, the exposure effect curve for the average daily temperature to different sexes and age groups displayed an M-shaped pattern. The influence of temperature on the daily morbidity of URI showed a significant amount of latency. Because of the low temperature, it manifested itself today, but the maximal impact didn't show up for another two days, and it lasted for another 12 days after that. The female was more susceptible to the effects than the male, and while the effects were readily apparent in adolescents and the elderly, they were not readily apparent in adults. Temperature is the most important determinant in the occurrence of upper respiratory infections (URI) in Lanzhou; nevertheless, meteorological elements have an essential effect as well. Temperature may directly cause the morbidity of URI; it can induce numerous symptoms of URI (such as cold, sore throat, and rhinitis), and it can directly alter the distribution of URI in the population. Temperature can also directly trigger the morbidity of URI.

Keywords- Upper respiratory tract infection; Impact; temperature; distributed lag non-linear model

1. INTRODUCTION

EarlyThe respiratory system's principal function is to transport gases from inside the body to the atmosphere outside of it. In order to guarantee that the body is able to operate effectively, it continually sucks in oxygen from the environment while simultaneously releasing the carbon dioxide that is formed by the circulatory system. The upper respiratory tract comprises the nose, throat, and larynx, which are all parts of the respiratory system. As a respiratory organ, this component of the respiratory system is also in close touch with the elements of the outside world. The common cold, frostbite, bronchitis, and other respiratory illnesses are all made worse by changes in the weather's influence on the lungs. [1] discovered that the age of patients with URI demonstrated that the impact of several climatic components on the commencement of URI is also vary in different seasons; these results are based on an analysis. [2] There is an inverse association between temperature and upper respiratory infections, according to study [3], the employed multiple regression to show that the lowest temperature reduced by 1.8 percent for every one degree Celsius that the temperature climbed. Various climatic elements, according to [4], impact this negative association. Luo et al. As a consequence of the study discussed above, we are aware that the type and extent of the climatic elements that impact the morbidity of URIs varies from place to region. [5] Furthermore, the study has led to the revelation that the results about these elements also vary, and this is due to the fact that various places have diverse geographical circumstances, temperatures, living situations, and levels of air pollution. [6] On addition, the most significant research fields are focused around China's coastal cities and other economically developed areas. There aren't many research on semi-arid places, and the morbidity rate of URI isn't split down according to gender or age, so it's hard to tell how temperature impacts distinct populations. [7] Temperature increase in semi-arid regions will be much faster than in other parts of the world if global warming continues at its current pace. Extreme weather events have increased in frequency and length during the same time period. Upper respiratory tract infections are on the increasing because of this [8]. An investigation of the effects of weather conditions on upper respiratory tract infections (URI), is the goal of this research, which aims to analyse the impact of temperature variations and provide effective prevention strategies. Between 2010 and 2015, we collected weather and URIs data and used distributed lag non-linear models (DLNM) to investigate the effects of temperature on URIs and the lag effects. A wide range of studies looking at the link between URI severity and body temperature were conducted, including studies involving men and women of all ages.

2. MATERIALS AND METHODS

2.1 Sources

During the months of January 2010 and December 2015, data on URIs were obtained from the First Hospital. [9] Patients' identification numbers, gender, age, and range of ages were all included in the daily outpatient records. The diagnosis was coded using the International Classification of Diseases, 10th Edition (ICD- 10). It was determined that patients were divided into two groups: those under 65 and those beyond 65. From January 2010 to December 2015, the Gansu Meteorological Bureau was in charge of gathering and distributing the daily meteorological data, which included information on temperature, pressure, wind speed, relative humidity, and precipitation totals..

2.2 Statistical Analysis Method

In Using a Spearman correlation, it was determined how closely meteorological factors and URI are linked in the early stages of the study. We included in our model the meteorological variables that were associated with the URI, and we defined statistical significance as p less than 0.05. To fit the data, a quasi-Poisson connection function was utilised using the daily morbidity as the dependent variable. The URI morbidity data and the weather data were used to create cross-basis matrices. [10] In order to examine the relationship between URI and meteorological factors, a distributed lag non-linear model was utilised (number of instances).

