Letter to the Editor

Association of Meteorological Factors with Labial Adhesions in Children: A 7-year Retrospective Analysis with 9,467 Cases*

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Labial adhesions (LA) (also called labial agglutination) are defined as partial or complete agglutination of labia minora. The condition commonly occurs in girls during childhood with an estimated prevalence of 0.6%–5% and a peak incidence in the age-group of 13–24 months[1]. Over half of all patients present with symptoms related to urinary outlet obstruction[2]. Manual separation is the most common treatment and is associated with a higher initial success rate (80%–100% *vs*. 15%–100%) and a lower recurrence rate (15%–20% *vs*. 11%–44%) as compared to topical oestrogen therapy[2-6]; however, manual separation causes severe pain[7]. There are no specific guidelines for home care and prevention of the disease. This is partly attributable to the lack of clarity on the exact etiology of LA. However, its occurrence is generally believed to be associated with hypoestrogenic status and vulvar inflammation[5,6,8].

According to our clinical experience, occurrence of LA may be related to the weather condition. For example, the numbers of outpatient visits due to LA tend to increase after rain. Children tend to be more vulnerable to climatic change than adults, due to their immature physiological metabolism, incomplete development, and unique pattern of behavior[9]. However, the relationship between the occurrence of LA and meteorological factors is not well characterized. In this study, we investigated the association between the incidence of LA and meteorological factors such as temperature, atmospheric pressure, humidity, wind speed, sunshine, and precipitation.

Data pertaining to residents of Chongqing city aged < 18 years, who were diagnosed with LA for the first time at the outpatient department at the Children's Hospital of Chongqing Medical University between January 2011 and December 2017 were retrospectively analyzed. Patients with incomplete records were excluded from the analysis. The study population was stratified into 3 age-groups: < 1 year; 1–3 years; and ≥ 3 years. All data were extracted from the electronic outpatient medical records. The diagnosis of LA was made by clinical examination, with findings of fusion of the labia minora and exclusion of the absence of vagina and imperforate hymen. This study was approved by the ethics committee of the Children's Hospital of Chongqing Medical University (File No. 20187), and all data were anonymized. Owing to the retrospective study design, the requirement for informed consent of the subjects was waived off.

Meteorological data, including monthly mean temperature (°C), monthly mean atmospheric pressure (hPa), monthly mean humidity (%), monthly mean wind speed (m/s), monthly mean sum of sunshine (h), and monthly mean sum of precipitation (mm) were obtained from the Chongqing Meteorological Bureau, Chongqing City, China. The geographic location of the meteorological monitoring station is 106°28'E, 29°35'N, 259.1 meters above sea level.

Statistical analysis was performed with SPSS version 20.0 (SPSS Inc., Chicago, IL, USA).

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Kolmogorov-Smirnov test was carried out to test for normality. Chi-squared goodness of fit test was used to analyze the seasonal and monthly periodicity of the number of outpatients with a diagnosis of labial adhesions. Pearson's correlation analysis was used to examine the relationships between meteorological variables and the monthly case load of patients with LA.

During the study reference period, a total of 9467 outpatients were diagnosed with LA. The distribution of patients in the different age-groups was: > 1 year: 5,040 (53.24%); 1–3 years: 3,586 (37.88%); > 3 years: 841 (8.88%). Consistent with the previous findings, our results showed that LA occurs predominantly in girls < 3 years of age, while girls aged < 1 year accounted for the majority of patients[1,10].

The seasonal and monthly variation in the number of patients with LA is shown in Supplementary Figure S1 (available in www.besjournal.com) and Figure 1. Overall, the total number of patients with LA appeared to be the highest in fall and the same phenomenon was observed in all 3 age-groups. We observed a seasonal and monthly pattern in the number of cases of LA. The peak incidence of labial adhesions was in the fall. The highest numbers of patients < 3 years of age were seen in the month of September. And an annual increase in cases during the observed period was noticed. It could be related to the expansion of outpatient service scale in our hospital and the increasing birth rate of the local population.

During the study reference period, the monthly mean temperature in Chongqing ranged from 5.21–31.51 °C; the monthly mean atmospheric pressure ranged from 969.99–995.84 hPa; the monthly mean humidity ranged from 50.71%–87.32%; the monthly mean wind speed ranged from 1.05–1.87 m/s; the monthly mean sum of sunshine ranged from 0–244.9 h; and the monthly mean sum of precipitation ranged from 3.4–401.3 mm.

