

Seasonality and association with climate factors of peritonsillar, retropharyngeal, and parapharyngeal abscesses in Korea

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Research Article

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Abstract

Background

Deep neck space abscesses are an important medical problem but the extent of their seasonality is not yet fully understood. Thus, we aimed to examine the seasonality of deep neck space abscesses and define the associated climate factors using a nationwide, population-based, cross-sectional data.

Methods

Korean National Health Insurance-derived database with records from January 2010 to December 2019 was utilized in this study. We identified patients with peritonsillar, retropharyngeal, and parapharyngeal abscesses who were assigned the following diagnostic codes as a principal or first additional diagnosis: The International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM) codes J36 (peritonsillar abscess), J39.0, and J39.1 (retropharyngeal and parapharyngeal abscess and other abscess of the pharynx). We calculated the seasonal ratio as the ratio of the highest to the lowest number of patients per each month to assess the degree of seasonality for each studied condition. In addition, climate data points corresponding to each month were obtained. Thus, we analyzed correlations between the monthly patient numbers for each disease and various climate-related factors.

Results

We detected seasonal variations in the number of peritonsillar, retropharyngeal, and parapharyngeal abscesses, which were highest in winter-to-spring and lowest in summer. Peritonsillar abscesses were strongly correlated with average temperature, ground temperature, relative humidity, precipitation, daily temperature range, and particulate matter < 10 μ m (PM10). Retropharyngeal and parapharyngeal abscesses were linked to similar climate factors but with sunlight rate instead of PM10.

Conclusion

This large population-based study highlights a clear seasonality and climate relevance in patients with deep neck space abscesses. Further studies exploring detailed demographic factors associated with the incidence of deep neck space abscesses are required to better characterize these conditions.

Background

Peritonsillar abscess is the most common type of deep neck space abscess of the head and neck regions in young adults [1]. Retropharyngeal and parapharyngeal abscesses, often collectively referred to as deep neck space abscesses, arise at adjacent spaces in the neck and are associated with potentially life-threatening conditions, including airway obstruction and systemic sepsis [2]. It is thought that the

incidence of peritonsillar abscesses is similar for all seasons of the year [3]. However, one study showed that peritonsillar abscesses are more likely to occur in warmer months [1]. Furthermore, one tertiary care center epidemiologic study showed that the incidence of parapharyngeal abscesses decreases during spring, whereas the incidence of peritonsillar abscesses increases in spring [4].

Deep neck space abscesses are an important medical problem and many studies have been carried out to determine the extent of their seasonality; however, the issue is not yet fully understood. Thus, we aimed to comprehensively examine the seasonality of deep neck space abscesses using a population-based cohort that reflected the entire population of Korea. Additionally, we hypothesized that detailed climate-related data could greatly contribute to answering this research question.

Methods

Study population

This nationwide, population-based, cross-sectional study utilized the compulsory health insurance claims records from January 2010 to December 2019, deposited in the Korean National Health Insurance (NHI) database. The following records were included: date of birth, region of residence, sex, and date of hospital visit.

We identified patients with peritonsillar, retropharyngeal, and parapharyngeal abscesses who were assigned with the following diagnostic codes as a principal or first additional diagnosis: The International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM) codes J36 (peritonsillar abscess), J39.0, and J39.1 (retropharyngeal and parapharyngeal abscess and other abscess of the pharynx). The age of patients was categorized as < 10, 10–19, 20–29, 30–39, 40–49, 50–59, 60–69, and ≥ 70 years.

We calculated the seasonal ratio as the ratio of the highest to the lowest number of patients per month of each studied year to compare the degree of seasonality for each condition [5]. Notably, each month may have a different number of working days due to vacations or national holidays. Thus, we standardized the monthly patient number of each disease by the number of patients with diabetes mellitus (E10-15, and R81) under the assumption that diabetes mellitus would have the least seasonal variation.

