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Original Article

# Impact of weather conditions and blood groups on primary spontaneous pneumothorax

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## ABSTRACT

**Background:** Primary spontaneous pneumothorax (PSP) is a clinical condition with an unclear etiology that occurs because of the rupture of pleural bulla or blebs. Several studies indicating the impact of weather conditions on PSP are present. However, the results are varying. The correlation between blood groups and PSP is yet unknown. In this study, we investigated the impact of altering weather conditions atmospheric pressure (AP), temperature, moisture, and wind velocity (WV) and blood groups on PSP.

**Materials and Methods:** Eighty-six patients PSP diagnoses who were under follow-up and treated in our clinic between 2007 and 2015 were included in our study. Patients' data were retrospectively collected from hospital database patient files. The Regional Directorate of Meteorology provided data on weather conditions.

**Results:** The collected data was examined. According to the results, AP and WV had no significant impact on PSP. Regarding the air temperature, values were statistically significantly high ($p = 0.019$). When comparing with other blood groups, the blood group with the highest resistance to temperature was type-0. This result was statistically significant ($p = 0.029$).

**Conclusions:** In this study, we determined that temperatures above 15°C had an unexpected effect on the site of the PSP. Surprisingly, PSP risk was lower in patients with blood type-0 at high temperatures. We suggest that multicenter studies with a more extensive sample size should be conducted to fully understand the impact of air condition and blood type on PSP.

**Keywords:** air condition, blood group, primary spontaneous pneumothorax

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## Introduction

Primary spontaneous pneumothorax (PSP) is defined as the presence of air in the thoracic cavity without trauma, and symptoms include chest pain and shortness of breath [1-4]. In general, there is no underlying pulmonary disease [4-7]. PSP is thought to be developed due to air leakage as a result of the rupture of alveolar structures to the pleural space [5-7].

According to some authors, PSP cases occur in short periods, and it was suggested that this might develop due to transpulmonary pressure differences based on the weather changes [2,3,8]. Again, some authors suggest that PSP is a type of meteoropathia occurring in unexpectedly low atmospheric pressures (AP) [5,6]. Although many studies have been conducted on etiology, PSP is still a manifestation of uncertainness [9]. Though not fully proven, it is thought to be associated with changes in the weather conditions [2,3,8,10,11].

To our knowledge, in the English literature, there is no study or researches done investigating the correlation between blood groups and PSP. In our study, we investigated the impact of weather conditions (atmospheric pressure (AP), temperature, moisture, and wind velocity (WV)) and blood groups on PSP.

## Materials and Methods

86 patients with PSP diagnoses who were followed up in our clinic between 2007 and 2015 were included in the study. The age, gender, blood group, and applied treatment data were retrospectively scanned from the patient files. The patients were diagnosed with posteroanterior (PA) X-ray in the emergency department. Patients who were diagnosed with iatrogenic, traumatic, or secondary pneumothorax were not included. This study was approved by the Ethics Committee of Selçuk University (Letter no: 2017/325).

### *Meteorological Data*

Meteorological data were provided from the Regional Directorate of Meteorology. Temperature (°C), moisture (%), air pressure (hPa), and wind velocity (m/sec) values between 2007 and 2015 were assessed. Meteorology values of the patients' application day and four days before the application were assessed for therapeutic purposes.

## Statistical Analysis

The statistical analyses of the study were performed with SPSS 21 software. Of the numerical values in the study, temperature and wind velocity parameters were analyzed with the Shapiro-Wilk test and hypothesis, ensuring approach to normal distribution was rejected. Therefore, the statistical analysis of these parameters was examined with One Way ANOVA, which is a parametric test, and the independent t-test. When analyzing moisture, air pressure, and WBC variables with the Shapiro-Wilk test, the hypothesis ensuring the approach of the present parameters to normal distribution was rejected. Thus, the mentioned parameters were analyzed with the nonparametric Kruskal Wallis and Mann Whitney U tests. During the research phase, since "days without disease" were not detected, literature research was conducted to review the differences between days with and without the disease. In line with the reviewed studies, it was seen that temperature from meteorological data tended to be averagely 15°C on days with the disease. Based on this data, some evaluations were made, and meaningful results were achieved. Moreover, definitive statistics for categorical variables were expressed as "n" and percentage, while statistics for numerical variables were expressed as minimum-maximum value and mean- standard deviation. In all analysis techniques, an error level of 0.05 was considered, and, thus, decisions were made at a confidence interval of 95%.

