Conclusion: changes in shape of collecting veins as determined by transmural pressure were studied in vivo. Major to minor axis ratio of femoral veins in dogs was shown to decrease with increasing transmural pressure from D_{max}/D_{min} 1.6 (at PV < 2 cm H_2O), approaching asymptotically unity (PV > 16.0 cm H_2O)[4].

Zusammenfassung. Es wird die Abhängigkeit der Gefässquerschnittsform der Vena femoralis vom Binnendruck in vivo am narkotisierten Hund untersucht. Bei zunehmendem Binnendruck vermindert sich die Relation des grossen Horizontaldurchmessers zum kleinen Vertikaldurchmesser ($D_{max}/D_{min} > 1{,}6$ / bei Venendruck < 2 cm H_2O) exponentiell, bis sich der Quotient bei einem Venendruck über 16 cm H_2O asymptotisch dem Wert 1,0 annähert. Es ergibt sich, dass die Venenquerschnittsform bei einem Binnendruck über 16 cm H_2O als praktisch rund zu betrachten ist.

J. GERO and M. GEROVÁ

Institute of Normal and Pathological Physiology, Slovak Academy of Sciences, Bratislava (Czechoslovakia), 13 May 1968.

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Effects of Environmental Temperature-Humidity and Cage Density on Body Weight and Behavior in Mice

Environmental temperature[1–3] and cage density[4,5] have been shown to influence body weight and behavior. Although cage density interacts with environmental temperature to potentiate[4] or inhibit[6] the effects of temperature on survival, the nature of this interaction could be expected to have differential effects when examined in reference to other measures of biological and behavioral adaptation. The present report investigates the effects of rearing mice under different conditions of environmental temperature-humidity and cage density on body weight and a test of swimming survival.

Method. A sample of 200 male mice of the C3H/HeJ strain from a larger population maintained by one of the authors (E. P. L.) was used as subjects. These animals were obtained from the Production Department of The Jackson Laboratory at weaning age (21 ± 3 days). They were housed under a condition of environmental temperature-humidity [70 °F with 60% relative humidity (R.H.), or 95 °F with 30% R.H.], and a condition of cage density (4 or 8/cage). Thus, 50 mice were in one of each treatment condition. Cages were solid stainless steel (11 × 5 × 5 inches deep) with wire mesh covers and pine shavings as bedding. Food and water were available ad libitum.

All mice were reared in environmental chambers (Hotpack, Inc., Philadelphia) under conditions of 12 h of light, 2 complete air changes per h, and the experimental conditions described above. The swimming survival test was conducted in a water tank described previously[7]. Except for weekly changing of cages and replenishing food and water, mice were not disturbed until 125 days of age. At this age, mice were placed in individual holding boxes and maintained at approximately 72 °F while being transferred from one laboratory building to another. This required about 40 min and occurred immediately prior to the swimming survival test.

Ten mice from each experimental condition were assigned randomly to a water temperature condition (65, 75, 85, 95 or 105 °F) for the swimming survival test. Each mouse was weighed, and a weight (weighted safety pin) in the ratio of 2 g of tail weight to 30 g of body weight was attached by a 9 mm wound clip 1 inch from the base of the tail. The mouse was held by the tail with forceps about 18 inches above the water surface and released. Swimming survival time (sec) was defined as the interval between release of the animal and the fifth consecutive second during which no part of its body was visible above the water surface. The animal was then removed.

Results and discussion. The mean body weights of the various groups of mice at 125 days of age are presented in the Table. Analysis of variance of these data show a significant environmental temperature-humidity effect ($F = 237.76$, $df = 1/196$, $p < 0.01$) and a significant environmental temperature-humidity × cage density interaction ($F = 8.82$, $df = 1/196$, $p < 0.01$). Comparisons of mean weight between the individual groups by the NEWMAN-KEULS method[8] showed that mice raised 8/cage at 95 °F-30% R.H. weighed significantly less ($p < 0.05$) than the other 3 groups. Regardless of cage density, mice raised at 95 °F-30% R.H. weighed significantly less ($p < 0.01$) than mice raised at 70 °F-60% R.H. The environmental temperature-humidity effect on body weight is consistent with previous reports[1,2,9]. However, the independent effect of cage density is not consistent with previous investigations[4,5]. This discrepancy could be related to the differences in the size of cage densities employed (i.e. isolated versus grouped, or grouped versus grouped). The interactive effect of cage density and environmental temperature-humidity may be related to temperature increases induced in the cage and in the animal as a function of cage density[10,11]. These temperature increases may not be sufficient to result in reduced body weight of mice raised at 70 °F-60% R.H. but may be sufficient to potentiate the effect already present at 95 °F-30% R.H.