Correlation analysis between climate factors and deep neck space abscesses

We acquired climate-related data for the aforementioned period from the Korean Meteorological Administration. Climate data included average temperature, daily temperature range, relative humidity, monthly aggregate precipitation, sunlight rate, average ground temperature, particulate matter < 10 μ m (PM10), ultraviolet A (UVA) dose, and ultraviolet B (UVB) dose of each month.

Pearson's correlation was used to determine the association between monthly patient numbers and various climate factors for peritonsillar, retropharyngeal, and parapharyngeal abscesses. Pearson's correlation coefficients R and P values were calculated to determine the relevant climate factors in deep neck space abscesses.

Statistical analysis

The R software package, version 4.2.1 (<http://www.r-project.org>) was used for all the statistical analyses. The prevalence of patients in the period 2010–2019 was visualized using the ggplot2 and ggpmisc packages. The annual incidence of each disease according to age and sex was also described. Correlations, including R and P values, between monthly patient numbers and climate factors were described using the ggpubr package. Statistical significance was set at $P < 0.05$.

Results

Seasonal and climatic relevance for peritonsillar abscesses

Figure 1A shows the seasonality of peritonsillar abscesses from 2010 to 2019. Patient numbers were highest between December and April and lowest in August every year. In other words, patient numbers were relatively highest in the winter to spring period and lowest in summer. Seasonal variation was > 2 for peritonsillar abscesses (seasonal ratio: 2.03). Peritonsillar abscesses were most prevalent in females aged < 10 years (Fig. 2A, B). However, the < 10 years age group showed the lowest seasonality (seasonal ratio: 1.69) and also showed seasonal variations (highest from spring to summer and lowest in autumn). The highest seasonality was observed in the 10–19 years age group (seasonal ratio: 2.99), followed by the 60–69 years age group (2.75).

In the analysis of the association with climate factors, peritonsillar abscesses were negatively correlated with average temperature, average ground temperature, relative humidity, and monthly aggregate precipitation (Pearson's R values were 0.427, 0.401, 0.577, and 0.280, respectively; Fig. 3A–D). In contrast, the daily temperature range and monthly PM10 were positively associated with the occurrence of peritonsillar abscesses (Pearson's R values were 0.240 and 0.430, respectively; Fig. 3E and F).

Seasonal and climatic relevance for retropharyngeal and parapharyngeal abscesses

The seasonality of retropharyngeal and parapharyngeal abscesses was similar to that of peritonsillar abscesses (Fig. 1B). Patient numbers were highest between December and April and lowest in August every year. However, the ratio of retropharyngeal and parapharyngeal abscesses to peritonsillar abscesses changed from 17.58–29.37% (January 2010 to December 2019). Similar to peritonsillar abscesses, seasonal variation was > 2 in retropharyngeal and parapharyngeal abscesses (seasonal ratio: 2.15). Retropharyngeal and parapharyngeal abscesses were most prevalent in females aged 30–39 years (Fig. 2C, D). The highest seasonality was observed in the 10–19 years age group (seasonal ratio: 3.19), followed by the 50–59 years age group (2.66).

In the analysis of the association with climate factors, retropharyngeal and parapharyngeal abscesses were negatively correlated with average temperature, average ground temperature, relative humidity, and monthly aggregate precipitation (Pearson's R values were 0.360, 0.343, 0.463, and 0.326, respectively; Fig. 4A-D), similar to peritonsillar abscesses. However, the daily temperature range and sunlight rate were positively correlated with retropharyngeal and parapharyngeal abscesses (Pearson's R values were 0.321 and 0.305, respectively; Fig. 4E and F).

Discussion

This study analyzed the seasonality of peritonsillar, retropharyngeal, and parapharyngeal abscesses according to the patient's sex and age group. The number of peritonsillar, retropharyngeal, and parapharyngeal abscesses was highest in winter and spring and lowest in summer in the 2010–2019 period. Additionally, female predominance in these diseases was observed. The highest numbers of peritonsillar abscesses were reported in patients aged < 10 years, whereas retropharyngeal and parapharyngeal abscesses were most prevalent in patients aged 30–39 years.

