

HUMAN PHYSIOLOGICAL STATUS AND ENVIRONMENT

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ABSTRACT

In this paper we present results from investigation of the influence of meteorological parameters on human physiological status. A group of 86 volunteers was examined in Sofia city during the periods: 01.10.2001 - 09.11.2001 and 08.04.2002 - 28.05.2002. The group included males and females at age between 25 and 65 years, concerned with scientific activity. Among the persons examined there were 26 persons who had cardio-vascular disturbances and were taking respective medicaments. The Fiodorov-Chubukov's complex-climatic method was used to characterize meteorological conditions because of the purpose to include in the analysis a maximal number of meteorological elements. 16 weather classes are defined in dependence of the meteorological elements values according to this method. The results obtained by MANOVA revealed statistically significant influence of the weather classes investigated on some of the physiological parameters examined. A higher sensitivity of some of the physiological parameters of females and persons taking medicaments to some of the weather classes was found through Post hoc analyses.

INTRODUCTION

It has been proved that environmental factors influence considerably on human health, physiological state and general condition. A lot of investigations, which confirm this impact, have been carried out. The mechanisms of this effect for the separate factors are not completely clarified and therefore the investigations in this direction are of a great interest. During the last years in a lot of publications the authors attempt to clear up these mechanisms (Hong, 1995; Oraevskii, et al., 1998; Zhadin, 2001) as well as to separate the impact of different factors from the factor complex of the environment, which influence on humans. The separation of the independent impact of each of the factors is a difficult and often almost impossible. Different approaches and methods for analysis have been used to find out the prevailing impact of definite factors. By collecting solid data sets, using reiteration of definite phenomena and employing different statistical data processes successful attempts have been made. Significant results are obtained in clarifying the influence of different environmental factors on cell processes (Hong, 1995), different organs and functional systems (Oraevskii, 1998; Pikin, et al., 1998) and human health (Stoupel, 1993).

Bulgarian scientists have also performed investigations in this field. From 1973 dated scientific investigations of J. Naumov, A. Mateev, P. Velinov for influence of different environmental factors including geophysical, meteorological etc. on human health at different regions in Bulgaria (Naumov, et al., 1973; Mateev and Spiridonov, 1976; Velinov and Mateev, 1977).

We have performed investigations in this field for several years. We have tried by collecting a significant number of measurements for each physiological parameter (about 3000 measurements), measuring at one and the same time during

the day for each person and using statistical data processes to obtain significance and differentiation of the influence of different geophysical factors on physiological parameters examined. We have employed MANOVA, Post hoc comparisons, correlation analysis etc. It was proved a statistically significant influence of geomagnetic activity changes on physiological parameters and behavior reactions (Dimitrova and Stoilova, 2002; Dimitrova, et al., 2002).

In this paper we present results obtained by employing 3-factor MANOVA for investigation of the influence of different meteorological factors on human physiology.

MATERIAL AND METHODS

Medical examinations performed in Sofia city¹ during the periods: 01.10.2001 - 09.11.2001 and 08.04.2002 - 28.05.2002 were used. The data are from registrations of physiological parameters of a group of 86 volunteers (33 males and 53 females) at an average age 47.8 r. (± 11.1).

Systolic and diastolic blood pressure and pulse-rate were measured. The difference between systolic and diastolic blood pressure was calculated and questionnaire data about subjective complaints (heart thumping, tachicardia, arrhythmia, stitches in the heart area, headache, dizziness, sleep problem etc.) were collected.

The measurements were performed at one and the same time during the day for different persons and totally 2799 registrations for each of the physiological parameters examined were got.

¹ Latitude: 42° 43' North Longitude: 23° 20' East

26 persons in the group examined had cardio-vascular disturbances and were taking medicaments prescribed by relevant specialists. They were referred to a group "persons taking medicaments" and the rest formed a group "persons without medicaments".

