Effects of meteorological factors on daily outpatient visits for skin diseases: a time series study in a Chinese population

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To the Editor: There is limited evidence as to the association between outpatient visits in dermatology and meteorological factors. A previous study has focused on the effects of meteorological factors on a certain disease, and seemed to lack systematic analysis for a class of diseases.[1] Here, we investigated the short-term effects of meteorological factors on the number of daily outpatient visits for skin diseases.

Data on daily outpatient visits (emergency department visits were excluded) for skin conditions between January 1st, 2014 and December 31st, 2016 (1096 days) were collected from the Affiliated Hospital of Guizhou Medical University, located in the downtown area of Guiyang. The identity card (ID), visit date, age, sex, contact number, residential address, and diagnosis (with its International Classification of Disease code 10) of each patient were included in the collected data, which only focused on patients living in the areas of Guiyang. Patients who repeatedly visited the hospital on the same day were excluded according to patient ID. This study was approved by the Ethics Committee of the Affiliated Hospital of Guizhou Medical University. The clinical information, records, and data involved in this study were analyzed anonymously without intervention. The need for informed consent was waived. Meteorological data on the daily mean temperature (T, °C), mean atmospheric pressure (P, hPa), relative humidity (RH, %), mean wind speed (W, m/s), and total hours of sunshine (ST, h) in 24 h during the study period were collected from the Guiyang Meteorological Information Center. The average concentrations of six air pollutants, including particulate matter with an aerodynamic diameter less than 2.5 microns and an aerodynamic diameter less than 10 microns, sulfur dioxide, nitrogen dioxide, carbon monoxide in 24 h, and ozone in 8 h during the period of this study were obtained from the Guiyang Environment Monitoring Center. To estimate the impacts of the main meteorological factors on daily outpatient visits, we choose generalized additive models to calculate the relative risk increase of 10 units for the main meteorological factors.[2,3] Several independent models were constructed to evaluate the associations between the main meteorological factors and daily outpatient visits to the department of dermatology. In each model, the regression spline function was used to control categorical variables including long-term time trends, seasonal patterns (Season), and the effect of holidays (Holiday) and day of the week.[2] We used the partial autocorrelation function (PACF) to select the degrees of freedom (df) of time trends based on minimization of the absolute values of the PACF. Akaike Information Criterion and a study of residuals were applied to evaluate the choice of df. All data analyses were conducted in R 3.3.3 statistical software with the "mgcv" package.[4]

Supplementary Table 1, http://links.lww.com/CM9/A406 presents a detailed summary of the statistical distribution of diurnal outpatient visits, meteorological factors, and air pollutants. The mean number of daily outpatient visits in the total population was 143.0, while those of preschoolers (≤6 years), school-aged children and teenagers (7–17 years), adults (18–64 years), and the elderly (≥65 years) were 17.8, 15.6, 96.9, and 12.8, respectively, meaning that adults made up the majority of the daily outpatient visits. When classified by sex, the mean numbers of daily outpatient visits were 79.1 and 63.9 for females and males, respectively, indicating a minor difference between males and females with respect to daily outpatient visits. Additionally, all the descriptive indicators of daily outpatient visits in the warm season were higher than those in the cool season, suggesting that daily outpatient visits are more common in warm season.

Given that meteorological factors are highly correlated with each other, as are air pollutants [Supplementary Table 2, http://links.lww.com/CM9/A406], we introduced

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them as covariates into models. In single-day lag structures, the significant effect estimates varied for T, W, and ST [Supplementary Table 3, http://links.lww.com/CM9/A406]. A significant association was found for T with the number of outpatient visits at lag 0 day. W was associated with the number of outpatient visits at lag 4, lag 5, and lag 6 days, and ST at lag 2, lag 3, and lag 4. However, no significant associations between P and RH and the number of daily outpatient visits were found in single-day lag structures. The multi-day metrics of the daily outpatient visit number showed a larger effect of meteorological factors than for single-day exposures. Generally, daily outpatient visits numbers showed similar results for its multi-day lag effects on T, W, and ST. The effects of the number of daily outpatient visits increased from lag 01 day and were the highest at lag 06 day. In Supplementary Figure 1, http://links.lww.com/CM9/A406, there were similar positive linear relationships between daily outpatient visits numbers and T, P, W, and ST, indicating that the RR of daily outpatient visits numbers increased as P, W, and ST increased during the study period, but the curve of P became flat when the pressure was high. The curve showed a negative linear relationship between T and daily outpatient visits below around 10°C, but a positive relationship above 10°C. By contrast, there was a negative linear relationship between daily outpatient visits numbers and RH.

Although the effect estimates on daily outpatient visit number of T in the ≥65 years age group were slightly higher than those in the 7 to 17 years and 18 to 64 years age groups, significant effects on daily outpatient visit number of all meteorological factors except P among those aged 7 to 17 years were found. Meanwhile, W had the strongest association compared with the other age groups. Female was vulnerable to above all meteorological factors including T, P, RH, W, and ST. More pronounced associations were found between daily outpatient visit number and meteorological factors for T, W, and ST among males, with the exception of P and RH. In the season-specific analysis, significant positive relationships were observed between the number of daily outpatient visits and T, W, and ST in the warm season. By contrast, a significant negative association between the number of daily outpatient visits and T was observed in the cool season. Similarly, a significant positive association between the number of daily outpatient visits and W and ST was observed in the cool season. Only RH was significantly associated with a decrease in the number of daily outpatient visits in both the warm and cool seasons [Supplementary Table 4, http://links.lww.com/CM9/A406]. As sensitivity analysis [Supplementary Table 5, http://links.lww.com/CM9/A406] the effect on the number of daily outpatient visits of the five major meteorological factors remained statistically significant before and after adjustment for the covariates. The analyses showed that a change in covariates for weather conditions and air pollutants did not substantially affect the estimated effects on the number of daily outpatient visits, suggesting that the findings were relatively robust in this aspect.

Our study showed a significant correlation between meteorological factors, especially T and W, and the number of daily outpatient visits. The association was positive between W and outpatient visits, and at the age of 7 to 17 years this effect was stronger than in the other age groups. This might be because allergic diseases account for a large proportion of patients in the department of dermatology, and allergic diseases are associated with the presence of allergens. Airborne pollen as a factor to induce allergic diseases is correlated with W. This could be one of the reasons why the W had a positive effect on the number of daily outpatient visits. The association was also positive between T and the number of outpatient visits, and in the warm season the number of daily outpatient visits increased as the T rose, whereas in the cold season an increase in temperature reduced the number of such visits. This result may be partly because the most suitable growth temperature for many human pathogens is 20 to 37°C. Above all, T and W were two independent risk factors for the number of daily outpatient visits to the department of dermatology. A new finding in our study was the positive correlation between temperature and daily outpatient visit number above a threshold temperature (about 10°C), and the negative correlation between these two variables below that threshold temperature. This is contrary to a previous study focusing on the relationships between meteorological factors and hospital outpatient visits for cardiovascular disease.[5] This also illustrated that different systems of the human body respond differently to meteorological factors; the causes of these different reactions require further exploration.

Our study has some limitations because the health data were from existing administrative databases for outpatients, medication use, personal habits, such as smoking, and comorbidities could not be considered. Another limitation of our study was that we did not include daily rainfall in the weather variables, due to limited data access and availability, and this could have affected our final result.

In conclusion, statistically significant evidence that meteorological factors have a non-negligible impact on the health of the general population was provided by our study, and further research with consistent methodology is needed to clarify the magnitude of these effects and the influence on each specific skin disease.

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Conflicts of interest

None.

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