A peritonsillar abscess is a collection of pus between the pharyngeal constrictor muscle and tonsillar capsule, and constitutes the most common deep neck space abscess type [6]. The majority of medical textbooks describe a peritonsillar abscess as a complication of acute tonsillitis [7]. Group A *Streptococcus* (GAS) and *Fusobacterium necrophorum* (FN) are both prevalent pathogens in the peritonsillar abscess [8]. Klug et al. found that the ratio between GAS and FN was highly dependent on the season (FN > GAS and GAS > FN in summer and winter, respectively) [8]. In addition, the relative incidence of GAS- and FN-infected patients with peritonsillar abscesses was highly dependent on age. Our study found an increased incidence of peritonsillar abscesses from winter to spring in all age groups. However, patients younger than 9 years showed an increased incidence in spring and summer.

Previous studies on deep neck abscesses have shown that the male-to-female ratio varies from male predominance [9] to female predominance [1]. In our study, we observed female predominance with a male-to-female ratio of 1:1.25. Peritonsillar abscesses commonly occur in adults aged 20–40 years [10]. Our study showed a peak distribution of peritonsillar abscesses in patients under 10 years of age, followed by patients aged 30–39 years. Frequent hospital visits at a young age (< 10 years) are thought to be related to the age distribution of patients with peritonsillar abscesses.

Retropharyngeal and parapharyngeal abscesses are often termed deep neck space abscesses, arising at one of two adjacent anatomical spaces in the neck [2]. The mean annual incidence rate of retropharyngeal and parapharyngeal abscesses has increased in recent years [11, 12]. Our study also showed an increasing tendency for retropharyngeal and parapharyngeal abscesses in the 2010–2019 period. The seasonality of retropharyngeal and parapharyngeal abscesses (with predominance in winter-spring) reported here supports the findings of another study on pediatric patients (≤ 20 years old) from the Kids' Inpatient Database of US 2003–2012 [13]. Female predominance (1:1.34) was observed for retropharyngeal and parapharyngeal abscesses in that study, similar to our observations of peritonsillar

abscesses. The peak distribution of retropharyngeal and parapharyngeal abscesses was 30–39 years, unlike that of peritonsillar abscesses. Analysis of additional risk factors for deep neck space abscesses will be necessary to determine the cause of these differences.

In this study, patients with deep neck space abscesses showed similar seasonality (highest in winter) but slightly different aspects (different usual age and peak). The common predisposing etiologic factor of deep neck space abscesses might be upper respiratory infection (common cold), pharyngitis, and tonsillitis. However, peritonsillar, retropharyngeal, and parapharyngeal abscesses are caused by slightly different causes in different predisposing age [14]. Incidence of peritonsillar abscess is associated with increasing acute tonsillitis in winter seasons. The occurrence of retropharyngeal and parapharyngeal abscesses in older ages is highly associated with dental manipulation as well as tonsillitis [15]. The common etiologic factors in children for retropharyngeal abscess are upper respiratory tract infections [16]. In addition, the origin of parapharyngeal abscess remains unknown because the sore throat may clear by the time of presentation.

In this study, detailed monthly climate data were acquired from the Korean Meteorological Administration and analyzed to determine the association between climate factors and deep neck space abscesses. A previous study showed that peritonsillar abscesses were positively correlated with monthly average and maximum temperatures and were not correlated with relative air humidity and precipitation [1]. However, that study was conducted on patients admitted to one tertiary hospital and differed from the present study on outpatients. Another previous study showed that peritonsillar abscesses were not correlated with meteorological conditions such as temperature and humidity [17]. However, that study did not analyze the entire Korean population, but only a sample cohort from the Korean Health Insurance dataset, and observed differences between patients and normal groups. In the current study, we analyzed climate data and corresponding patient data in one country during every month in a 10-year period, and found that peritonsillar abscesses were negatively correlated with several climate factors, including average temperature, ground temperature, relative humidity, and precipitation. In contrast, daily temperature range and monthly PM10 were positively correlated with peritonsillar abscesses. In this line, PM10 affects host defense mechanisms and is associated with various airway diseases [18].

