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Effect of Chronic Noise or Water Restriction on Weight of Body and Organs in the Rat

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The effect of either chronic noise or water restriction on body weight gain and weight of several glands and organs has been studied in male Wistar rats. The results indicate that chronic noise does not affect the relative weight of glands and organs but it induces a slight decrease in body weight gain. Water restriction provokes a strong decrease in body weight gain and relative weight of the liver while it increases significantly the relative weight of other glands and organs as a likely consequence of the decrease in body mass. Chronic noise does not seems to be a strong stress and it markedly differs from water restriction which is not appropriate as a model of chronic stress.

Since SELYE it has been accepted that chronic stress provokes in rat inhibition of growth rate, increase in adrenal weight and decrease in the relative weight of other glands and organs such as hypohysis, thyroid, reproductive organs and thymus (15). In recent works SELYE's results have been confirmed using strong stresses such as immobilitzation (18). However, using other stresses the effect were milder (17) and somewhat contradictory, since it has been reported an increase in testis weight in rats daily exposed to cold (6).

In this regard, pilot studies done in our laboratory in which the effect of chronic noise or water restriction on the weight of some glands was studied, have given unexpected results. Since both chronic noise and water restriction have been used as models of chronic stress (3, 13), and water restriction could induce important metabolic alterations independently on the stress syndrome, it seems interesting to study the effect of both chronic treatments on weight of body and organs. These could reveal differences between both chronic treatments and evaluate the state of malnutrition induced by a water restriction regimen.

Materials and Methods

Male Wistar rats weighing approximately 150 g when they arrived at the laboratory were used. They were maintained four per cage, in a controlled environment (temperature 22° C, light on from 6 a.m. to 6 p.m.) and received food and water *ad libitum* for two weeks before the experimental phase was started. Further, the rats were randomly assigned to three experimental groups: 1) control, 2) noise stress: rats exposed 4 h daily for 28 days to noise (85 db), and 3) water restriction: rats drink water only 1 hour per day (between 11.30 and 12.30) for 28 days.

Each week, all the rats were weighed. In the last day rats were killed by decapitation and brain, hypophysis, adrenal glands, thyroid, testis, seminal vesicles, thymus, heart, liver, spleen and kidney quickly taken out and weighed nearest 0.1 mg. The organs were further exposed to 100° C for 24 h and dry weight was also measured.

The Student *t* test or the Berhens-Fisher modification when variances were differents (12) was applied to see statistically significant differences between means.

Results

Chronic noise provoked a decrease in the rate of body weight gain that reached statistical significance after three and four weeks. Water restriction caused a strong inhibition of body weight gain maintained throughout all the weeks but especially evident in the first one in which

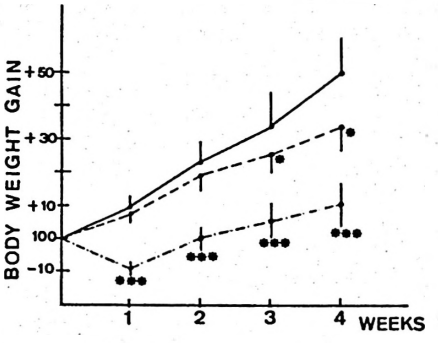

Fig. 1. *Effect of different chronic treatments on body weight gain with respect to initial body weight (%).*
It is represented Means ± S. D. In each group n = 14. ——— control, — — — rats stressed with noise (4 h daily for 28 days), — · — · — rats submitted to a water restriction regimen for 28 days.* $p < 0.05$, *** $p < 0.001$ vs control group at the same time period after stress.

Table I. *Relative weight of organs (mg/100 g body weight) after various chronic treatments.* It is represented means ± S.D. In each group n = 14.

	Control	Chronic noise	Chr. water restriction
Hypophysis	2.7 ± 0.3	3.0 ± 0.2	3.0 ± 0.5
Adrenals	12.6 ± 1.5	12.2 ± 2.2	14.3 ± 1.7 *
Thyroid	3.9 ± 1.3	4.7 ± 1.8	5.2 ± 1.5
Testis	1 038 ± 221	1 072 ± 102	1 383 ± 93 ***
Seminal vesicles	306 ± 69	317 ± 65	330 ± 93
Brain	537 ± 46	533 ± 40	659 ± 64 ***
Thymus	202 ± 48	209 ± 31	190 ± 36
Liver	4 375 ± 239	4 342 ± 312	3 896 ± 247 ***
Spleen	197 ± 22	204 ± 28	197 ± 23
Heart	337 ± 28	320 ± 28	338 ± 26
Kidney	845 ± 71	800 ± 45	812 ± 76
Anterior tibialis muscle	216 ± 27	212 ± 22	252 ± 27 *

* $p < 0.02$, *** $p < 0.001$ vs control.

an absolute decrease in body weight was observed. Fig. 1 shows the effect of both chronic treatments on body weight gain.