Afterward, the long-term and seasonal trends were regulated. We choose to utilise the daily mean temperature as our temperature indicator in order to look at the relationship between daily average temperature and URI. Both the deceptive effects of relative humidity and the daily average air pressure were taken into consideration. [11] A two-dimensional temperature-lag time matrix was built to examine the lag influence temperature has on the URI. The model may be dissected into the following parts: log For each day, the number of patients is Yt; an is a constant term; the "cross-basis" matrix of temperature obtained by using the "cross-basis" function in the "DLNM" is called TEMt;l; and the coefficient of explanatory variables in the regression model is known as b; for each year, the number is cDut. Natural cubic splines with three degrees of freedom are used in the formula, as well as the notation "ns" (presst, df 3), which denotes the impact of air pressure on the equation. Seasonal and long-term patterns may be controlled by the use of a new time series variable, known as the ns (Timet df7), which has a degree of freedom of 7 per year. The seasonal and long-term trends are controlled by adding time to the natural cubic spline function. The dummy variable Dut is used to indicate which day of the week it is. [12]

The maximum lag period was established at 14 days based on relevant studies in order to capture the negative impact in its entirety. RR values were also calculated using the median annual average temperature (P50) as a reference value for different temperatures and delays. The relative risk (RR) calculation is as follows: For all possible values of b in the regression model, the following equation may be used to estimate the probability of URI morbidity as a function of temperature: Experiment with the expression (b*t + b* t + b* t + b* t + b* t (b). In addition, the 5th percentile of the daily mean temperature range was used to determine the extreme low temperature threshold. The threshold was then used to identify extreme low temperatures, which were recorded daily mean temperatures lower than the threshold. We used the relative risk of low temperature (P5) in comparison to the median temperature as a measure of the effect temperature has on the morbidity of URI (RR). The effect of temperature on URI daily morbidity was studied in a variety of sexes and ages of people.

..3. RESULTS

2.3 Description of Statistical Data

TheTable 1 shows that between 2010 and 2015, Lanzhou saw 78,220 outpatients with URI, with an average of 121.52 cases per day. Among the 428798 male cases there were 354022 female cases; the male-to-female ratio was 1.21:1. A total of 534434 cases (68.27 percent) were found in the group of adolescents aged 0 to 18 years old, while 213216 cases (21.32 percent) and 35170 cases (4.49 percent) were found in the group of adults aged 19 to 64 years old. Pressure, temperature, relative humidity and precipitation had the following daily mean values for the same time period: In this case, the values are: 848.38 hPa, 11.14 degrees Celsius, 50.23 percent, 0.82 millimetre and 1.28 m/s, in that order.

Variables	x±s	Minimum	P25	P50	P75	Maximum
Dailymorbidity	131.43±48.00	1.56	32.00	68.00	92.00	316.00
Male	66.92±37.76	1.50	51.00	111.00	141.00	512.00
Female	55.63±32.17	1.58	26.00	52.00	72.00	232.00
0–18yearsold	102.37±58.33	1.50	51.00	111.00	141.00	512.00
19–64yearsold	2.63±2.03	1.00	1.00	2.00	3.00	17.00
≥65 yearsold	2.43±2.05	1.01	1.01	2.01	3.01	18.10
Dailyaveragepressure(hPa)	86.38±5.52	622.79	643.55	646.17	650.31	688.42
Dailyaveragetemperature(°C)	22.13±61.23	−24.82	3.11	11.42	21.14	32.88
Dailyaveragerelativehumidity(%)	42.12±11.52	13.75	35.66	51.72	62.10	111.00
Dailyprecipitation(mm)	0.82±0.22	0.21	0.21	0.21	0.02	41.00
Dailyaveragewindspeed(m/s)	1.21±0.34	0.02	2.01	2.12	2.51	2.00

