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Effect of Temperature and Humidity on Nasal Flora of Mice. (22060)

SAMI A. MAYYASI,* JORGEN M. BIRKELAND, AND MATTHEW C. DODD.
Department of Bacteriology, Ohio State University, Columbus.

The possibility that atmospheric conditions are reflected in changes in physiological status of the nose and nasopharynx which are related to susceptibility to upper respiratory infections and poliomyelitis have been suggested. Thus, Armstrong(1) observed a correlation between absolute humidity and incidence of poliomyelitis in certain localities and suggested that atmospheric humidity influences susceptibility by its action on the nasopharynx.

In the present investigation an attempt was made to demonstrate local alterations in normal microflora of nasal passages of mice after exposure to different atmospheres of temperature and humidity, preliminary to a study of association of these changes with local resistance.

Material and methods. White Swiss male mice (9-12 g) were used. Atmospheres of low and high humidity were prepared in metal chambers with glass covers in which cages containing the mice were placed. A low relative humidity in range of 25-30% was maintained by introducing dry air into an enclosed chamber and measured directly by means of hydrodial supplied by the Bendix Co. of Baltimore, Md. A high relative humidity was maintained by introducing air saturated with water into the enclosed chamber. Three sets of the experimental chambers were maintained at 21°C, to study the effect of humidity and normal temperatures. One set was maintained at approximately 31°C to study the effect of increased temperature and humidity. Mice were kept at 21°C with a relative humidity of 45-50% for at least 2 to 3 weeks before they were subjected to experimental conditions. They were fed a balanced diet, and every care taken to avoid infection, exposure, or overcrowding. Bacterial flora of the nasal tract was determined by plating nasal washings on blood agar plates. Nasal washings were obtained as follows: Mice were killed by ether. The skin covering anterior part of head was removed after being moistened with ethyl alcohol. The nasal bone covering the nasal passage was lifted using aseptic technic, thus exposing the nasal cavity. Using a capillary pipette, .05 ml of sterile buffered saline was introduced and after drawing it up and down several times, the washing was spread on a blood agar plate using sterile bent glass rod. The plates were incubated at 37°C for 48 hours and the number and type of normal flora were determined. Nasal washings from 20 mice which had been exposed to low humidity were tested for antibacterial action on isolated gram positive and gram negative bacteria.

Results. The effect of temperature and humidity on normal flora of nasal passage was studied by exposing 4 groups of mice to conditions mentioned previously for 3 weeks. The results summarized in Table I indicated

* Present address: Camp Detrick, Frederick, Md.

TABLE I. Effect of Temperature and Humidity on Normal Flora of the Nasal Tract of Mice.

Humidity	50%		25%		85-90%		85-90%	
Temp.	21°C		21°C		21°C		31°C	
	Total No.	% gram positive	Total No.	% gram positive	Total No.	% gram positive	Total No.	% gram positive
	>1000	50	3	66	>1000	90	about 1000	70
	"	90	111	5	"	90	"	75
	"	90	5	40	about 1000	95	200	90
	"	90	36	22	>1000	95	>1000	90
	450	70	102	2	"	90	"	60
	1000	50	33	9	"	95	700	70
	"	65	69	6	"	90	>1000	70
	"	84	45	28	"	90	500	80
	250	60	47	28	about 1000	90	500	50
	>1000	80	95	5	"	90	about 1000	90

a significant reduction in total numbers of bacteria in the nasal tract of mice kept under low humidity (25%) as compared to those kept at normal (50%) or high (85-90%) humidity. In none of the mice kept at low humidity did the numbers of bacteria equal the lowest number observed in any of the mice kept under normal conditions.

At normal or high humidity the flora was predominantly gram positive, whereas under low humidity the reverse was true. This appears to be due to the marked reduction in gram positive flora and whatever the mechanism involved in these changes is, it seems to have its effect primarily in this group. This inhibition was maximum after 3 weeks exposure. Fig. 1 shows typical plates of normal flora of mice under these different conditions. Fig. 2 shows typical plates of normal flora in nasal washings of mice exposed to low humidity for one and two weeks time as compared with organisms obtained from mice under normal conditions. No antibacterial action could be demonstrated in nasal washings by filter disc method.