As shown in Figure 2, the number of patients with LA showed an upward trend with increase in five meteorological factors other than atmospheric pressure, and vice versa. On Pearson's correlation analysis, the monthly mean temperature and the monthly mean sum of precipitation showed the strongest correlation with the monthly overall case load (r = 0.295, P = 0.007 and r = 0.344, P = 0.001, respectively). The monthly mean humidity and the monthly mean sum of precipitation showed the strongest correlation with the monthly number of patients in the < 1 year age-group (r = 0.253, P = 0.020 and r = 0.272, P = 0.012, respectively). The monthly mean temperature and the monthly mean sum of precipitation showed the strongest correlation with the monthly number of patients in the 1–3 year age-group and ≥ 3 year age-group (r = 0.326, P = 0.002, r = 0.385, P = 0.000, r = 0.300, P = 0.006 and r = 0.257, P = 0.018, respectively) (Figure 3). Overall, temperature and precipitation showed a significant positive correlation with LA. These two meteorological factors were also the most relevant to LA among girls in the age-groups of 1–3 years and ≥ 3 years. Humidity (but not temperature) and precipitation showed the strongest correlation with LA in the < 1 year age-group.

To the best of our knowledge, this is the

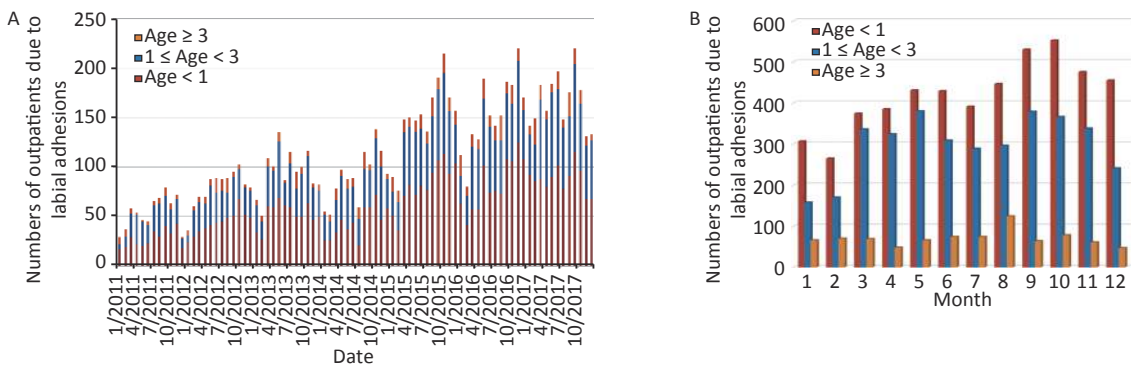

Figure 1. Monthly distribution of outpatients with labial adhesions from January 2011–December 2017 at the Children's Hospital of the Chongqing Medical University. (A) The total case-load of LA shows a peak in the months of September and October (χ^2 = 316.658, df = 11, P < 0.001). (B) The number of patients in the < 1 year, 1–3 year, and > 3 year age-groups peaks in September and October (χ^2 = 180.067, df = 11, P < 0.001), May and September (χ^2 = 204.327, df = 11, P < 0.001) and in August and October (χ^2 = 59.571, df = 11, P < 0.001), respectively. df, degrees of freedom; LA, labial adhesions,

advanced study that demonstrates a significant association of LA with environmental temperature, humidity, sunshine, and precipitation. Interestingly, the most relevant meteorological factors varied across different age-groups. We speculate that this result may be related to the typical activity status of girls. Girls under the age of 1 year are more likely to spend most of their time indoors with a regular amount of activity and receive close parental care in response to changes in external temperature. Thus, the vulvar local environment in this age-group is less liable to be affected by external temperature. Girls in the age-group of > 1 year are more likely to engage in outdoor activities, which renders them vulnerable to changes in external temperature (for example, sweating due to increased temperature). In addition, greater precipitation in the external environment is liable to render the vulval environment more humid. Therefore, the occurrence of LA is more related to temperature and humidity.