Table 1. Descriptive statistics of meteorological standards andthe numberof URI affected patients

The According to Table 2, there was a statistically significant (p 0.01) correlation between URI outpatient visits and air temperature, air pressure, relative humidity, precipitation, and wind speed. (r = −0.3158, p 0.01). The link between URI morbidity and temperature, relative humidity, and other variables has been established. The air pressure and precipitation, on the other hand, had a positive relationship with it Out of all the variables examined, the greatest correlation was found between the URI and temperature

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Variables	Air Pressure (hPa)	Temperature (°C)	Relative humidity (%)	Precipitation (mm)	Wind speed (m/s)	Daily number of patients (case)
Pressure (Pa)	1					
Temperature (°C)	−0.2258a	1				
Relative humidity (%)	0.2107a	−0.2237a	1			
Precipitation (mm)	−0.2294a	−0.2680a	0.3760a	1		
Wind speed (m/s)	−0.2413a	0.2283a	−0.249a	0.3207a	1	
Daily patient (case)	0.1183a	−0.4158a	−0.0540a	−0.2275a	−0.2237a	1

Table 2. Spearman Correlation coefficients of meteorological factors

Note:*p*<0.01

Figure 1 depicts the link temperature sequence diagram and daily outpatients diagnosed with URI throughout the study period. Between January and March and September and November, URI's morbidity grew sharply, with the second peak occurring between September and November.

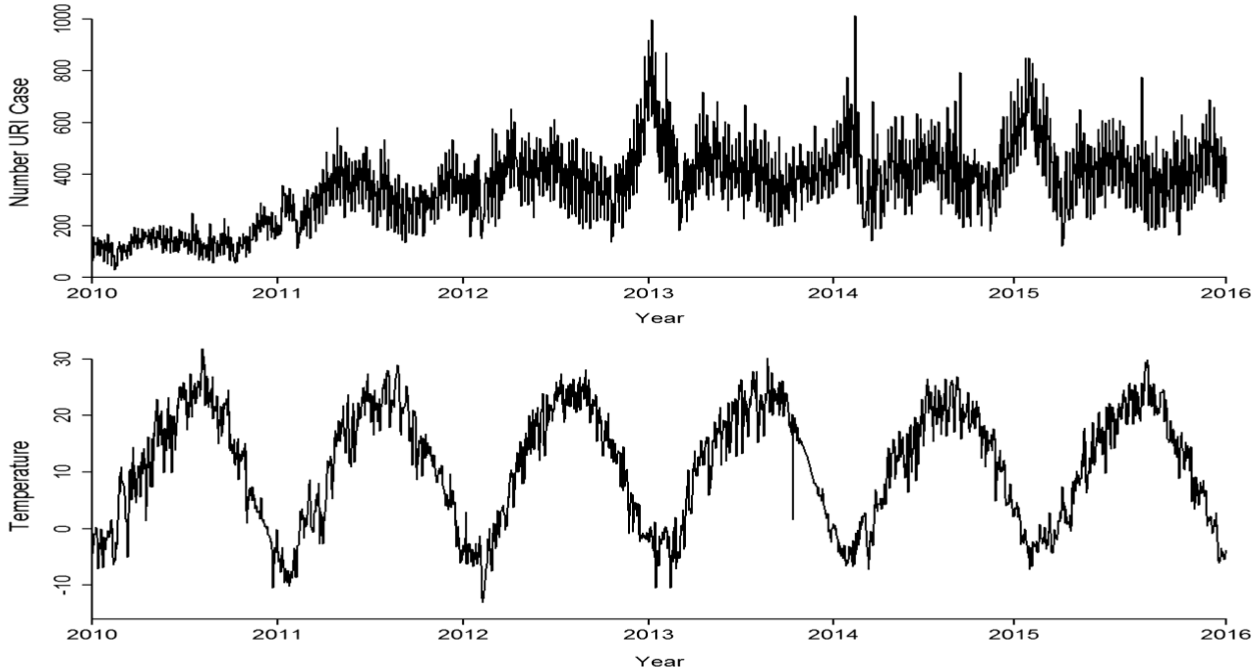
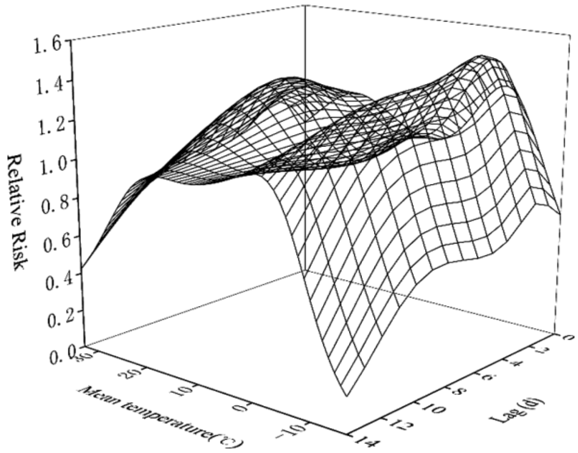


