BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg
BG PULSE JOURNAL

HYGIENIC ASSESSMENT OF THE COMPLEX EFFECT OF METEOROLOGICAL FACTORS ON THE HUMAN BODY

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Abstract. This article examines the complex effect of meteorological factors on the human body and the issues of their hygienic assessment. The influence of air temperature, relative humidity, atmospheric pressure, wind speed and solar radiation on thermoregulation and on the cardiovascular, respiratory and nervous systems is reviewed. Meteorological factors act on the body not in isolation but in interaction, and this may considerably affect a person's functional state and work capacity. The article describes the main principles of the hygienic assessment of meteorological conditions, the determination of microclimate parameters, and measures to reduce the adverse effects of unfavorable meteorological factors.

Keywords: meteorological factors, hygiene, microclimate, air temperature, relative humidity, atmospheric pressure, wind, thermoregulation, heat exchange, meteorological conditions.

INTRODUCTION

The human body is in constant interaction with the external environment. Physical, chemical and biological environmental factors affect human health, work capacity and overall functional state. Among these factors, meteorological conditions occupy a special place.

Meteorological factors include air temperature, atmospheric humidity, atmospheric pressure, wind speed and direction, solar radiation and other meteorological indicators. Their effect depends on the season, geographical region, time of day, level of physical activity, type of clothing and the individual characteristics of the body.

Under climate change, heat waves and sharp weather fluctuations are observed more and more often, which increases the importance of the correct assessment of meteorological factors for protecting public health. In addition, control of microclimate conditions in industrial and residential premises is an important prerequisite for maintaining work capacity.

From the hygienic standpoint, the main purpose of studying meteorological factors is to determine optimal conditions for humans, to prevent the adverse health effects of unfavorable meteorological conditions, and to improve working and living conditions.

Aim of the study: to analyze the complex effect of meteorological factors on the human body and to systematize the main approaches to their hygienic assessment.

Objectives: (1) to describe the physiological effects of the main meteorological factors on the body; (2) to define the stages of the hygienic assessment of meteorological factors; (3) to substantiate preventive measures aimed at reducing the effects of unfavorable meteorological factors.

MATERIALS AND METHODS

This work is a theoretical and analytical review. Scientific and regulatory-methodological literature on hygiene, occupational hygiene and general hygiene, as well as World Health Organization documents on heat and health, were analyzed. The data were processed using content analysis, comparison and systematization.

The methodology for the hygienic assessment of meteorological factors is based on determining the following indicators and comparing them with the current sanitary and hygienic standards:

- air temperature (measured with a thermometer);
- relative air humidity (measured with a psychrometer or hygrometer);
- air movement speed (measured with an anemometer);
- atmospheric pressure (measured with a barometer);
- intensity of solar and thermal radiation (measured with an actinometer and similar instruments).

The assessment also takes into account the severity of work (level of physical load), the season, the type of clothing and the individual characteristics of the person.

RESULTS

Air temperature

Air temperature is one of the most important meteorological factors influencing the body's heat exchange. As a result of metabolism, heat is constantly produced in the human body, and part of it is continuously released into the environment.

At high temperature, heat release by the body becomes difficult: sweating intensifies, the heart rate increases and the body loses more fluid. If very high temperature persists for a long time, heat exhaustion may develop and, in severe cases, there is a risk of heat stroke.

At low temperature, the body loses more heat. Thermoregulatory mechanisms are activated, peripheral vessels constrict and heat production increases. If extreme cold persists for a long time, hypothermia and local cold injuries may occur.

Relative humidity

Relative air humidity is important in the process of heat release by the body. When high humidity accompanies high temperature, sweat evaporation becomes difficult and the body cannot release enough heat into the environment. Under low humidity, the skin and the mucous membranes of the respiratory tract may become dry. Therefore, air humidity in residential and industrial environments should remain within hygienically acceptable limits.

Wind

Wind is characterized by the speed and direction of air movement and affects convective heat exchange between the body and the environment. In cold conditions, strong wind accelerates heat loss from the body. In hot conditions, a certain degree of air movement improves sweat evaporation and helps the body to cool. However, a very strong air flow may cause discomfort and increase the risk of chilling.

Atmospheric pressure

Changes in atmospheric pressure may affect the functional state of the body. In individuals who are sensitive to sharp pressure changes, symptoms such as headache, weakness, drowsiness or general discomfort may be observed. The effect of reduced atmospheric pressure is even more important at altitude: the decrease in oxygen supply activates the body's adaptation mechanisms.

