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THE INFLUENCE OF METEOROLOGICAL PARAMETERS ON THE ASTHMATIC ATTACKS IN CHILDREN

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1. INTRODUCTION

Asthma is one of diseases very much influenced by weather. The most authors emphasise the relation between asthmatic attacks and low temperatures or cooling. Tromp (1957, 1963, 1977, 1980) and Tromp and Bouma (1965) established the influence of cold air masses at the greater number of asthmatic attacks, specially polar and continental ones. Derrick (1969) and Goldstein (1980) emphasise the relation between asthmatic attacks and the passage of cold front, and Derrick points the unfavourable influence of cold and dry polar air masses. Similar results are observed in Yokohama (Aihara et al, 1996), Birmingham (McGregor et. al, 1996) and Tokyo (Ito et al, 1999). In Yokohama the mortality from asthmatic attacks was greater in situations with lower temperatures and air humidity, and higher air pressure. In the hospital in Birmingham the acceptance of the patients with asthmatic attacks was greater in cold anticyclonic situations, while in Tokyo in situations with atmospheric cooling. At the other hand, Millquist (1995) refers at the beneficial influence of the warm and wet air therapy in prevention of asthma induced by cold air. At the contrary, Ito et al (1989) found the unfavourable influence of high temperatures at asthmatic patients.

2. DATA AND METHOD

The frequency and intensity of asthmatic attacks have been determined on the basis of observations deduced for patients in Hospital for lung diseases with children in Zagreb during 1984. The meteorological data were measured at the meteorological station Zagreb-Maksimir. The influence of mean, minimum and maximum daily temperatures, daily temperature ranges, relative humidity, air pressure, insolation, wind speed, interdiurnal changes of temperature and air pressure, thermal sensation and stability of the atmosphere at the asthmatic attacks was studied.

The correlation between meteorological parameters and asthmatic attacks were analysed taking into account not only the frequency but also the intensity of asthmatic attacks. The appearance of asthmatic attacks was taken with different weight depending on their intensity (weighted asthmatic attacks). The frequency of easier asthmatic attacks were taken without changes, the frequency of asthmatic attack of medium intensity were multiplied by 2 and the frequency of heavy asthmatic attacks were multiplied by 3.

It was supposed that the greater number of asthmatic attacks in a day is influenced by weather. Therefore the days (“n” days) with more than $>\overline{x}+\sigma$ weighted asthmatic attacks (mean plus standard deviation) were chosen. The influence of weather was investigated by means of correlations between meteorological parameters in 7-day period with “n” day in the centre and three days before and after it (n±3) and the frequency of asthmatic attacks in the “n” day. Namely, it was supposed that the asthmatic attacks are not influenced by the weather only simultaneously but also by the weather in the neighbouring days. The analysis is deduced for all seasons and for the cold (from October to March) and warm part of the year (from April to September) .

3. RESULTS

During the analysed period 84 children were treated in the hospital. Some of them were accepted in hospital several times, some of them only once. There were 323 asthmatic attacks, but 634 weighted asthmatic attacks. There were 54 situations with more than $\overline{x}+\sigma$ asthmatic attacks. The attacks were the most frequent in May (38), the rarest in February (13). It can be supposed that hay fever may be partially the reason for the great number of asthmatic attacks in May.

The analysis showed that the relation between asthmatic attacks and meteorological parameters is strongest during winter, summer and during cold part of the year. In winter the correlations between asthmatic attacks and temperature parameters are the strongest showing more asthmatic attacks in cold situations (Tab. 1). The negative correlation coefficients between asthmatic attacks and mean, maximum and minimum air temperatures appear in the most days of the 7-day period around the “n” day, while are significant only for the mean and maximum temperatures two days after the “n” day. The negative correlation coefficients between thermal comfort index TWH (Zaninovic, 1992) and asthmatic attacks, although insignificant, confirm the unfavourable effect of cold winter periods on the asthmatic patients. Further, there are as more asthmatic attacks as air pressure is higher, the relative humidity lower, with longer insolation, stronger wind, lower daily

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temperature range, during cooling and when the air pressure rises. Although these correlations are insignificant, the results considered together point at cold, clear and dry winter anticyclonic situations as dangerous for the asthmatics. The analysis of asthmatic attacks and weather types showed similar result (Zaninovic, 1999).

The relation between low air temperatures and asthmatic attacks is even more evident for the whole cold part of the year. The negative correlation coefficients appear for all temperature parameters, and they are significant for 1, 2 and 3 days after the "n" day. The negative correlation with thermal comfort is significant in "n" and "n+1" day. The influence of high air pressure, cooling and air pressure rising in the period around the day with a lot of asthmatic attacks is more pronounced than during winter.

During summer the relations between air temperatures and asthmatic attacks are weaker than during the winter. Although insignificant, the correlations between temperatures and frequency of asthmatic attacks are negative at the beginning of 7-day period around the "n" day. In the "n" day the correlations between mean and maximum temperatures and asthmatic attacks frequency become positive. The relations with other meteorological parameters during summer indicate that the greater frequency of asthmatic attacks appear in situations with greater daily temperature range, low relative humidity, stronger wind, high air pressure and longer insolation, warming and stable atmosphere (positive dt/dz). However, at the end of the 7-day period around the "n" day, in "n+2" and "n+3" days, the correlation coefficient for most parameters change the sign, indicating at the weather change manifested by cooling, lower daily temperature range, fall of the air pressure and shorter insolation. Although most of these correlations are insignificant, their combination indicates at the unfavourable influence of summer anticyclones followed by weather change. The result also agrees with the results got for relations between asthmatic attacks and weather types (Zaninovic, 1999).