Figure 1: Distribution of materological variable and URI Cases in 2012-2018



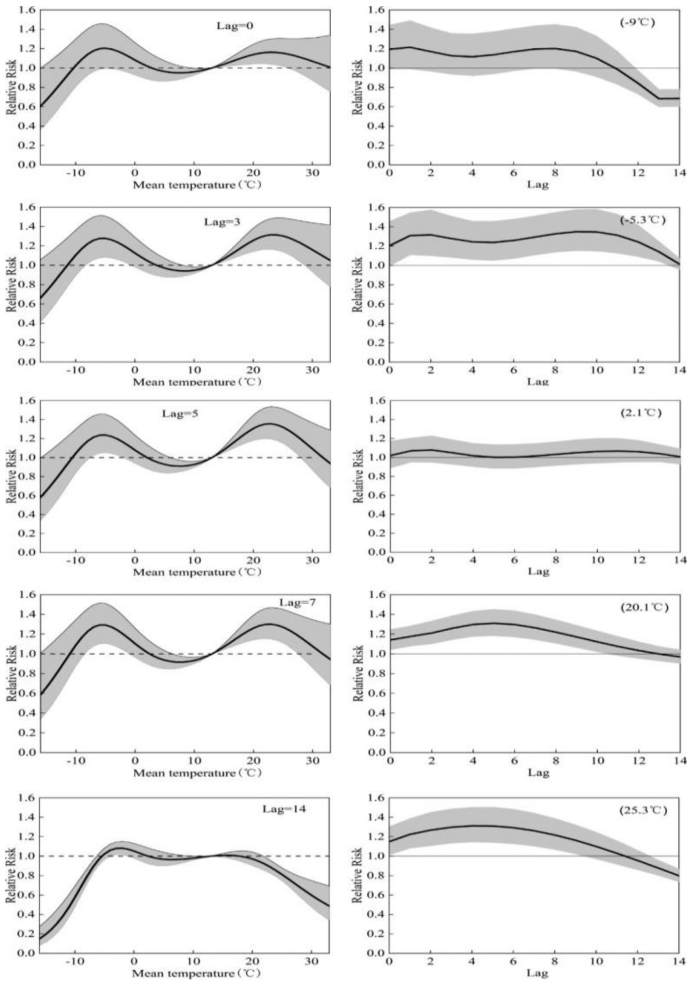
Analysis of Air and Temperature on Distributed lag model