In addition, the association between climate factors and retropharyngeal and parapharyngeal abscesses has not been discussed to date. Our study showed that retropharyngeal and parapharyngeal abscesses are characterized by a comparable degree of seasonality as peritonsillar abscesses. Retropharyngeal and parapharyngeal abscesses were also correlated with several climate factors, including average temperature, ground temperature, relative humidity, precipitation, and daily temperature. PM10 showed a weaker correlation with retropharyngeal and parapharyngeal abscesses than with peritonsillar abscesses. Instead, the sunlight rate showed a strong correlation with retropharyngeal and parapharyngeal abscesses. We hypothesize that this observation is related to the stronger seasonality of retropharyngeal and parapharyngeal abscesses compared to peritonsillar abscesses.

Our study is not free from certain limitations. First, the utilized medical claims database uses diagnostic coding rather than medical chart records. Second, there is a lack of information on other social factors, such as medical history, smoking, and alcohol consumption history, that may affect the incidence of deep neck abscesses. However, the medical claims database included most patients in Korea, significantly reducing the selection bias. Finally, the unique characteristics of each region could not be considered because the monthly climate data used were the national average data of the whole of Korea.

To the best of our knowledge, this is the first study to comprehensively analyze the seasonality and climatic relevance of neck space abscesses using a large population database and meteorological data. We focused not only on determining the seasonality of peritonsillar, retropharyngeal, and parapharyngeal abscesses, but also on determining their correlation with detailed climate data in the period of 10 years.

Conclusion

In conclusion, we performed a large population-based study which demonstrated a clear link between the incidence of peritonsillar, retropharyngeal, and parapharyngeal abscesses and seasonal and climate factors. Further studies investigating more specific demographic factors affecting deep neck abscesses are needed to characterize these diseases in more detail.

Declarations

Ethics approval and consent to participate

This study was reviewed and approved by the Institutional Review Board of Kyung Hee University Hospital at Gangdong (2022-05-060). The NHI database provides only de-identified previously collected data that do not require privacy regulation for public health research and policy development. In addition, the data could be accessed with the permission of the Korean Health Insurance Review & Assessment Service. Therefore, the data used in our research is allowed to be made publicly available. In this reason, written informed consent was exempted by the Institutional Review Board.

Consent for publication

Not applicable

Availability of data and materials

The researchers can access on the intranet of Korean Health Insurance Review & Assessment Service through the URL <http://opendata.hira.or.kr/home.do> after approval of the request. The researchers can request the same periods, terms and items (claim codes) as done in this study. The authors did not have any special access privileges that others would not have.

Competing interests

The authors declare no conflicts interest.

Funding

None

Authors' contributions

SIK, YGE, and YCL designed the study and wrote the manuscript text.

SIK, HHL, and YCL analyzed the results.

SIK, HHL, and YCL designed the figures and tables.

HHL, YGE, and YCL reviewed and edited the paper.

All authors have read and approved the manuscript writing

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Authors' information (optional)