The Fiodorov-Chubukov's complex-climatic method adapted to climatic conditions for Bulgaria (Tishkov, 1970) was used to characterize meteorological conditions. According to this method a maximal number of meteorological elements are taken in consideration. This enables a detailed characterization of a different kind of changes in the weather. In the frame of this classification the numerous manifestations of the weather are grouped in 16 classes according to the values of the following meteorological elements: mean day temperature, mean day humidity, mean cloudiness for the day and night, wind speed, maximal and minimal air temperature for the day. For each class each of the meteorological parameters has exactly defined range of values.

During the periods when the medical examinations were performed 6 of the 16 weathert classes were observed:

III class - little cloudy,

IV class – cloudy during the day,

V class - cloudy during the night,

VI class - gloomy,

VII class - rainy,

IX class – with negative transition of the temperature through 0°C.

3-factor analysis of variance (MANOVA) for factors: weather class (6 levels - III, IV, V, VI, VII and IX weather class), gender (2 levels – males and females) and medicaments (2 levels – persons taking medicaments and persons not taking medicaments) was employed to reveal a statistically significant influence of the factors under consideration on the physiological parameters examined. Post hoc comparisons were performed to check the statistical significance of the obtained changes between the levels of the factors.

RESULTS

Arterial blood pressure

When a 3-factor MANOVA for the factors investigated was employed it was found that the main effect of the weather class on the arterial (systolic and diastolic) blood pressure is statistically significant ($p < 0.05$). The systolic blood pressure was highest during III, VI and IX weather class and lowest when V weather class was observed (Fig. 1a). The diastolic blood pressure is highest during III and VI weather class and lowest also during V class (Fig. 1b).

The two-way and three-way interactions of the factors under consideration (weather class, gender and medicaments) did not reveal significant influence on the arterial (systolic and diastolic) blood pressure. In consequence of that it could be supposed that the both genders as well as taking and not taking medicaments have a slight influence on the arterial blood pressure for the weather classes investigated.

However Post hoc analysis revealed statistically significant differences in the influence of V and VI weather class on the

diastolic blood pressure of females - when the weather is gloomy (VI class) women rise statistically significantly the diastolic blood pressure in comparison with the weather when it is cloudy during the night (V class). For males and for persons taking and do not taking medicaments Post hoc analysis did not reveal a statistically significant difference in their reaction to changes of the weather classes regarding the arterial blood pressure.

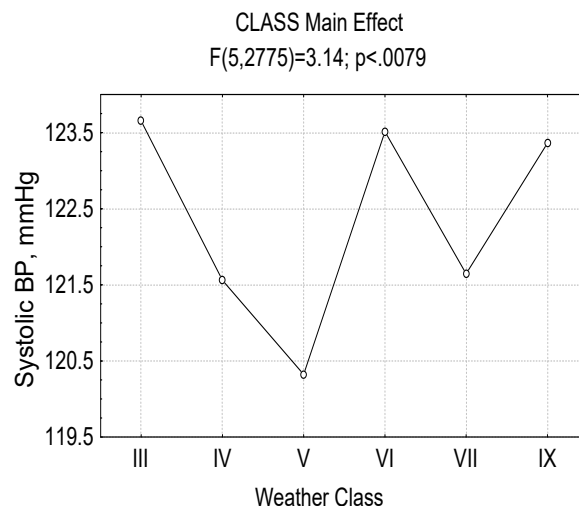


Figure 1a. Influence of the weather class on the systolic blood pressure.

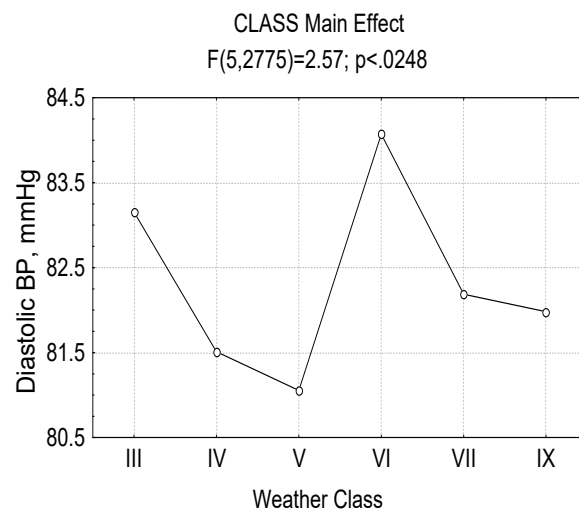


Figure 1b. Influence of the weather class on the diastolic blood pressure.