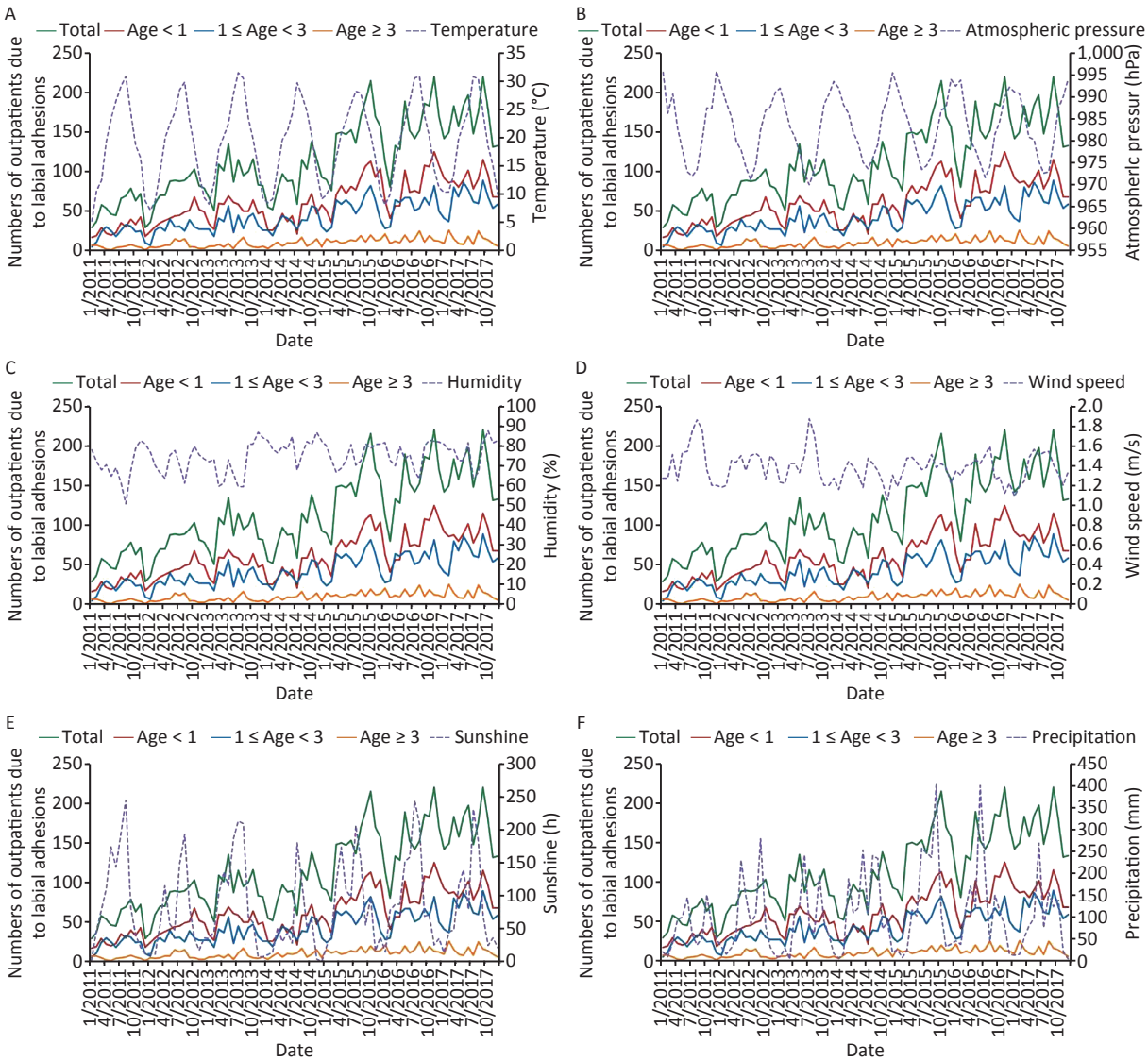

Figure 2. Monthly variation of meteorological factors and labial adhesion cases from January 2011–December 2017. (A) Monthly mean temperature and number of patients with labial adhesion in the three age-groups. (B) Monthly mean atmospheric pressure and number of patients with labial adhesion in the three age-groups. (C) Monthly mean humidity and number of patients in the three age-groups. (D) Monthly mean wind speed and number of patients in the three age-groups. (E) Monthly mean sum of sunshine and number of patients in the three age-groups. (F) Monthly mean sum of precipitation and number of patients in the three age-groups.

