NOTICE

THIS DOCUMENT HAS BEEN REPRODUCED FROM MICROFICHE. ALTHOUGH IT IS RECOGNIZED THAT CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED IN THE INTEREST OF MAKING AVAILABLE AS MUCH INFORMATION AS POSSIBLE

NASA TECHNICAL MEMORANDUM NASA TM-76192

CALORIGENIC EFFECT OF ADRENALINE IN RATS UNDER CONDITIONS OF RESTRICTED MOTOR ACTIVITY

L. Tomaszewska, H. Kaciuba-Uscilko, and S. Kozlowski

(NASA-TM-76192) CALORIGENIC EFFECT OF ADRENALINE IN RATS UNDER CONDITIONS OF RESTRICTED MOTOR ACTIVITY (National Aeronautics and Space Administration) 8 p HC A02/MF A01 CSCL 06C G3/51

N80-27988

Unclas 28026

Translation of "Kalorigennoye deystviye adrenalina u krys v usloviyakj orgranichennoy dvigatel'noy aktivnosti", Artificial Satellites, Vol. 8, No 1/2, 1973 pp 75-80, (Polish Academy of Sciences, Symposium on Cosmic Biology and Medicine, Warsaw, Poland, June 12-17,1972)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546 JUNE 1980

STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA TM-76192		

4. Title and Subtitle	5. Report Date
CALORIGENIC EFFECT OF ADRENALINE IN RATS UNDER CONDITIONS OF RESTRICTED MOTOR ACTIVITY	JUNE 1980
	6. Performing Organization Code
7. Author(s) L. Tomaszewska, H. Kaciuba-Uscilko, S. Kozlowski	8. Performing Organization Report No.
	10. Work Unit No.
9. Performing Organization Name and Address .SCITRAN Box 5456 Santa Barbara, CA 93108	11. Contract or Grant No. NASW-3198
	13. Type of Report and Period Covered Translation
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546	14. Sponsoring Agency Code

15. Supplementary Notes Translation of "Kalorigennoye deystviye adrenalina u krys v usloviyakh orgranichennoy dvigatel'noy aktivnosti", Artificial Satellites, Vol. 8, No 1/2, 1973 pp 75-80 (Polish Academy of Sciences, Symposium on Cosmic Biology and Medicine, Warsaw, Poland, June 12-17, 1972) (A74-20558)

16. Abstract

The previous studies of the authors demonstrated that long-term restricted motor activity in rats induces a decrease in body weight, increase in release of adrenaline and decrease in the release of noradrenaline with the urine, as well as a reduction in activity of the thymus gland and level of thyroxin in the blood.

17. Key Words (Selected by Author(s))	18. Distribution Statement
	Unclassified - Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22.
Unclassified	Unclassified	8	

NASA-HQ

CALORIGENIC EFFECT OF ADRENALINE IN RATS UNDER CONDITIONS OF RESTRICTED MOTOR ACTIVITY

By L. Tomaszewska, H. Kaciuba-Uscilko, and S. Kozlowski

The previous studies of the authors demonstrated that long-term restricted /75* motor activity in rats induces a decrease in body weight [9], increase in release of adrenaline and decrease in the release of noradrenaline with the urine [8], as well as a reduction in activity of the thymus gland and level of thyroxin in the blood [6]. At the same time a decrease was found in the internal body temperature, that is accompanied by an increase in the rate of metabolism in a state of rest [9]. The goal of this work is to clarify whether the calorigenic effect of adrenaline under conditions of increased metabolism in the period of immobility is exposed to changes.

The studies were conducted on albino rats of the Wistar strain, weighing 160- /76 180 g.

In the control periods the rats spent a week in metabolic cages. Their rate of main metabolism was measured, and the calorigenic effect of adrenaline (Pol'fa) administered subcutaneously in a dose of 50 μg/100 g of body weight was determined.

*Numbers in margin indicate pagination in original foreign text.

Both the rate of metabolism in the state of rest, and the calorigenic effect of adrenaline were evaluated based on measurements of oxygen absorption by the organism. The oxygen absorption analyses were made in a closed system [5]. On the 10th and 21st day of stay of the rats in the special hypokinetic cages the analyses of the metabolic rate and calorigenic effect of adrenaline (50 μg/100 g of body weight) were repeated. In addition in six rats a study was made of the calorigenic effect of a large dose of adrenaline (100 μg/100 g) under control conditions on the 21st day of restricted motor activity.