None

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Figures

Fig. 1

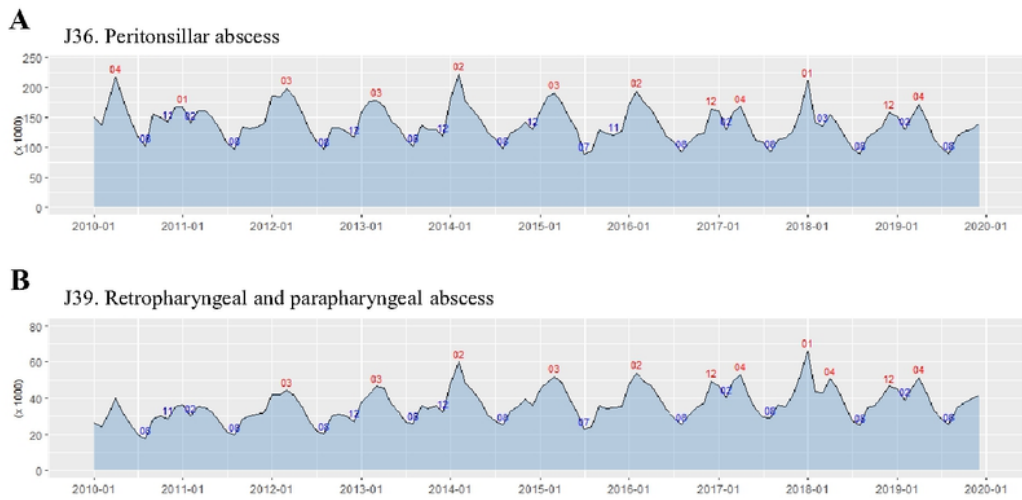


Figure 1

The prevalence of deep neck space abscesses between 2010 and 2019 in Korea.

(a) The prevalence of peritonsillar abscesses and (b) retropharyngeal and parapharyngeal abscesses.

Fig. 2

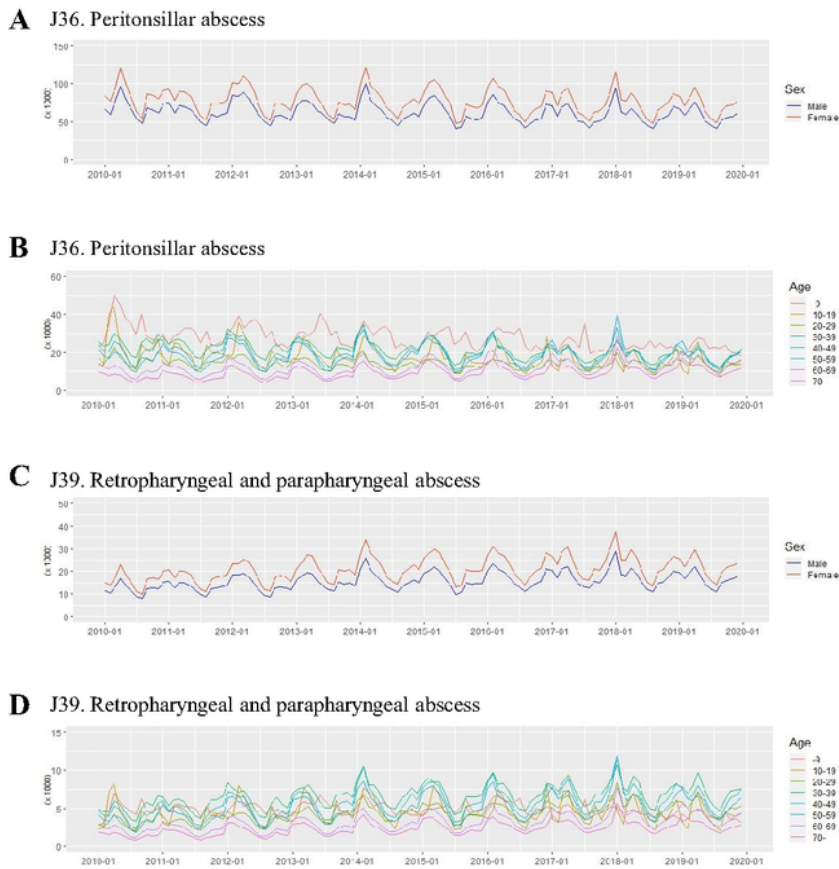


Figure 2

The prevalence of deep neck space abscesses according to sex and age group.

(a, b) The prevalence of peritonsillar abscesses and (c, d) retropharyngeal and parapharyngeal abscesses according to sex and age group between 2010 and 2019 in Korea.