Solar radiation

Solar radiation has biological and thermal effects on the human body. A normal amount of ultraviolet radiation is of important biological significance for the body, but its excessive exposure may damage the skin and eyes. The infrared part increases the heat load on the body.

The results of the analysis are summarized in Table 1.

Table 1

Effects of the main meteorological factors on the body

Meteorological factor	Main physiological effect	Hygienic significance
Air temperature	At high temperature, sweating and heart rate increase and fluid is lost; at low temperature, peripheral vessels constrict and heat production rises	Determines the risk of heat stroke and cold injuries
Relative humidity	High humidity impairs sweat evaporation; low humidity dries the skin and mucous membranes	Determines the efficiency of heat dissipation
Wind (air movement)	Alters convective heat exchange: heat loss increases in the cold, and cooling is aided in the heat	Taken into account when assessing the risk of chilling and discomfort
Atmospheric pressure	Sharp changes may cause headache, weakness and drowsiness; oxygen supply decreases at altitude	Important for weather-sensitive individuals and mountainous areas
Solar radiation	Ultraviolet radiation has biological importance, but excess harms the skin and eyes; the infrared component increases heat load	Requires protective measures for outdoor workers

Effects of meteorological factors on body systems

An unfavorable combination of meteorological factors may affect various body systems.

Cardiovascular system. At high temperature, dilation of peripheral vessels and increased cardiac activity are observed. In the cold, vasoconstriction predominates.

Respiratory system. Changes in temperature and humidity may affect the functional state of the respiratory tract. Air that is too dry or excessively humid causes discomfort.

Nervous system. Sharp meteorological changes may be accompanied in some people by subjective symptoms such as weakness, headache, and changes in sleep and work capacity.

Thermoregulatory system. One of the most important directions of the effect of meteorological factors is the process of maintaining the body's heat balance. Effective thermoregulation is important for a person's adaptation to environmental conditions.

Stages of the hygienic assessment of meteorological factors

In the hygienic assessment of meteorological factors, a number of meteorological indicators are determined and evaluated in accordance with current sanitary and hygienic requirements. The main stages of the assessment are as follows:

1. Air temperature is determined.
2. Relative air humidity is measured.
3. Air movement speed is determined.
4. When necessary, atmospheric pressure and solar radiation indicators are taken into account.
5. The obtained results are compared with the relevant hygienic standards.
6. The complex effect of meteorological factors and the person's thermal state are assessed.
7. Preventive measures are defined to eliminate or reduce the identified unfavorable conditions.

DISCUSSION

Meteorological factors usually do not act on the human body separately. For example, the same air temperature is perceived by the body differently under different humidity and wind conditions. In hot and humid air, sweat evaporation becomes difficult and the body's capacity to release heat decreases, whereas in hot but dry conditions with sufficient air movement, evaporation may proceed more effectively. In the cold, high wind speed increases heat loss. Therefore, assessing meteorological conditions by air temperature alone does not give a complete and objective result.

The complex effect of meteorological factors is manifested primarily through their influence on the body's heat balance. When the balance between heat production and heat release is disturbed, the load on the thermoregulatory system increases. For this reason, in the hygienic assessment, humidity and air movement must be taken into account together with temperature.

The work performed by a person should also be considered in the hygienic assessment. During physical work, heat production in the body increases; therefore, microclimate requirements

in places where heavy physical work is performed differ from those in rooms where light work is performed.

A limitation of this work is that it is a review and does not present independent measurement data. In the future, it is advisable to carry out practical studies that measure microclimate indicators in specific regions and workplaces and compare them with the functional state of the population.

Preventive and hygienic measures

The following measures can be implemented to reduce the effect of unfavorable meteorological factors on the human body:

- organizing effective ventilation and air-conditioning systems in rooms;
- drinking sufficient fluid during hot periods;
- wearing seasonally appropriate clothing in cold conditions;
- properly organizing the work and rest regime at high temperature;
- protecting outdoor workers from solar radiation;
- regularly monitoring microclimate indicators in workplaces;
- strengthening preventive measures for risk groups during periods of sharp meteorological change.

CONCLUSION

Meteorological factors affect the human body in a complex and interrelated manner. Air temperature, relative humidity, wind, atmospheric pressure and solar radiation may influence thermoregulation and the functioning of the cardiovascular, respiratory and nervous systems.

The hygienic assessment of meteorological factors should not be limited to determining a single meteorological indicator, but should take into account their complex effect. In particular, air temperature, humidity and air movement are important in assessing a person's thermal state.

Correct hygienic assessment of meteorological factors makes it possible to identify unfavorable microclimate conditions, improve working and living conditions, preserve human work capacity and prevent the adverse effects of meteorological factors.

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