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Mood Effects of Weather Conditions of the Zagreb Population, Croatia

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A B S T R A C T

The level of information on biometeorologic reports and mood effects of weather conditions on the Zagreb population were assessed in a sample of 782 subjects. Only 103 (13.2%) study subjects had not been informed on biometeorologic reports. Mood effects of weather conditions were reported by more than 76% of study subjects, 18.3% of them reporting meteorosensitivity. Meteorosensitivity showed a female predominance, and increased with age and level of education. 88% of chronic patients reported discomforts caused by changes in atmospheric conditions. Apathy and sleepiness were the most common mood changes associated with weather changes, whereas humid weather was indicated as a weather type that caused most discomforts in study subjects.

Key words: *biometeorology, mood effects, meteorosensitivity, Zagreb, Croatia*

Introduction

Since ancient times, the people have been aware of the association between health and atmospheric conditions. The link between humans and atmosphere is dual, as the weather, climate and various atmospheric phenomena exert either favorable or unfavorable impact on the human life and health. The first scientific attempt trying to shed some light on the link between meteorology and medicine in Croatia dates back to the 16th century and the physician Santorio Santorio (1561–1636), one of the most distinguished representatives of a medical school that tended to explain various life phenomena by mechanical-physical processes. Furthermore, the calendars issued by Pavao Ritter Vitezović (1692–1706) regularly contained weather reports accompanied by some advice. In 1937, lectures in balneoclimatology and physical therapy were first introduced at the Zagreb School of Medicine, Department of Neurology and Psychiatry[1]. In 1956, Dr. Leo Trauner, a balneologist, visited Weather Bureau of the People's Republic of Croatia asking for data and cooperation in developing climatic layouts of some Croatian health resorts (Hvar, Vela Luka, Brestovac), or meteorologic data for particular periods of time when some relevant medical tests were performed in patients treated in these resorts. The proposed cooperation was accepted by Nada Štrok-Pleško, then a junior meteorologist[2].

The first algorithm-based biometeorologic report in the current form was released on March 3, 2003, after several-month preparatory activities and internal simulations[3]. Biometeorologic reports are developed by a multidisciplinary team of experts consisting of physicians specialized in particular medical specialties, psychologists, medical biochemists, biologists and meteorologists. It should be noted that they do not come from a single institution but from a number of collaborating institutions in the City of Zagreb. Zagreb Institute of Public Health (Institute) acts as a central institution, where the development of daily biometeorologic reports and other related activities are being coordinated. First, weather report is received at the Institute, where it is then coupled with data from the Institute Laboratory of Aerobiology on air-borne pollen type and concentration, levels of sulfur dioxide and carbon dioxide, and suspended particles in the air. These data are forwarded to five Zagreb health institutions (Polyclinic for Prevention of Cardiovascular Diseases and Rehabilitation; Polyclinic for Respiratory Diseases; Department of Gastroenterology, Zagreb University Hospital Center; Dr. Drago Čop Polyclinic for Rheumatic Diseases; and Vrapče Psychiatric Hospital), where the respective specialists add their opinion, instructions and advice for particular

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groups of chronic patients. For the time being, cardiac, pulmonary, rheumatologic, gastroenterologic and allergic patients are included.

Biometeorologic report is daily published in mass media (newspapers, radio, teletext, and Institute web site: www.publichealth-zagreb.hr).

The impact of weather conditions on the mood was researched many times[4,5,6] with different approaches.

Objective

The study had a dual objective. One was to assess the level of information and the attitude of the Zagreb population on biometeorologic reporting, since it has for now been provided for the city of Zagreb and its surroundings.

The other part of the study referred to the impact of weather conditions on the population disposition, i.e. to identify the population's appraisal of the extent to which their mood is influenced by weather conditions and which weather conditions are perceived as exerting most significant effects. Furthermore, some mood types were analyzed that may be considered consequential to weather conditions, e.g., low spirit, irritability, quarrelsomeness, apathy, tiredness, melancholy, sleep disturbances, and concentration difficulties. All these categories were analyzed according to age, sex, level of education, and health condition relative to chronic diseases.

Subjects and Methods

The study was performed by use of an anonymous questionnaire distributed to 782 subjects from the City of Zagreb and its surroundings. Subjects were not selected; all examinees on psychological testing for a driver's license were asked to fill the questionnaire. Over 90% of examinees filled it (the questionnaire about effects of weather on their mood was interesting to them). The study was conducted during September 2003 characterized by stable meteorologic conditions. The first part of the questionnaire contained questions on age, sex, level of education, health condition relative to chronic diseases, and knowledge about the project of biometeorologic reporting. The second part of the questionnaire consisted of questions on the following parameters: mood types influenced by weather conditions and by changes in these weather conditions; variation in weather conditions most commonly associated with mood changes and other health changes; mood changes (sleep disturbances, concentration difficulties, melancholy, quarrelsomeness and irritability, apathy, and sleepiness).