## Results

According to the population census in 2007, the population of the city our study was conducted in was 638,464, and the altitude of the location was 1,285 m. The study was performed in the Middle-Anatolian region with an arid climate. 86 PSP cases were investigated. Of the cases, 74 (86%) were male, and the mean age was 37.34 ± 16.12 years. When analyzing patient files, the blood type of 61.6% of the patients was type-A, 15.1% was the type- B, 16.3% 0, and 7% was type-AB. Right site pneumothorax was seen in 65.1% of the patients. Descriptive features of patient results and treatment methods are presented in Table 1.

| **Table1.** Descriptive features of PSP patients. | | | |
|---|---|---|---|
| | | Mean±standard deviation | Frequency values (%) |
| Age | | 37.34±16.12 | - |
| Gender | Male | - | 74-86% |
| | Female | | 12-14% |
| Site | Right | - | 56-65.1% |
| | Left | - | 30-34.9% |
| Treatment | Bulla excision | - | 10-11.6% |
| | Tube thoracostomy | - | 49-57.0% |
| | Thoracentesis | - | 2-2.3% |
| | Nasal oxygen | - | 16-18.6% |
| | Tube thoracostomy - Bulla excision | - | 6-7.0% |
| | Thoracentesis - Nasal oxygen | - | 2-2.3% |
| | Tube thoracostomy - VATS | - | 1-1.2% |
| Blood Groups | A | - | 53-61.6% |
| | B | - | 13-15.1% |
| | O | - | 14-16.3% |
| | AB | - | 6-7.0% |

While mean air temperature at the time of admission to the healthcare facility was detected as 9.88 ± 9.04°C, the moisture was found as 61.72 ± 12.34%. Moreover, mean air pressure was identified as 871.53 ± 3.834 hPA, while wind velocity was detected as 2.569 ± 0.740 m/sec. Meteorological values were calculated on the day of patients' admission to the hospital and the four days before the admission (Table 2).

| **Table 2.** The meteorological data. | |
|---|---|
| Air Condition | Mean±Standard Deviation |
| Temperature (°C)* | 9.88±9.04 |
| Moisture (%)* | 61.72±12.34 |
| Air pressure (hPa )* | 871.53±3.834 |
| Wind velocity (m/sec) * | 2.569±0.740 |

**Meteorological findings were calculated upon the mean of the day of patient's admission to the hospital with the therapeutical aim and 4 days before.*

Considering a cut-off value of 15°C, we reviewed the impact of meteorological parameters on PSP in two different periods, one with the temperature above and one under this value, separately. At >15°C, the mean temperature during the period when patients experiencing a pneumothorax attack on the right site applied to the hospital was found 19.87 ± 3.18°C, while this was found as 17.61 ± 1.83°C during the period when patients were experiencing an attack on the left side, and this difference was found to be statistically significant (p = 0.019) (Table 3).

While mean moisture was found 49.66 ± 9.75% during the period when patients with PSP on the right site applied to the hospital, this value was 57.12 ± 8.11% with patients with left-side PSP. In addition, these values were found to be statistically significantly high (p = 0.041) (Table 3).

| **Table 3.** Descriptive features on PSP patient's results at temperatures above 15°C. | | | | | | |
|---|---|---|---|---|---|---|
| | | Temperature | Moisture | Air pressure | Wind velocity | WBC |
| Site* | Right | 19.87±3.18 | 49.66±9.75 | 871.20±2.68 | 3.05±0.71 | 9769.56±3262.79 |
| | Left | 17.61±1.83 | 57.12±8.11 | 871.80±1.78 | 2.85±0.65 | 8611.11±2686.74 |
| p Value | | 0.019 | 0.041 | 0.472 | 0.468 | 0.317 |
| Blood Groups* | A | 19.04±2.88 | 50.17±10.57 | 871.42±2.14 | 3.08±0.63 | 10026.31±3357.22 |
| | B | 18.29±2.41 | 55.28±3.91 | 871.06±3.31 | 3.15±0.70 | 8066.66±3013.08 |
| | O | 23.92±3.06 | 50.63±14.88 | 869.71±1.49 | 2.54±0.94 | 10100.00±2151.74 |
| | AB | 18.09±1.65 | 54.84±9.72 | 872.85±3.00 | 2.70±0.82 | 8250.00±2469.14 |
| p Value | | 0.029 | 0.658 | 0.468 | 0.317 | 0.476 |

