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CERTAIN QUESTIONS OF THE ACCLIMATIZATION OF CONSTRUCTION WORKERS TO THE CONDITIONS OF A SUBTROPICAL CLIMATE

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The purpose of our observations was to determine the period /106* of active acclimatization of a previous population under conditions of subtropical climate. For this, observations were made of persons of the male sex, aged 25-40 years, in the construction of the Nurek Hydroelectric Station. Meteorological conditions, the volume and nature of the physical work and loads, nutrition, clothing and footwear, and the regime of work and rest in the observation period were the same, on the average, for all those examined.

The climate of the Tadzhik SSR is characterized by a prolonged, hot, subtropical summer, noticeable oscillations of temperature during a 24-hour period, low humidity, and little air movement. Air temperature in the open construction area in the summer during the morning hours varies from 20 to 29°C (23±0.3°); relative humidity is 27-33% and rate of air movement is 0.3-2.1 m/sec. At the end of the first half of the work shift, the air temperature increases to 29-37° (33.2±0.3°), the relative humidity of the air decreases to 20-30%, and the rate of air movement increases to 1.2-3 m/sec. At the end of the work shift (4-5 PM), air temperature increases to 35-42° (37.7±0.5°), relative humid-

*Numbers in the margin indicate pagination in the foreign text.

ity is 20-26%, and rate of air movement increases to 2.3-4.5 m/sec. Hereupon, the total solar radiation reaches 1.4-1.5 cal/cm^2/min.

A number of authors have noted some decrease in metabolic processes in the residents of hot and tropical countries. The data we obtained, involving studies of gas exchange at different times of the year, indicate that the need for oxygen in sufficiently acclimatized construction workers (84 persons) in a state of relative quiet at the beginning of the shift in the summer is, on the average, 284.9±12.8 ml/mm, and in winter 333± 10.5 ($P < 0.01$). The increase in oxygen requirements after the working day while executing the same work functions in the summer is equal to 11 ml/min (296±13.2 ml/min) and in winter 41.2 ml/min 374±7.2 ml/min). Oxygen needs in the summer after the work shift are not essentially changed ($P < 0.5$), but in winter they are noticeably increased ($P < 0.001$). These data indicate the fact that the human organism, while working under hot-climate conditions, is attempting to keep the oxidation processes at a lower level, which facilitates somewhat the maintenance of heat balance in the organism.

Oxygen needs in local residents (36 persons) working on the construction of the hydroelectric station are, at the beginning of the shift in the summer, 282±7.7 ml/min, and in those arrivals with a period of residence of up to 6 months, 289±4.7 ml/min. The rather high level of oxygen requirements in arrivals

is evidently caused by the different degrees of participation of the chemical heat-regulation of persons acclimatized to heat.

In the observation, 14 construction workers were found who had lived under subtropical-climate conditions up to 10 days, 84 persons up to 6 months, 16 up to 12 months, 30 from 1 to 2 years, 32 from 2 to 5 years, and 36 more than 5 years. In the control group were 34 construction workers from the local popul- /107

TABLE 1
AMOUNT OF WATER DRUNK AND WATER LOSS AFTER THE WORK SHIFT IN CONSTRUCTION WORKERS WITH DIFFERENT RESIDENCE PERIODS UNDER SUBTROPICAL-CLIMATE CONDITIONS (IN ML)

1 Время пребывания приезжих рабочих	2 Число обследованных	3 Количество выпитой воды	4 Дефицит веса тела	5 Количество общих влагопотерь
6 До 10 дней	14	4012	2700	6712
7 » 6 мес	84	4070	2500	6570
8 » 12 мес	16	2585	2400	4985
9 От 1 года до 2 лет	30	2250	1600	3850
10 » 2 лет до 5 »	32	1673	1900	3573
11 Более 5 лет	36	1837	1600	3438
12 Местные жители	54	2945	1401	4347

Key: 1. Residence time of arriving workers
2. Number of those examined
3. Amount of water drunk
4. Shortage in body weight
5. Amount of overall amounts
6. Up to 10 days
7. Up to 6 mos
8. Up to 12 mos
9. From 1 year to 2 years
10. From 2 to 5 years
11. More than 5 years
12. Local residents

ation. Observation of physiological functions was done over 5-6 days within the dynamics of a working day. The operations carried out by the workers could be assigned to the work category of moderately heavy labor. Energy consumption in carrying out basic operations was within the limits of 3.66-4.07 kcal/min.