The statistical method used in the study consisted of several segments:

- preset problem definition,
- data collection and development of preliminary tables,
- data description, development of analytical tables and graphs, and
- testing and interpretation of results.

The following computation and statistical methods were used:

- tabulation and calculation of proportion (percentage) of particular answers,
- cross-tabulation, i.e. computation of conditional frequencies (dependence of variable distribution according to a criterion variable),
- computation of conditional frequency significance by use of χ^2-test, and
- computation of correlation coefficient;
- principal components factor analysis is performed on normalized data (on 8 ordered variables)

Study sample

Study sample consisted in part of subjects presenting for a medical checkup or attending a popular-science lecture at the Institute in September 2003, and in part of university and high-school students and employees in state-owned and private institutions. A total of 782 subjects were included, 464 women and 318 men. Their age distribution was as follows: <18 9.2%, 19–40 48.8%, 41–64 33.9%, and >65 years 8.1%. According to the level of education, there were 10.5% of subjects with low education, 49.2% with high-school, and 40.3% with under- or postgraduate university education.

Results and Discussion

More than 86% of study subjects answered affirmatively the question on the frequency of following (at least occasionally) biometeorologic reports, suggesting a satisfactory level of information on the project of biometeorologic reports.

Twenty-two percent of study subjects suffered from a chronic disease. As expected, the distribution of answers was age related, indicating a higher proportion of chronic diseases in older age groups.

The majority of study subjects (>76%) confirmed their meteorosensitivity[7], which was described as moderate by most of them, and severe by some of them (18.3%).

Occasional apathy and somnolence associated with weather conditions were reported by nearly 70% of study subjects.

The proportion of subjects confirming irritability and quarrelsomeness due to weather conditions was lower, slightly exceeding 50%.

The question on feeling sad due to weather conditions showed a similar answer distribution as the latter one, i.e. some more than 50% of study subjects declared they felt gloomy due to some weather conditions.

Approximately the same percentage of study subjects confirmed and denied sleep disturbance due to weather conditions, however, the percentage of those experiencing it frequently was slightly higher.

More than 56% of study subjects reported concentration difficulties associated with weather conditions,

which was the second most common discomfort caused by weather conditions, immediately following listlessness and somnolence that were by far most frequently described.

Humid weather ranked first as a weather type causing discomfort and mood changes, followed by pressure changes (implying that our study subjects were highly sensitive to weather changes, in which atmospheric pressure changes are only one of the warm front manifestations). It was immediately followed by overcast and rainy weather, indicating that difficulties associated with weather conditions are in part related to poor lighting[8].

Only 16% of study subjects reported some other discomforts associated with weather conditions. The most common other discomforts caused by weather changes were headache, migraine, rheumatic pain etc; results revealed that almost all discomforts reported by study subjects were related to physical health rather than mood, indicating the questionnaire had properly covered the investigated area.

The following tables present conditional frequencies (product of cross-tabulation), where a particular phenomenon (in this case, meteorosensitivity) was related to various variables (age, sex, level of education, presence of chronic diseases, and frequency of following biometeorologic reports) (Table 1, 2, 3, 4), to show the pattern of answers provided by a specific segment of our study sample. At the end of each table, the significance (p) of the hypothesis that particular answers were not accidentally distributed was calculated by use of χ^2-test. Thus, if the test proved significant for certain degrees of freedom (df), it implied that particular answers were not accidentally distributed but there was a significant association between the answers related to two cross-tabulated variables. This association was also expressed as a contingency correlation coefficient α.

TABLE 1
METEOROSENSITIVITY vs. AGE

Meteorosensitivity	–18	19–40	41–64	65+
Strong	4.2%	13.6%	27.2%	25.4%
Moderate	44.4%	63.1%	55.1%	52.4%
No	51.4%	23.3%	17.7%	22.2%

Obviously, meteoropathy is a problem associated with age over 40. Younger individuals denied meteorosensitivity (χ^2=57.412, df=6, p=0.0000, α=0.192).

TABLE 2
METEOROSENSITIVITY vs. SEX

Meteorosensitivity	Male	Female
Strong	9.7%	24.1%
Moderate	57.5%	58.0%
No	32.7%	17.9%

There was a significant sex difference in the frequency of affirmative answers to the question on meteorosensitivity, i.e. women were by far more meteorosensitive than men (χ^2=38.693, df=2, p=0.0000, α=0.222).