**Results belong are from the period with the temperature above 15°C.*

While air temperature during the period when patients with blood type-A applied to the hospital was 19.04 ± 2.88°C, this value was 18.29 ± 2.41°C for blood type-B, 23.92 ± 3.06°C for type-0 and 18.09 ± 1.65°C type-AB. When comparing with other blood types, the most temperature- resistant ones were the patients with blood type-0. This difference was found as statistically significant (p = 0.029) (Table 3). There was no statistical correlation between the PSP side and air temperatures below 15°C (p = 0.483). Again no statistical difference was found between the PSP side and the mean air pressure values (p = 0.763). At the hottest period, patients that applied to the hospital were found to be blood type-AB, while at the coldest temperature values, type-B applied dominantly. However, this present difference was not statistically significant (p = 0.173). When investigating both periods separately, a significant impact of AP and WV on SP was found.

## Discussion

According to the literature, meteorological events play a role in the pathogenesis of various diseases. These include many diseases, ranging from sudden hearing loss to facial paralysis, from arthritis to rupture of abdominal aortic aneurysm. One of the diseases whose pathogenesis is thought to be affected by changes in weather conditions is spontaneous pneumothorax. Changes in weather conditions may change airway pressure. The visceral pleura covering the blebs is weak. Therefore, blebs are capable of tearing. Moreover, changes in airway pressure can cause blebs to rupture. There are many studies in the literature regarding this issue [7].

Meteorological events in our city that occurred during the period PSP was seen were investigated. When we assessed the achieved data, we found that changes in AP and WV had no impact on PSP. Regarding this fact, studies have found variable results in the literature. Yamaç et al reported that there was no correlation between the frequency of spontaneous pneumothorax (SP) and AP alterations. However, it was seen that primary SP appears to occur more frequently in fall and secondary SP in summer. Again, in their study, an association between moisture and SP was found. Also, they concluded that wind velocity was slower on SP days [2]. In another study by Çelik et al, it was also observed that AP, temperature, and moisture showed no significant difference on days with and without SP. Although they considered that SP episodes are more frequent in June and November, the results were not statistically significant [3]. In our study, we found a significant difference between moisture and the site of pneumothorax. We suggest that this difference is due to the anatomic variation of hemithoraxes. Alifano et al demonstrated that there was no correlation between atmospheric temperature and SP groups, and AP had no impact on SP, but that it caused an increase of symptoms, contributing to diagnosis. In contrast, when analyzing minimum and maximum AP values on the baseline and the day before, a correlation was identified. SP and stormy days were found to be strongly correlated [5]. The results of the study by Smit et al. showed that AP had no impact on SP. However, they found that temperature alteration is correlated with SP [6]. Obuchi et al. support our results about the impact of AP on SP [10].

Bertolaccini et al demonstrated a correlation between daily WV and SP. However, no association between alteration in AP and temperature and SP was found [12]. Besides, Scott et al showed no strong relation between AP alterations and SP [13]. In terms of AP and impact on SP, in the most extensive series in literature published by Haga et al in 2012, it was shown that the decrease of AP played a significant role in the occurrence of SP [1]. In the study by Özpolat et al, no significant correlation between SP and season and months was shown [7]. In the study by Vodicka et al, significant differences in air temperature on days when SP was seen was identified. Although they had shown that WV is higher on days when SP occurred, it was shown that the storm had no impact on SP. They have shown a significant correlation between AP and SP [8]. Araz et al demonstrated that SP was associated with air-related factors and that AP, moisture, and temperature had an impact on SP development [9]. Obuchi et al had shown that a decrease in sunny days and an increase of temperature two days before was efficient on SP occurrence [10]. Mishina et al had identified that a decrease in AP had an indirect impact on SP development and that AP alteration on days of SP development was inefficient, while AP changes 24-96 hours before had an impact on SP development [11]. Diversely, in our study, we identified that temperature values above 15°C and moisture parameters had no unexpected impact on the side of SP. Surprisingly, patients with blood type-0 were at lower SP risk at high temperatures. We think this is related to the absence of

A and B antigens in that blood group. The limited number of patients restricted our study.

When scanning the literature, we saw that studies were conducted at different altitudes in countries and cities with different climates. Thus, we consider that this fact may have caused to the achievement of various results.

The main limitation of this study is the limited number of cases.

In conclusion, to fully understand the impact of air condition and blood group on PS and each other, we suggest that multicenter and more extensive studies with similar altitudes and climatic factors should be conducted.

## Declaration of conflicting interests

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