In A link was shown between the daily average temperature between 2010 and 2015 and the number of daily URI outpatients by using the DLNM model. We opted to limit the maximum lag time to 14 days since a normal weather cycle is seven days long. We used two cycles rather than one because we wanted to accurately portray the delayed effect that temperature has on URI. For each lag-day, the model generated a 3-D graphic showing how temperature affects URI throughout the course of each lag-day (Fig. 2). There was a bimodal influence on the number of outpatients based on the lag duration, which changed depending on the daily average temperature. Fig. 2 shows a non-linear connection between temperature and the URI. The RR value peaked at 23 degrees Celsius, 5 days after it had first spiked. As the lag days wore on, the impact of the high temperature became less pronounced. When the temperature fell below 5 degrees Celsius, the effect of the low temperature was most apparent on URI at lags of two days and nine days. Despite the rising number of lag days, the RRs were increasing. As shown in Figure 3, the risk of upper respiratory infection (URI) may be correlated with the number of days from the most recent exposure (lag 0 or the current day). There are temperatures that may range from -9 to 5.3 degrees Celsius in the winter, 50 degrees Celsius in winter, 75 degrees Celsius in summer, and 95 degree Fahrenheit in summer. We choose 11.14 degrees Celsius as our reference number for the annual average temperature. There is a solid line of colour that represents relative risk

estimates, and a confidence interval that goes out to 95%. (CI). In terms of URI risk, there is currently just one peak trend related with rising daily average temperatures. When the temperature was below 5°C, the biggest impact was seen, and as the lag days went on, this effect lessened. At lags of three days, five days, and seven days, the relative risk of infection with URI fluctuated in the same way, indicating a typical bimodal pattern.The least impact was seen at 13 degrees Celsius, while the second-highest RR was seen at 23 degrees Celsius. It wasn't long until the RR began to decline. The RR of URI was not immediately obvious after a 14-day delay. Lanzhou's daily average temperature and URI morbidity do not correlate linearly, as shown by Figure 4 (see below). It was at this point that the relative risk (RR) showed statistical significance.

Figure 3: Relative risk plot by temperature at specific lagd and temperature

It was 1.22 (94 percent confidence interval: 0.82–1.22) at a temperature of 18 degrees Celsius, and its value was 1.24 (94 percent confidence interval: 0.81–1.32) at that temperature. Adolescents' RR, as seen in Figure 5, is characteristically immoral. There was a progressive



decrease in the RR and none at temperatures below 5.2 degrees Celsius, but the influence peaked at 1.52 (95 percent confidence interval: 1.40–1.65)at temperatures above 10 degrees Celsius. Females had a somewhat higher relative risk (RR) than men. Despite this, the findings of the age subgroups research were statistically significant. The risk ratio (RR) for individuals over 65 was higher when the temperature was low or 20 degrees Celsius, although teens were at greater risk when the temperature was low.

A statistically significant cumulative impact was seen in all instances when the temperature was 5.3°C and 2°C, respectively. After three and five days the cumulative RR value was 1.01 (95 percent confidence interval: 0.96–1.08) and 1.01 (95 percent confidence interval: 0.93–1.09), respectively.

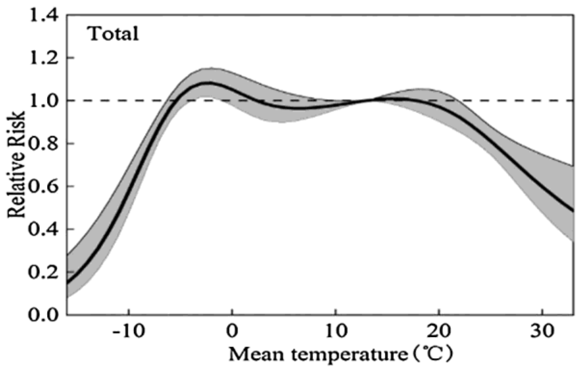


Figure 4: overall relative risk of mean temperature for total URI Cases.

.At a temperature of 2°C, the cumulative RR for men was 1.97 (95 percent confidence interval: 0.89–1.06) with statistical significance; for females, the cumulative RR was 1.24 (95 percent CI: 1.02–1.51) at 5.3°C, which suggested lower daily mean temperature had a significant influence. After a 14-day lag, the relative risk was 1.04 (95 percent confidence interval: 0.96–1.14), which was larger than the cumulative effect at any other temperature but was not statistically significant.