Difference between systolic and diastolic blood pressure

The tree-factor MANOVA employed revealed a trend to influence ($p < 0.06$) of the main effect of the weather class on the difference between systolic and diastolic blood pressure.

The difference between systolic and diastolic blood pressure is narrowest for V, VI and VII weather class and widest for IX class.

The two-way and three-way interactions of the factors investigated as well as Post hoc comparisons employed did not reveal a difference in the reaction of males and females as

well as of persons taking and not taking medicaments regarding the difference between systolic and diastolic blood pressure.

Subjective physiological complaints

Three-factor MANOVA for the factors investigated regarding the part of the persons examined, who reported subjective physiological complaints, revealed a statistically significant influence ($p < 0.0001$) of the weather class main effect (Fig. 2).

The results show that the percentage of the persons who had subjective physiological complaints is smallest for V class (cloudy during the night) – 5.8% and largest for IV and VI class (cloudy during the day and gloomy), respectively: 16.6% and 18%.

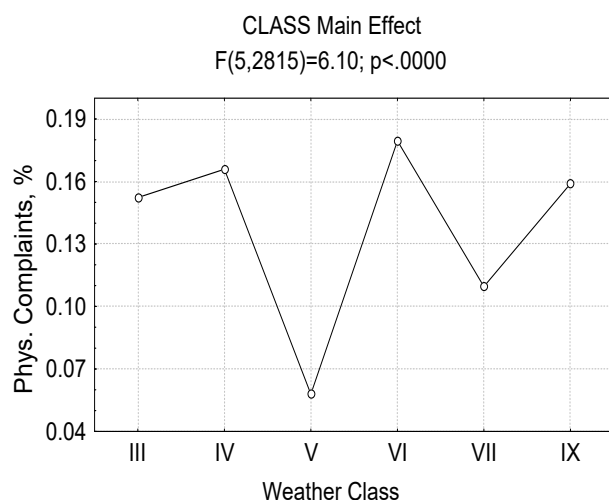


Figure 2. Influence of the weather class on the percentage of the persons reported subjective physiological complaints.

The two-way and three-way interactions of the factors investigated (weather class, sex and medicaments) did not reveal significant influence on the subjective physiological complaints, which suppose identical sensitivity of the both genders as well as of the persons taking and not taking medicaments to the weather classes investigated regarding subjective complaints.

The additional investigations by Post hoc comparisons revealed that subjective physiological complaints are statistically significantly smaller when the weather is cloudy during the night (V class) in comparison with the weather when it is a little cloudy, cloudy during the day and gloomy (III, IV and VI class). And as well that the percentage of the persons with subjective physiological complaints, who were taking medicaments, rises statistically significantly when the weather is gloomy (VI class) in comparison to V class. It suggests a higher sensitivity for them in comparison with the persons who were not taking medicaments.

Pulse-rate

Although 3-factor MANOVA did not reveal statistically significant changes ($p < 0.25$) of the pulse-rate upon influence of the weather class main effect (Fig. 3), Post hoc analysis revealed that the pulse-rate increases statistically significantly during VI class (gloomy weather) in comparison with all of the rest weather classes investigated.

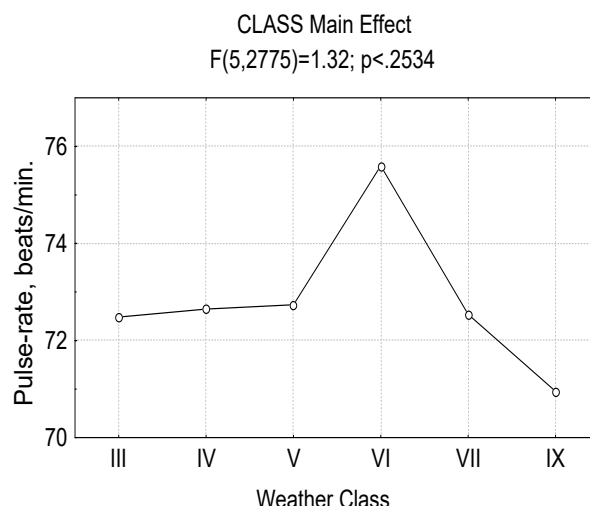


Figure 3. Influence of the weather class on the pulse-rate.