The mean swimming survival time as a function of water temperature for the different experimental groups is presented in the Figure. Analysis of variance showed a significant water temperature effect ($F = 63.51$, $df = 4/180$, $p < 0.01$) and a significant environmental temperature-

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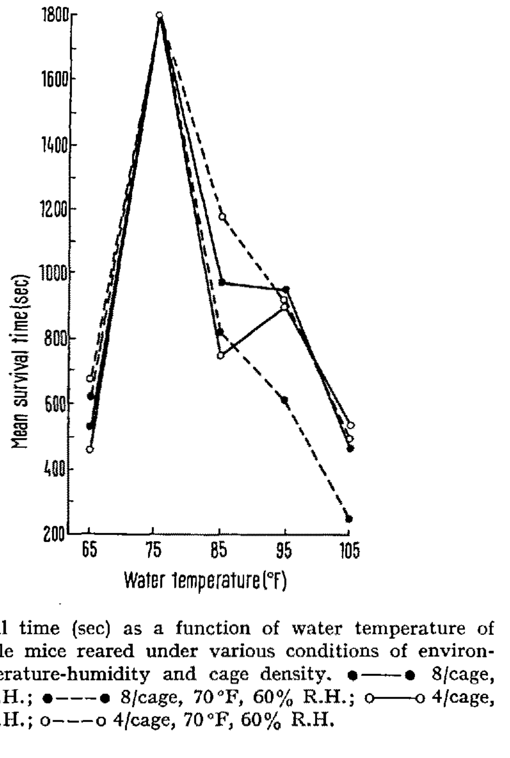
humidity × cage density interaction ($F = 4.48$, $df = 1/180$, $p < 0.05$). Comparisons by the NEWMAN-KEULS method between the mean swimming survival times of the different water temperature groups regardless of the experimental treatment showed that the extreme water temperatures (65 and 105 °F) resulted in significantly ($p < 0.05$) shorter swimming surval times than the intermediate water temperatures (75, 85 or 95 °F). The mean survival times for the groups tested at 75 °F were significantly ($p < 0.05$) longer than for all the other water temperature groups. In contrast to previous studies that employed measures of performance and maze learning[1,2], the present investigation revealed no apparent effects of adaptation from being reared in particular temperature-humidity environments on swimming performance at various water temperatures. The relatively acute nature of the swimming task required immediate and excessive expenditures of energy so that temperature adaptive mechanisms could not be discerned.

The mean swimming survival times for the 4 treatment groups regardless of the water temperature are presented in the Table. Although no significant differences between

Mean body weight at 125 days of age and mean survival time (sec) of C3H/HeJ male mice reared under various conditions of environmental temperature-humidity and cage density

		Environmental factors			
		70 °F-60% R.H.		95 °F-30% R.H.	
Cage density (No./cage)		4	8	4	8
No.		50	50	50	50
Body weight	Mean	27.3	27.9	21.9	19.9
(g)	S.D.	4.1	3.5	2.1	2.2
Survival time	Mean	1014.4	817.1	888.8	945.2
(sec)	S.D.	634.3	628.3	626.5	656.9



Mean survival time (sec) as a function of water temperature of C3H/HeJ male mice reared under various conditions of environmental temperature-humidity and cage density. ●——● 8/cage, 95 °F, 30% R.H.; ●– – –● 8/cage, 70 °F, 60% R.H.; o——o 4/cage, 95 °F, 30% R.H.; o– – –o 4/cage, 70 °F, 60% R.H.

these means (NEWMAN-KEULS) as a function of either environmental temperature-humidity or cage density were evident, the significant ($p < 0.05$) interaction suggests that environmental temperature-humidity has differential effects on swimming survival which are dependent upon cage density. The shortest survival time occurs in the group reared 8/cage at 70 °F-60% R.H. followed by the group reared 4/cage at 95 °F-30% R.H. This interactive effect extends the findings of previous reports that environmental temperature[1,2] and cage density[4,5] independently influence various aspects of behavior. The unique feature of the swimming survival task is that it requires the animal to expend energy in what is for it a 'life or death' situation with rapid submersion being associated with increased emotionality and an inability to sustain activity[7]. The conditions of increasing environmental temperature-humidity tends to decrease speed of metabolism and levels of stored energy[12,13] and would tend to decrease swimming survival time; while the conditions of increasing cage density would make the animals more emotional and decrease swimming survival time. Thus, the prediction could be made that the group reared at 70 °F-60% R.H. with 4/cage would show the best performance, while the group reared at 95 °F-30% R.H. with 8/cage would show the worst performance. The data indicate that the former is true while the latter is not. The effects of being reared at 95 °F-30% R.H. may obviate the social stress effects of cage density so that these mice are less emotional rather than more emotional than mice reared under the 70 °F-60% R.H. condition. This hypothesis is documented by observations of the 95 °F-30% R.H. animals being lethargic, with little or no social contact or huddling.

It is evident that environmental temperature-humidity and cage density are important factors in the rearing experiences of animals. Yet their effects on a variety of biological and behavioral measures of adaption are not simply cumulative but interact differentially as a function of the particular physiological and behavioral requirements of the tasks[14].

Zusammenfassung. Es wurden Mäuse des C3H/HeJ-Stammes nach Entwöhnung bis zum Alter von 125 Tagen unter verschiedenen Umweltbedingungen wie Temperatur, relative Luftfeuchtigkeit und Käfigdichte aufgezogen. Je höher Temperatur, relative Luftfeuchtigkeit und je grösser die Käfigdichte, um so grösser waren die Körpergewichtsverluste. Umwelttemperatur, Feuchtigkeit und Käfigdichte beeinflussten zusammen das Überleben der Mäuse nach Schwimmen.

A. ANDERSON, J. WERBOFF and E. P. LES

Department of Psychology, University of Maine, Portland (Maine 04103), University of Connecticut Health Center, Hartford Plaza, Hartford (Connecticut 06105) and The Jackson Laboratory, Bar Harbor (Maine 04609, USA), 18 June 1968.

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