░4. **DISCUSSIONS**

Temperature and URI morbidity were shown to be non-linearly linked, according to the results. According to [Citation required], If the temperature is too hot or too cold, it might lead to an upper respiratory infection (URI).

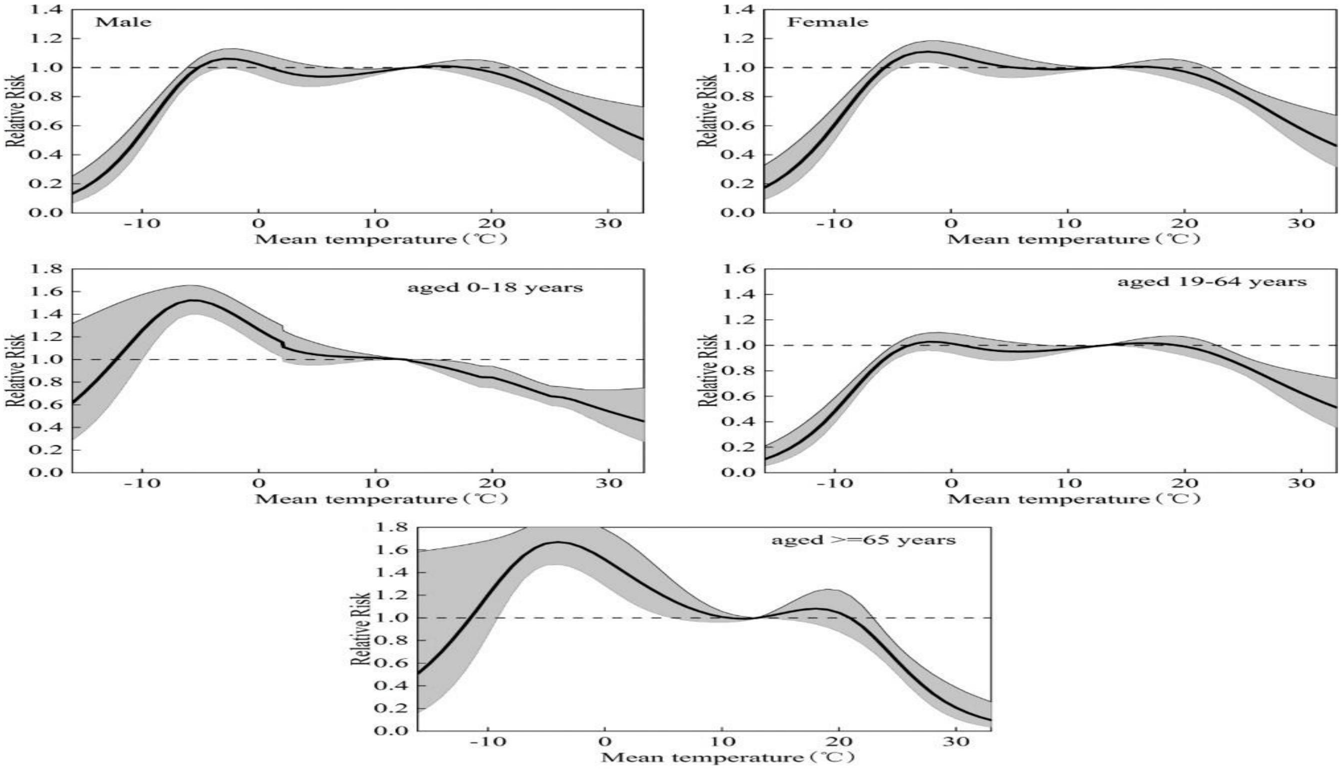


Figure 5: Overall Relative risk interms of age and Gender

░5. **CONCLUSIONS**

Women, teenagers, and those over the age of 65 are more likely to get sexually transmitted illnesses than men and those of childbearing age. health agency and assist in the development of steps to avoid the occurrence of excessively high temperatures In addition, the results might serve as a guide for the local community.

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