Post hoc comparisons also revealed a higher sensitivity of the pulse-rate for the persons taking medicaments – they increase statistically significantly the pulse-rate during VI class (gloomy weather) in comparison to all of the rest weather classes, while for the persons not taking medicaments any significant differences were not established.

The results obtained by Post hoc analysis revealed a higher sensitivity of the pulse-rate for females in comparison to males upon weather classes influence. It turned out that females increase statistically significantly the pulse-rate during a gloomy weather (VI class) in comparison with IV, V, VII and IX class.

DISCUSSION

The results presented are an initial attempt for a generalized presenting of the influence of meteorological factors on the physiological parameters examined. It was established a presence of definite effect of meteorological conditions changes on the physiological reactions of the group examined.

A lot of scientists have investigated different meteorological factors and aspects. They have proved their influence on the physiology, behavior reactions and human health (Gavryuseva and Kroussanova, 2002; Belisheva, et al., 2000; Ivanova, 2002; Marinov, et al., 1989 etc.).

The three-factor MANOVA employed revealed that the arterial (systolic and diastolic) blood pressure is highest when the weather is a little cloudy and gloomy and it is lowest when the weather is cloudy during the night. And the systolic blood pressure is high also during weather with negative transition of the temperature through 0°C.

The examination of the arterial blood pressure is an easily available and quite informative method for estimation of the functional state of the cardio-vascular system. There are different external and individual factors that could influence on the arterial blood pressure. But when there is a set of a lot of everyday measurements for a big group of persons and a statistically significant changes in blood pressure upon influence of changes in a definite external factors are obtained, we could suggest that this factor has a prevailing impact.

The difference between systolic and diastolic blood pressure is narrowest when the weather is cloudy during the night, gloomy and rainy, and widest during weather with negative transition of the temperature through 0°C. Having in mind that widening as well as narrowing of the difference between systolic and diastolic blood pressure is unfavorable indicator, especially for persons who have cardio-vascular disturbances, the dependence obtained could be used for precautions during advent meteorological precursors.

The percentage of the persons who had subjective physiological complaints is largest when the weather is cloudy during the day and gloomy – IV and VI class according to the classification used and smallest when it is cloudy during the night – V class. The increase of the cloudiness in combination with a decrease of lighting turns out to be considerably more adverse factor.

On the basis of the results obtained by 3-factor MANOVA and Post hoc comparisons the most unfavorable weather class in respect of all of the physiological parameters examined turns out to be VI class (gloomy). When the weather is gloomy systolic and diastolic blood pressure increase statistically significantly, the difference between them is narrowest as well as the subjective physiological complaints reach the largest percentage. The higher sensitivity of females as well as of persons taking medicaments is also related to VI weather class – then females increase statistically significantly the diastolic blood pressure in comparison with V class (cloudy during the night) as well as the pulse-rate in comparison with IV, V, VII and IX class. And the persons taking medicaments increase statistically significantly pulse-rate in comparison with the rest of the weather classes investigated as well as the subjective physiological complaints in comparison to V class (cloudy during the night).

The general review of our results obtained for the influence of geophysical (Dimitrova, et al., 2002) and meteorological factors reveals that geomagnetic activity (planetary and local) has more clearly expressed influence on physiological parameters examined in comparison with meteorological factors. This summary of course refers only for the group and factors examined. Additional investigations are needed to confirm the common validity of these results.

The influence of solar activity changes on human health goes through meteorological and geophysical factors. That is why the investigations of these environmental factors are very important. As far as they could be foreseen to some extend the results obtained could be utilized for prevention adverse consequences.

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