Fig. 3

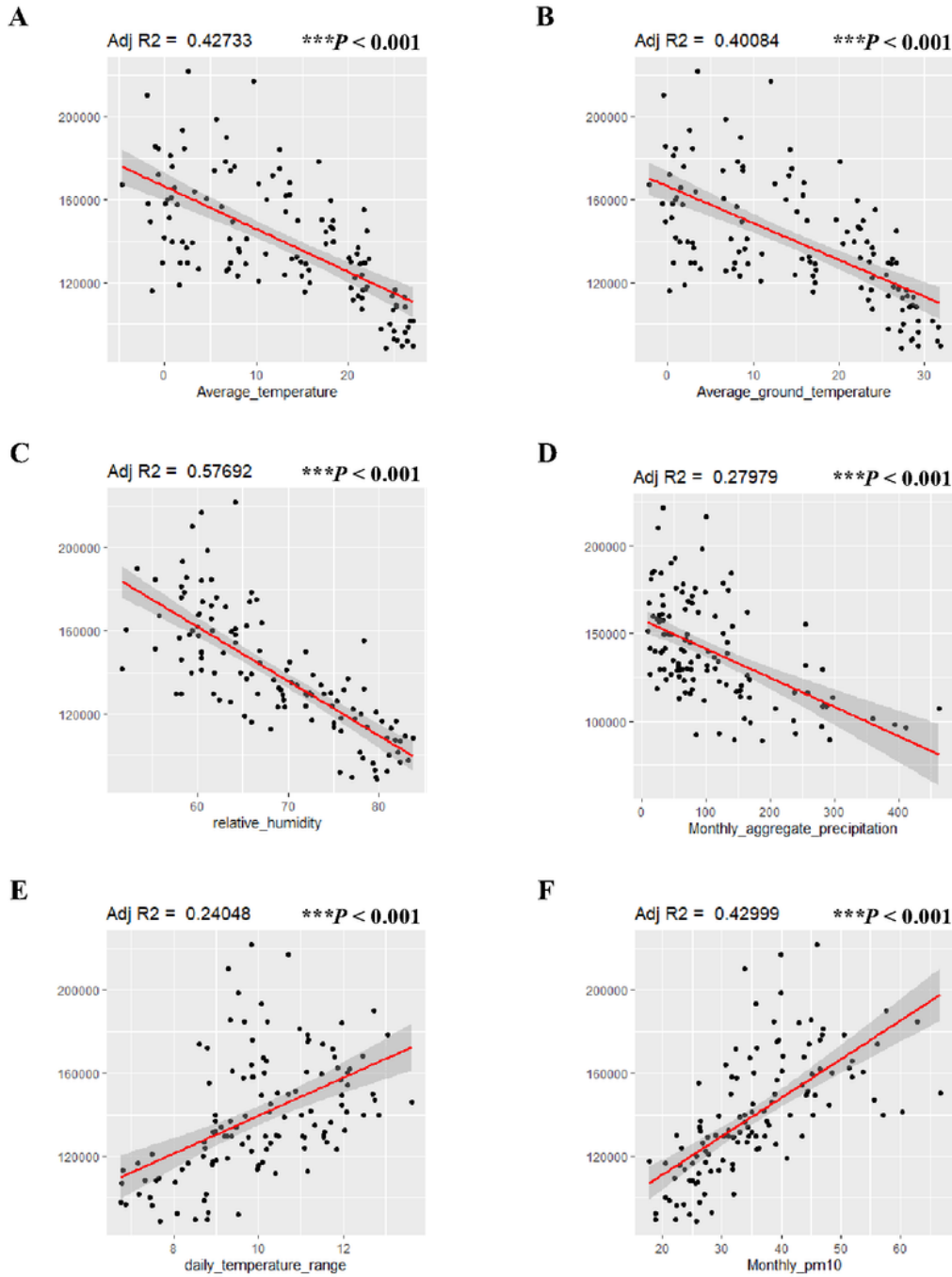


Figure 3

Correlation between monthly incidence of peritonsillar abscesses and climate factors.