After 21 days of staying in hypokinetic cages the rats were transferred to metabolic cages, where they stayed for another 21 days. On the 1st, 10th and 21st day after return to conditions of normal motor activity the measurements described above were repeated.

In all the rats and additionally in the 20 control rats daily portions of urine were taken and the quantity of adrenaline in them was determined according to the method of Von Euler and Lishajko [3].

1. RATE OF METABOLISM IN STATE OF REST (OXYGEN ABSORPTION)

The rate of oxygen absorption increased to a statistically reliable degree ($d < 0.001$) from 28.1 to 42.3 ml/min/kg already after 10 days of restricted motor activity, and to 49.1 ml/min/kg after 21 days of hypokinesia.

After return to normal conditions of motor activity (in metabolic cages), still after 10 days the rate of oxygen absorption was significantly increased (38.1 ml/min/kg) ($d < 0.001$), returning to amount close to the control only after 21 days (Table 1).

TABLE 1. CHANGES IN RATE OF METABOLISM IN STATE OF REST (OXYGEN ABSORPTION IN ml/kg/min) UNDER THE INFLUENCE OF RESTRICTED MOTOR ACTIVITY

	Control, Normal Motor Activity	Hypokinesia		Normal Motor Activity After Hypokinesia		
		10 Days	21 Days	1 Day	10 Days	21 Days
Metabolism M	28.1	42.3	49.1	43.2	38.1	30.4
Sustances E	0.98	3.18	1.97	2.56	1.37	0.58
At rest D	0.001	0.001	0.001	0.001	0.001	-

/77

Key:
M. Average E. Standard error D. Confidence level

2. CALORIGENIC EFFECT OF ADRENALINE

Injection of adrenaline (50 μg/100 g of body weight) induced under control conditions an increase in oxygen absorption (28.1 to 36.7 ml/min/kg) ($d < 0.001$). Injection of 100 μg/100 g increased the rate of oxygen absorption from 29.3 to /78
40.9 ml/min/kg (Figure 1).

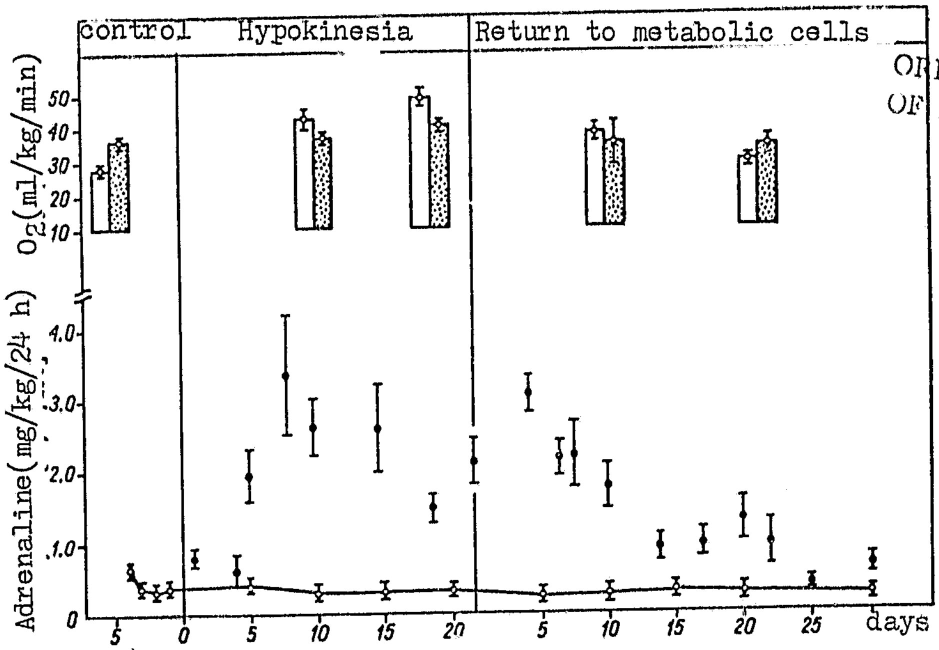

Figure 1. Above: Absorption of Oxygen Under Conditions of Hypokinesia

White columns--control, columns with dots after injection of adrenaline. Below: Excretion of Adrenaline with Urine Under Conditions of Hypokinesia (black dots), control: white dots. In both cases the average amounts are given with their standard error.

Already after 10 days of restricted motor activity the rats lacked a calorigenic reaction to the adrenaline injection. It was also missing after 21 days of hypokinesia, and then after a dose of 50 μg/100 g and after injection of 100 μg/100 g.