The relations between asthmatic attacks and meteorological parameters during spring and autumn are weaker than during summer and winter, especially for the temperature parameters. It doesn't surprise because of the great temperature range in these seasons.

4. CONCLUSION

The correlations between asthmatic attacks and meteorological parameters during, winter, summer and cold part of the year indicate at the characteristic weather patterns unfavourable for the asthmatic patients, but not for the spring, autumn and warm part of the year. It seems that during winter and summer the greater number of asthmatic attacks appears in dry anticyclonic situations. During winter these are cold situations, often with very low temperatures. Unfavourable summer situations are anticyclones often very warm and followed by the cold front.

The results agree with the results referred by other authors. According to Derrick (1969), the inefficient thermoregulation system in asthmatics could be the reason for direct influence of coldness, especially in situations with abrupt temperature decrease. Cold air can irritate the respiratory mucosa by the drying effect, as it must become unsaturated when warmed to 37^oC. On the other hand, the dry air can have the cooling effect, as moisture evaporates from the mucosa.

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Table 1. Correlation coefficients between meteorological parameters and frequencies of weighted asthmatic attacks in days around the "n" day with $> \overline{x} + \sigma$ asthmatic attacks Shadings denote the significant correlation coefficients at the level 0.05 (light) and 0.01 (dark). Zagreb, 1984.

	n-3	n-2	n-1	n	n+1	n+2	n+3
WINTER							
t	0.19	0.05	-0.11	-0.56	-0.50	-0.72	-0.55
t_{max}	0.34	-0.03	-0.09	-0.45	-0.54	-0.75	-0.39
t_{min}	0.01	0.25	-0.09	-0.45	-0.38	-0.59	-0.29
t_A	0.34	-0.16	-0.05	0.23	-0.09	-0.33	-0.05
U	-0.30	-0.34	-0.43	-0.32	0.01	0.14	0.28
v	0.26	0.32	0.35	0.05	-0.25	-0.35	-0.56
p	0.40	0.47	0.49	0.52	0.56	0.60	0.66
S	0.51	-0.15	0.37	0.30	0.36	0.12	-0.29
dt/dz	-0.37	0.30	0.16	0.13	0.19	-0.07	0.12
dt		-0.17	-0.17	-0.49	-0.20	-0.18	0.39
dp		0.04	0.30	-0.14	0.11	0.27	0.30
TWH	-0.19	-0.28	-0.34	-0.40	-0.21	0.07	0.34
COLD PART OF THE YEAR (X-III)							
t	-0.04	-0.16	-0.26	-0.38	-0.51	-0.55	-0.48
t_{max}	-0.02	-0.21	-0.28	-0.36	-0.48	-0.46	-0.42
t_{min}	-0.19	-0.06	-0.27	-0.44	-0.46	-0.59	-0.43
t_A	0.18	-0.29	-0.18	-0.05	-0.29	-0.14	-0.22
U	-0.37	-0.29	-0.23	-0.25	0.01	0.11	0.18
v	0.32	0.28	0.25	0.33	-0.15	-0.19	-0.35
p	0.06	0.32	0.27	0.34	0.45	0.41	0.35
S	0.20	-0.22	-0.22	-0.09	-0.15	-0.19	-0.19
dt/dz	-0.02	0.05	0.01	-0.28	0.18	0.02	0.17
dt		-0.30	-0.34	-0.33	-0.31	-0.16	0.25
dp		0.32	0.04	0.09	0.11	-0.07	-0.08
TWH	-0.21	-0.29	-0.32	-0.46	-0.39	-0.28	-0.20
SUMMER							
t	-0.39	-0.12	-0.08	0.12	0.36	0.33	-0.11
t_{max}	-0.24	0.06	-0.09	0.29	0.50	0.13	-0.40
t_{min}	-0.25	-0.50	-0.19	-0.10	-0.06	0.23	0.49
t_A	-0.03	0.58	0.11	0.31	0.53	-0.03	-0.64
U	-0.10	-0.34	-0.10	-0.45	-0.57	-0.45	0.06
v	0.40	0.21	0.03	-0.10	0.32	0.57	0.08
p	0.15	0.20	0.19	0.40	0.18	-0.21	-0.48
S	-0.16	0.55	-0.04	0.40	0.54	-0.26	-0.70
dt/dz	-0.32	0.15	0.27	0.05	0.09	0.28	-0.52
dt		0.47	0.08	0.31	0.38	-0.08	-0.51
dp		0.00	-0.11	0.47	-0.22	-0.69	-0.16
TWH	-0.42	-0.18	-0.09	0.12	0.31	0.13	-0.12

Legend:

t – mean daily temperature
t_{max} – maximum daily temperature
t_{min} – minimum daily temperature
t_A – daily temperature range (t_{max}-t_{min})
U – mean daily relative humidity
v – mean daily wind speed
p – mean daily air pressure
S – insolation
dt/dz – vertical temperature gradient, stability of the atmosphere
dt – interdiurnal temperature changes ("n-2" → t_{n-2}-t_{n-3})
dp – interdiurnal air pressure changes
TWH – thermal comfort index