Correlation between peritonsillar abscesses and (a) average temperature, (b) average ground temperature, (c) relative humidity, (d) monthly aggregate precipitation, (e) daily temperature range, and (f) particulate matter < 10 μm (PM10). *** $P < 0.001$

Fig. 4

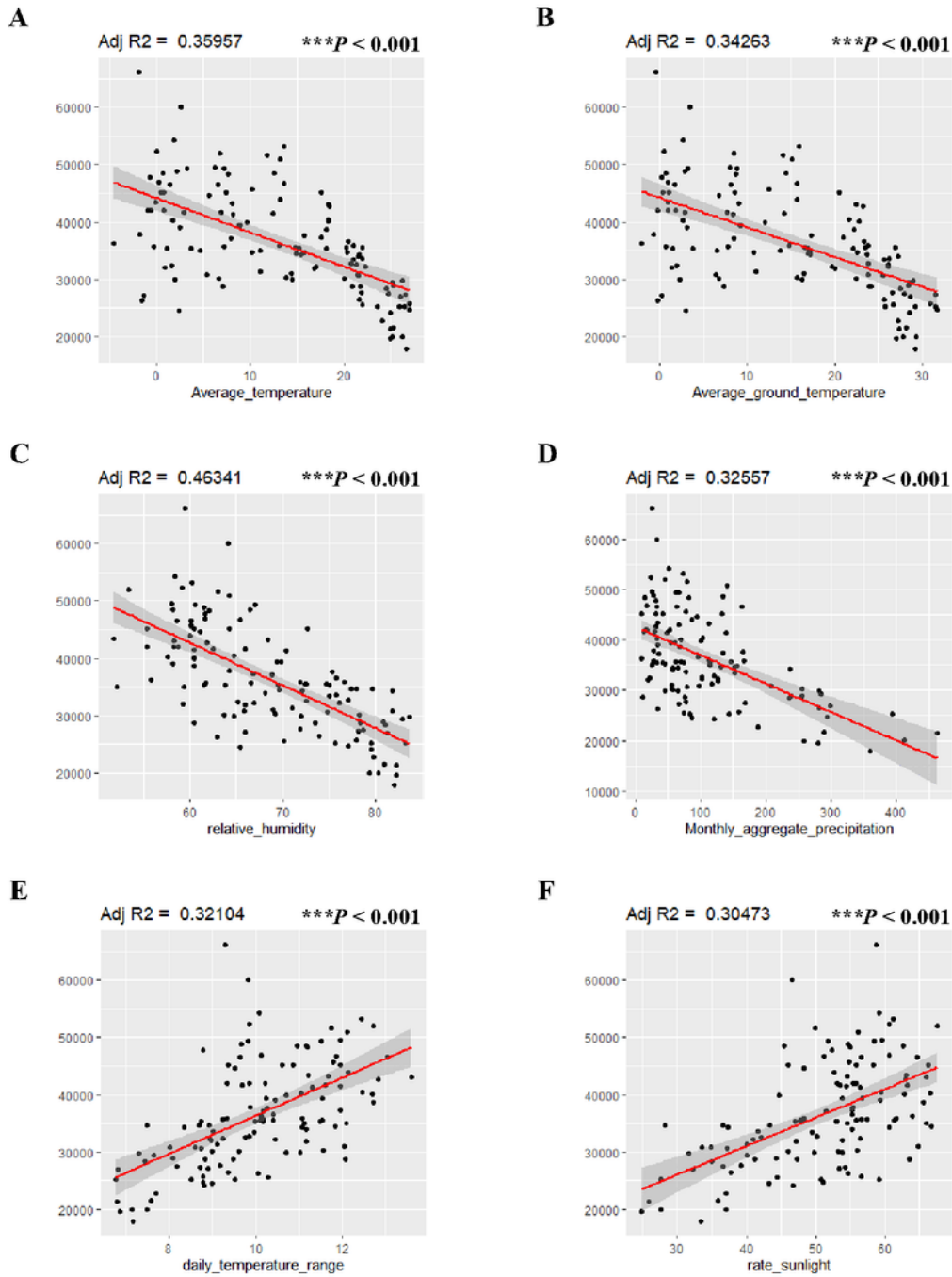


Figure 4

Correlation between monthly incidence of retropharyngeal and parapharyngeal abscesses and climate factors.

Correlation between retropharyngeal and parapharyngeal abscesses and (a) average temperature, (b) average ground temperature, (c) relative humidity, (d) monthly aggregate precipitation, (e) daily

temperature range, and (f) sunlight rate. *** $P < 0.001$