Discussion. Our results suggest a significant change in the physiological condition of the nasal passage in response to changes in humidity. Changes in temperature did not produce similar effects. However, there were indications that mice kept under high temperature were "stressed" in that systemic responses associated with stress phenomenon could be demonstrated(2). Previous work on correlation of temperature changes with upper respiratory infections has been concerned

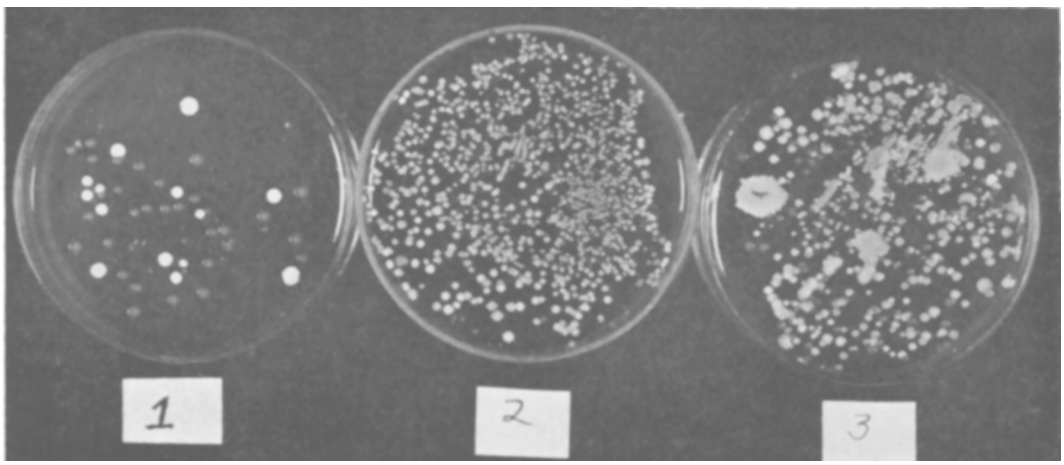

FIG. 1. Plates of nasal washings of mice exposed to the following conditions: 1. Normal temperature (21°C) and low humidity (25%). 2. *Idem*, but high humidity (90%). 3. High temperature (31°C) and high humidity (90%).

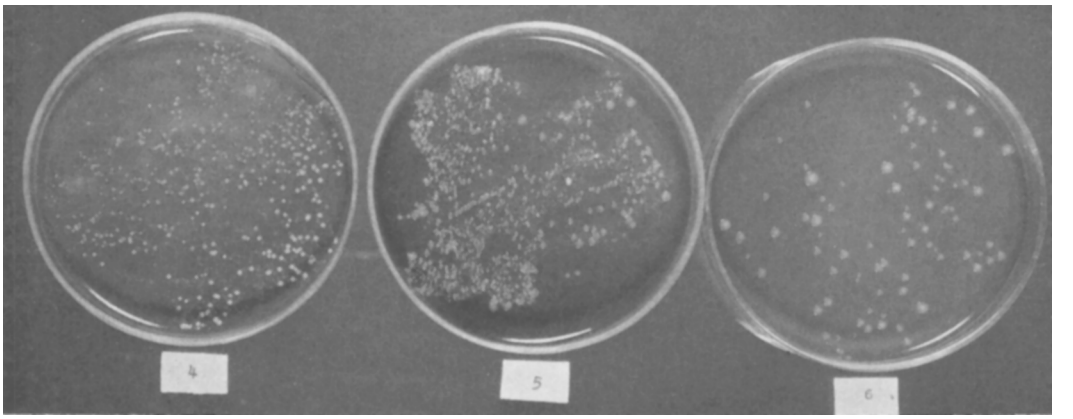

FIG. 2. Plates of nasal washings of mice exposed to normal temperature (21°C) and low humidity (25%) for different periods of time. 4. Control (21°C, 50%). 5. Mice exposed for one week. 6. Mice exposed for 2 weeks.

with the effect of chilling on the physiology of the nasopharynx(3).

Specific antibodies in nasopharyngeal secretions have been demonstrated. Amoss and Taylor(4), Howitt(5), and Bell(6) found specific antibodies against poliomyelitis virus in nasal secretions of a portion of persons examined. Burnet, Lush, and Jackson(7) reported a heat-labile, possibly enzymic substance, in nasal secretions which inactivated certain viruses, notably those of influenza, herpes, and poliomyelitis, but not vaccinia virus. Our failure to show any antibacterial substance in the nasal washings from mice kept at low humidity may be due to the fact that such a substance was present in quantities too minute to be observed by the method used.

Preliminary results have indicated further that conditions favorable for gram positive bacteria in nasal passages appeared to be favorable for infection with influenza virus(2). The reason for the relationship is not clear. It may be that the effect of high humidity on the mucous membrane produced a more favorable environment for gram positive organisms, which in turn affected the mucous membranes in such a way as to make them more susceptible to infection by the virus. On the other hand, it may be that the relationship is more direct and that the change favorable for gram positive organisms also favored the virus. Further work is needed to investigate the association of changes in normal flora of the nasal passage and lowering of local resistance.

Summary. The count of the normal bacterial flora of the nasal cavity was markedly reduced when mice were maintained under low humidity for three weeks, whereas no significant change was observed under high humidity. The reduction was noted mainly in the gram positive organisms.

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