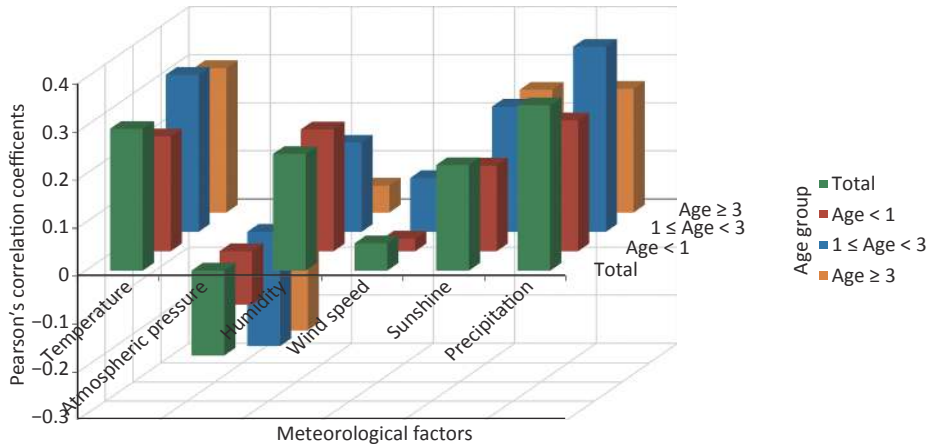

Figure 3. Pearson correlation analysis of the association between the monthly number of meteorological factors and cases of labial adhesion.

Although we observed the association between meteorological factors and LA, the correlation coefficients were not high. This is likely attributable to the role of multiple factors in the causation of this disease including the hormone levels and other factors which are not related to meteorological factors[8]. We believed that the observed correlation between occurrence of LA and meteorological factors is largely driven by the hot and humid environment of the vulva. Thus, our results can inform some recommendations for the home care of girls, i.e., the need for parental attention to vulval hygiene and to keep the vulva dry in hot and humid weather, especially in fall.

Some limitations of our study need to be acknowledged. First, the meteorological data represented the average for the main city of Chongqing, and personal exposure levels could not be measured accurately. Second, we did not assess the combined effect of multiple meteorological factors and we didn't include some other factors like diaper use in this study. Finally, the correlation between meteorological factors and the case load of patients was not strong and our results need to be validated in further studies.

In conclusion, the incidence of labial adhesions shows seasonal variations with a peak incidence in hot and wet months, which indicates a positive correlation with certain meteorological factors. Close parental attention towards vulval hygiene and maintenance of dry vulva in hot and humid conditions (especially in fall) is a key imperative to prevent LA.

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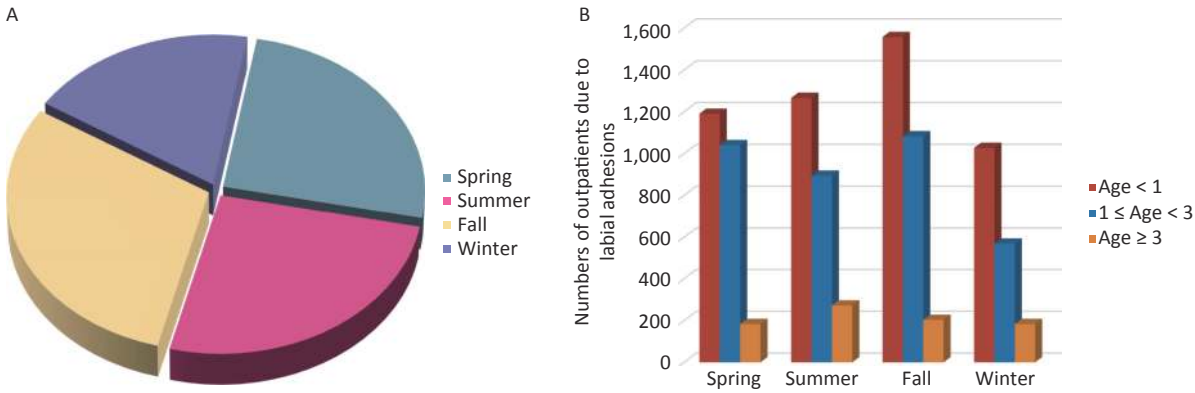

Supplementary Figure S1. Seasonal distribution of outpatients with labial adhesions at the Children's Hospital of Chongqing Medical University (January 2011–December 2017). A. Number of total patients disaggregated by season. The highest case-load is seen in fall (χ^2 = 244.496, *df* = 3, *P* < 0.001). B. Number of patients in different age-groups disaggregated by season. The highest number of patients in < 1 year (χ^2 = 117.011, *df* = 3, *P* < 0.001) and 1–3 year age-groups (χ^2 = 181.413, *df* = 3, *P* < 0.001) are seen in fall. *df*, degrees of freedom; LA, labial adhesions