After injection of adrenaline in a dose of 50 μg/100 g, after 21 days of restricted motor activity of the rats in the majority of animals the rate of oxygen absorption was somewhat reduced (on the average from 49 ml to 41.9 ml, $d < 0.001$).

The calorigenic effect of adrenaline appeared again only after 21 days of return of the animals to normal motor activity, and then only in some of the rats (in 3 out of 7). However, this effect was still considerably weaker than in the control conditions. Oxygen absorption rose in the group of animals where the effect of this hormone was found on the average from 29.9 ml/min/kg to 34.0 ml/min/kg.

Among the rats who received adrenaline in a dose of 100 μg/100 g, the body weight dropped by half under influence of the injection employed on the 21st day of restricted motor activity.

3. EXCRETION OF ADRENALINE WITH URINE

The occurrence of change in adrenaline excretion with urine is presented in Figure 1. In the control period (rats in one of the metabolic cages) excretion of adrenaline with urine was maintained on a constant level. After movement of the animals to hypokinetic cages adrenaline excretion gradually rose (from the 5th day differences were statistically reliable, $d < 0.001$), starting with about the 10th day it was stabilized on a level over two times greater than excretion of this hormone in the control conditions.

Return of the rats to normal (control) conditions of motor activity in the metabolic cages induced a very slow, gradual drop in adrenaline excretion, which reached the control level only after about 4 weeks.

The results of the presented study confirm the increase in the rate of metabolism in the state of rest in rats under conditions of restricted motor activity completely described by Tomaszewska and Poczopko [9]. This most likely is the reason, at least partially, for the drop in body weight in the animals under these conditions. One can assume that one of the factors inducing the unexpected phenomenon of a rise in metabolic rate at rest is the decrease in the thermal insulation of the animals (decrease in the subcutaneous fatty tissue, exacerbation in the insulation quality of the fur). /79

In this situation the lower critical temperature must be reduced, and the increase in metabolic rate would be a thermal regulating reaction. Stimulation of the cerebral matter in the adrenal glands and increase in adrenaline secretion in the studied situation [8] agree with this hypothesis. The high level of endogenous adrenaline in circulation of the brain in turn can be the cause of the lack of reaction to exogenous adrenaline. Swanson [7] found in rats a decrease in calorigenic effect in a medium of low temperature, i.e., under conditions in which excretion of endogenous adrenaline rises.

The absence of a calorigenic effect of adrenaline was still maintained for a long period of time after return of the animals to a condition of normal motor activity. Attention is drawn here to the similarity with the slow return of adrenaline secretion with the urine to control amounts after the end of hypokinesia.

A small decrease in the metabolic rate at rest after injection of small doses of adrenaline to rats in a period of restricted motor activity can be linked to its effect on the behavior of the animals noted under these conditions. One should stress the death of a number of animals after injection under such conditions of a large adrenaline dose. The dependence of the pharmacological effects of a number of drugs on the level of motor activity of the animals has been described by Wisniewski et al., [10].

REFERENCES

1. Bartsch, P.; Choinawski, H. and Eckelmann, W.: Acta biol. med. germ., 1971, 26, 1187.

2. Bezhaniyan, S. A. Regulyatsiya funktsii v razlichnyye vozrastnyye periody ["Regulation of Function in Different Age Periods"], Kiev.

3. Euler, U. S. V., and Lishajko, F.: Acta Physiol. Scand., 1961, 51, 348.

4. La France, L.; Rousseau, S.; Begin-Heick, N. and Le Blanc, J.: Proc. Soc. Exp. Biol. Med., 1972, 139, 157.

5. Lyszczarz, J.: Acta Physiol. Pol., 1964, 15, 297.

6. Reklewska, B.; Tomaszewska, L.; Kaciuba-Uscilko, H. and Kozlowski, S.: Bull. Acad. Pol. Sci.: Cl. II 1972, 20, 685.

7. Swanson, H. E.: Endocrinology, 1957, 60, 205.

8. Tomaszewska, L.; Kaciuba-Uscilko, H.; Reklewska, B.; Sobocinska, J.; and Kozlowski, S.: Space Life Sci., 1971, 3, 174.

9. Tomaszewska, L. and Poczopko, P.: Acad. Pol. Sci., Cl. II 1972, 20, 743.

10. Wisniewski, K.: Materialy z Sympozjum w Bialowiezy, 1971.