TABLE 3
METEOROSENSITIVITY vs. CHRONIC DISEASE

Meteorosensitivity	Chronic disease	
	Yes	No
Strong	43.4%	11.0%
Moderate	44.6%	61.6%
No	12.0%	27.3%

The distribution[9] of answers to the question on meteorosensitivity relative to the presence of a chronic disease was as expected, i.e. chronic patients considerably more frequently reported discomforts due to weather changes[10], and significantly more frequently described it as severe disturbances (χ^2=98.141, df=2, p=0.0000, α=0.354). These two variables showed the highest correlation.

TABLE 4
METEOROSENSITIVITY vs. BIOMETEROLOGIC REPORTS FOLLOWING

Meteorosensitivity	Following biometerologic reports		
	Frequently	Occsionally	Never
Strong	45.1%	12.8%	9.7%
Moderate	47.2%	63.7%	41.7%
No	7.7%	23.5%	48.5%

The distribution of answers to the question on meteorosensitivity relative to the frequency of following biometeorologic reports was as expected, i.e. those burdened with meteoropathy regularly followed biometeorologic reports (χ^2=120.810, df=4, p=0.0000, α=0.278). Interestingly enough, more than two-thirds of those decisively denying the weather having any effect on their mood followed biometeorologic reports at least occasionally.

TABLE 5
METEOROSENSITIVITY vs. LEVEL OF EDUCATION

Meteorosensitivity	Level of education		
	Elementary	High school	University
Strong	15.9%	17.1%	20.3%
Moderate	46.3%	57.1%	61.6%
No	37.8%	25.7%	18.1%

The answers to the question on meteorosensitivity showed an interesting distribution according to the level of education, i.e. those with a higher level of education showed a greater frequency of meteoropathy (χ^2=15.523, df=4, p=0.0017, α=0.100).

TABLE 6
PRINCIPAL COMPONENTS ANALYSIS (ROTATED FACTOR MATRIX, VARIMAX CRITERION)

	Factor 1	Factor 2	Communality
Follow reports	0.181	–0.334	0.145
Chronic illness	–0.065	–0.843	0.715
Mood effects	0.511	–0.574	0.591
Sleepiness	0.775	–0.020	0.601
Irritability	0.676	–0.192	0.494
Sadness	0.730	–0.114	0.546
Insomnia	0.293	–0.642	0.497
Attention problems	0.587	–0.156	0.369

Factor 1 – related to general meteorosensitivity, Factor 2 – related to specific meteorosensitivity related to chronic illness

Results of principal components analysis are presented in the following (Table 6).

Two principal components were isolated (by Guttman-Kaiser criterion). These 2 principal components (factors) are explaining almost 50% of common variance. First principal component is related to general meteorosensitivity; the second one to specific meteorosensitivity related to chronic illness.

Interestingly enough, insomnia (sleep disturbances) is related to specific meteorosensitivity; mood effects are split between general and specific meteorosensitivity, these are stronger when related to chronic illness.

Conclusion

The results showed the study population to be very well informed about the project of biometeorologic reports, with 86% following these reports, 18.2% of them frequently. The proportion of subjects following biometeorologic reports was especially high among chronic patients, who very frequently reported a strong mood effect of weather conditions. These two variables yielded highest positive coefficient of correlation of 0.35.

The proportion of subjects experiencing the mood effect of weather conditions was higher among women, older age groups, and those with a higher level of education.

Humid weather and atmospheric pressure changes were the most commonly reported weather changes causing discomforts in study subjects. Of other discomforts, headache and rheumatic pain were most frequently reported.

In general, results of this study confirmed that meteorosensitivity is significant in local population, very similar to aforementioned studies.

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UTJECAJ VREMENSKIH PRILIKA NA RASPOLOŽENJE STANOVNIŠTVA ZAGREBA

SAŽETAK

Ispitana je informiranost o bioprognozi u gradu Zagrebu, te utjecaj vremenskih prilika na raspoloženje stanovništva. Uzorak se sastojao od 782 ispitanika, od kojih samo 103 (13.2%) nije čulo za bioprognozu. Utjecaj vremenskih promjena na raspoloženje afirmira preko 76% ispitanika, od čega ih 18.3% navodi da su jako osjetljivi na vremenske promjene. Žene su osjetljivije od muškaraca, stariji od mlađih ispitanika, visoko obrazovani od onih s manje škole. Naročita razlika među ispitanicima vidljiva je kod kroničnih bolesnika, gdje 88% ispitanika navodi da ih vremenske promjene smetaju. Bezvoljnost i pospanost je najčešća promjena raspoloženja vezana uz vremenske promjene, a sparno vrijeme je navedeno kao vrsta vremena koja najviše smeta naše ispitanike.