HYPERGRAVITY MODULATES BODY COMPOSITION

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INTRODUCTION

Mechanical stress is a major determinant of bone mass and bone architecture. Subjecting animals to sustained acceleration in a centrifuge, leading to an increased gravitational force (hypergravity or HG) results in changes of various parts of the organism[1]. HG decreases body weight in the long term while food intake is only decreased in the first few days of HG. Anatomical examination of HG animals shows a pronounced decrease in body fat, particularly in the abdominal fat depots and the lipid content of internal organs[2]. Concerning bone mass the literature is equivocal. Some studies show shorter femur length, indicating that hypergravity inhibits the longitudinal growth[3]. Jaekel *et al*[4] show a higher bone mineral density resulting in a better capability to withstand mechanical stress.

AIM OF THE STUDY

The aim of this study was to measure the body composition by dual x-ray absorptiometry (DXA) after long-term acceleration in a centrifuge, inducing HG conditions.

METHODS

Twentyeight Long Evans rats were subjected to HG (2,5xG) in a 4 meter swing-out centrifuge or to control conditions according to table 1. After sacrificing all animals were frozen at –20 °C until scanning. Body weight (BW), bone mineral content (BMC), bone mineral density (BMD), lean body mass (LBM) and fat mass were determined at room temperature by DXA (Hologic QDR 2000). BW was also measured on a balance. The Mann Whitney signed rank test was used to test for differences between HG and control conditions for males and females seperately.

group	No. rats	control	HG	conditions
1	7	-	4 3	6 months HG from 9 weeks old
2	8	1 3	4	6 months HG or control from 9 weeks old
3	12	5 3	2 2	12 months HG or 8 months control from birth

Table 1: Hypergravity and control conditions.

Figure 1: Swing-out centrifuge

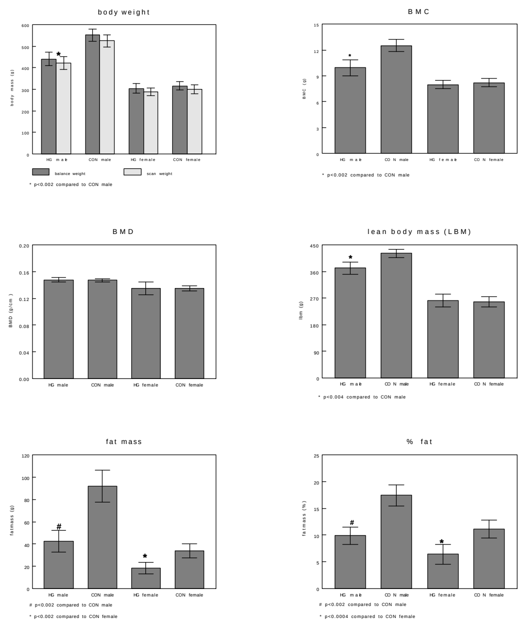

Figure 2: DXA and body weight measurements

	Hypergravity	Control	% change
BM males	441.3 ± 31.9g	551.5 ± 28.0g	-20%
BMC males	9.9 ± 0.9g	12.5 ± 0.7g	-21%
LBM males	371.5 ± 20.4g	420.9 ± 13.5g	-12%
Fat males	42.5 ± 9.7g	91.8 ± 14.4g	-54%
Fat females	18.3 ± 5.1g	33.9 ± 6.4g	-46%
% fat males	9.9 ± 1.6%	17.4 ± 1.9%	-43%
% fat females	6.4 ± 1.9%	11.2 ± 1.7%	-43%

table 2: DXA and body weight measurements

RESULTS

DXA scan results and bodyweight measurements are depicted in figure 2 and table 2. Body weight, BMC and LBM of HG males were significantly reduced compared to control males although there was no difference in BMD. No significant differences in these variables were seen between HG females and control females. Both in females and in males there was a significant reduction of fat mass in the HG rats compared to the control rats. This reduction was still significant as a percentage of body weight.

CONCLUSIONS

In male rats as well as in female rats long-term HG conditions induced a decrease in fat mass. Only in male rats did HG conditions decrease body weight and this was reflected in all body compartments: bone mass, lean body mass and fat mass. Although there is a decrease in BMC, when bone mass is corrected for size, no differences can be observed.

References:

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