With increasing temperature of the environment around people in subtropical-climate conditions for a period of up to 10 days, pulse rate increases, on an average, 51%, up to 6 mos 27%, up to a year 15%, from 1 to 2 years 7.5%, and in local residents 7.5%, compared to the initial values ($P < 0.001$). Consequently, to the degree that the human organism adapts to the conditions of a subtropical climate, a gradual reduction in pulse rate occurs, which agrees with the data of other investigators (N.M. Shamarina, B.B. Kovranskiy, T.D. Simonovich). Pulse-rate reduction with adaptation of the workers to high temperature of the environment is associated with a decrease in reaction to thermal action and depends to a known degree on a smaller increase in body temperature (M.E. Marshak). Compensatory shifts in the human organism are evident based on a change in arterial pressure. Thus, in workers under the conditions of a subtropical climate for up to 10 days, toward the end of the work shift when the air temperature reaches a maximum, systolic pressure decreases on the average to 8.3 mm Hg, up to 6 mos 11 mm, up to a year 4 mm, and in local residents 5 mm, compared with

initial values (in the morning).

Depending on the degree of acclimatization of a person to conditions of subtropical climate, body temperature in workers after the shift increases various amounts. Thus, in construction workers in residence under the conditions of the subtropics up to 10 days, it increases, on the average, to 37.8±0.2°, for no more than 6 mos to 37.1±0.01°, and 12 mos to 36.9±0.2°; in local residents, body temperature increases toward the end of the work day to 36.9±0.03°.

The skin surface of a human being is extremely sensitive to changes in the temperature of the external surroundings, which dictates the need for studying its parameters in people with different degrees of adaptation to the conditions of a subtropical climate. In workers not adapted to these conditions, a noticeable increase in skin temperature is observed. After 6 mos or more, it increases somewhat less; almost the same shifts take place as in the local residents.

High air temperature and intense solar radiation serve as powerful factors in contributing to heat loss through the evaporation of sweat. In the process of repeated thermal action, to the degree that a person is acclimatized to a subtropical climate, a quantitative change in sweating sets in. We studied water loss in the usual nutritive regime. The workers drank water with no limitation. The water drunk was always in suffi-

cient amounts. As is seen from the table, the amount of water drunk, the shortage in body weight, and general water loss with increasing periods of residency of the workers in subtropical-climate conditions are gradually decreased. Toward the end of one year, the amount of general water loss is the same as in local residents doing the same work in construction and being in the identical meteorological conditions.

One of the basic integral indicators of a person's acclimatization to a subtropical climate is the displacement of the line of comfort in heat sensitivity toward higher temperatures. The data we obtained indicate that in construction workers recently arrived in Tadzhikistan (being there up to 10 days), the comfort zone of heat sensitivity is within 19-22°, but in persons working in these conditions in the course of a year and local residents, "good" heat sensitivity is observed at an air temperature of 28-30°. A similar phenomenon is associated with functional changes in the system of heat analyzers, in their cerebral endings, and in the upper sections of the central nervous system of the brain core as a result of the formation of conditioned-reflex associations under the repeated action of heat.

An increase in the comfort zone of heat sensitivity has great significance in a person's acclimatization. It is expressed by the good state of health and high work capacity of people under subtropical-climate conditions. In the experiment, under the conditions of a hot room which approximated those of /109

subtropical-climate conditions, we noted the effort in heat-regulation processes. In the findings for those tested in a state of relative quiet, their body and skin temperature increased, pulse rate increased, and significant water loss and certain changes in the oxygen reserve occurred. Carrying out the administered physical load of moderately heavy labor aggravates the effort of the heat-regulation processes. Upon the repeated action of heat with the physical load administered, the development of adaptive changes to high air temperature in the organism of those tested sets in more rapidly than during their occurrence in a state of relative quiet. This confirms the fact that with active daily activity, the organism adapts more quickly to extremum conditions.

It is known that air temperature under the conditions of a subtropical climate increases gradually from winter to summer; therefore, adaptation of an organism coming there in the cool season is significantly facilitated. In addition, the stressful influence of a hot climate, which occurs with arrival in the warm season, is thus eliminated. Depending on increasing length of service of those examined, a gradual adaptation of the organism is noted to factors in the external environment and to industrial conditions. Thus, based on the data of an intracutaneous probe, V.I. Joffe recorded, in persons with a service time of up to 1 year, a positive reaction in 61% of them, 1-5 years 77.8%, 5-10 years 76% ($P < 0.01$). More than 1000 workers were examined

in all. The phagocyte number in 210 incoming workers with a residence time in Tadzhikistan of up to 1 year was somewhat higher (77±0.7) than in 78 workers from the local residents (72.6± 0.5). The corresponding phagocyte indices are 4.9±0.1 and 3.9± 0.2 ($P < 0.1$). Consequently, in the daily activities of workers in the course of 1 year, sufficient adaptive mechanisms are developed which contribute to a certain increase in the level of overall immunobiological reactivity of the organism.

The residency of a person under subtropical-climate conditions for a year is a period sufficient for the development of adaptive mechanisms.

For the prevention of heat prostration and the more effective development of adaptive mechanisms in a region with a hot climate, the unacclimatized person must be sent in in the late fall or winter, when the optimum temperature of the surrounding environment is recorded there. For the steady development of adaptive mechanisms in the human organism, carrying out physical work is necessary in connection with the continuous effect of the climate.

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