In table I are indicated the relative weight of glands and organs. Water restriction induced a significant increase in relative weight of adrenals, testes, brain and anterior tibialis muscle, and a decrease in the relative weight of the liver. Chronic noise did not modify the relative weight of any organ or gland.

The relative dry weight of organs were also measured but not include here, since no change was observed respect to relative wet weight.

Discussion

No increase in relative adrenal weight was observed in rats chronically stressed with noise. Furthermore, the decrease in body weight gain was slight. This indicates that noise is not a strong enough stress as being confirmed by the lack of effect on the weight of organs and glands. Then, chronic stress not neccessarily must induce drastic impairment of either immunologic or gonadal function, at least reflected in weight changes. It appears that intensity and duration of chronic stress could be very important in determining the kind of alterations in body function.

Although the study of the effect of chronic stress on food intake has given contradictory reports (9, 10, 14, 16), recent studies have clearly demonstrated that stress induces eating in the rat (1, 11). The decrease in body weight cannot be due to this fact and are probably mediated by the release of catabolic hormones such as catecholamines, corticosterone, and thyroxine (7), and the decrease in growth hormone secretion (2) induced by stress.

Water restriction provoked a severe loss of body weight, presumably as consequence of the decrease in food intake secondary to a water restriction regimen (5). This effect was especially evident in the first week. This fact could be explained taken into consideration: a) the loss of water accompanying the initial phase of malnutrition and starvation (8), and b) the progressive decrease in basal metabolism as a mechanism of adaptation to prolonged caloric deficit (8). The results obtained using dry weight were similar to those of wet weight. It indicates that the decrease of body weight at the end of the experiment could be basically attributed to depletion of fat stores and to the decrease in the growth of some organs. The effect was especially evident in the liver in which a decrease in its relative weight was observed. It is well known that liver is the most sensitive to malnutrition and starvation (8).

The relative weight of pituitary, adrenal, thyroid and testes were higher in water restricted rats, although only adrenal and testes changes reached statistical significance. An enhancement of corticoadrenal activity has been suggested after malnutrition (4, 8), but we do not know data about such an effect on testicular function, excepting those obtained in a previous work done in our laboratory in which a similar increase in relative testicular weight was found using water restriction (unpublished data). The increase in relative weight of glands can be interpreted, until direct hormonal assays can be done, as the result of a greater resistance to weight loss of this organs compared to total body. Thus, a significant increase in the relative weight of the brain has been observed and this organ is the most resistant to weight loss after malnutrition (19). A surprising finding was the significant increase in the relative weight of anterior tibialis muscle. It indicates that diminished food intake due to water restriction was not severe, the higher relative muscle weight reflecting only the greater loss of total body weight.

It appears that only strong enough stresses induce the expected changes in the thymus and endocrine system. The

alterations induced by water restriction and the nature of these changes suggest that these ones could be due to malnutrition and not to stress induced by water restriction. Therefore this treatment can not be used as a model of chronic stress.

Resumen

Se estudia en ratas Wistar macho, el efecto del ruido o la restricción de agua sobre el peso corporal y el de diversas glándulas y órganos. Los resultados muestran que el ruido crónico no afecta al peso relativo de ninguna de las glándulas y órganos investigados, pero induce un ligero descenso en la tasa de crecimiento ponderal. La restricción de agua provoca un acusado descenso en la ganancia de peso corporal y en el peso relativo del hígado. Por el contrario, el peso relativo de otros órganos y glándulas aumenta significativamente, probablemente como consecuencia de un mayor descenso del peso corporal secundario al descenso en la ingesta de alimento. Se concluye que el ruido crónico aplicado no es un stress potente y que la restricción de agua no es utilizable como modelo de stress crónico.

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