Gastric Lesions in Food-Restricted Young Rats (36882)

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Adult rats offered food for only 1 hr/day and kept in activity wheels lost weight and died within 2 wk. Similarly food-restricted rats housed in standard laboratory cages adapted to the reduced food intake and survived (1, 2). Results of subsequent studies have shown that the food-restricted rats in activity wheels developed extensive gastric lesions (3).

The investigations on the relationship between limited food intake, activity and gastric ulcers have now been extended to younger rats and our present results indicate that restriction of food intake in young animals may lead to development of gastric ulcers, even if the rats are kept in standard laboratory cages.

Materials and Methods. Two series of experiments were carried out. In the first experiment, male Sprague-Dawley rats (Sprague-Dawley Co., Inc., Madison, WI) weighing initially 110 to 120 g each (av, 113 g) were housed either in activity wheels (Model No. LC-34, Wahmann Manufacturing Co., Baltimore, MD—10 animals) or individually in the standard laboratory cages (Model No. HB-11A, Hoeltge, Inc., Cincinnati, OH—5 animals). Food intake (Purina Laboratory Chow, Ralston Purina Co., St. Louis, MO) was restricted to 1 hr/day (9:00 to 10:00 AM) and the amount of food eaten was measured. All animals in the activity wheels died during the first 4 days of the experiment. All rats in the standard cages survived and were sacrificed on the fifth day of the study. Stomachs and intestines of all animals were removed and examined for macroscopic damage.

The second series was carried out using 24 male Sprague-Dawley rats in the weight range of 96 to 110 g (av wt, 104 g). They were divided into 3 groups of 8 animals each and received food (Purina Laboratory Chow diet) either for 1 hr/day (9:00 to 10:00 AM), 2 hr/day (9:00 to 11:00 AM) or without any restriction. The amount of food eaten was again measured. All animals were kept in standard laboratory cages and the survivors were sacrificed on the fifth day of the experiment. The gastrointestinal tracts were again inspected for gross lesions.

Results. The average daily food intake of the animals in activity wheels amounted to 3.3 ± 0.2 g/day (mean ± standard error), while the rats in standard laboratory cages ate 4.1 ± 0.2 g/animal/day. All animals kept in the activity wheels developed gastric lesions, which ranged from multiple pinpoint hemorrhagic spots to extensive confluent ulcerations. All animals also had fresh or digested blood in the intestinal tract. Unexpectedly, the control animals kept in standard rat cages also developed gastric lesions. However, their lesions were, in general, less extensive than those seen in the "activity wheels" group and were, in general, limited to pinpoint ulcers.

In the second series, in which all animals were kept in standard laboratory cages, the rats fed for 1 hr/day reduced their food intake, lost about 25% of their weight, and only 3 of them remained alive by the fifth day of the experiment (Table I). In the group on the 2-hr feeding schedule, the animals gradually increased their food intake and all of them survived. Their average weight loss was less than 5% of the initial weight. The animals fed *ad libitum* also survived and gained an average of 54 g.

Gross evaluation of the gastrointestinal tract revealed extensive gastric ulceration in all animals receiving food for 1 hr only (Fig.

TABLE I. Weight and Food Intake of Young Rats Fed 1, 2 or 24 Hr/Day.

Feeding schedule (hr/day)	Initial wt (g)	Food intake (g)		Final wt (g)
		Day 1	Day 4	
1	104 ± 2.1[a]	2.6 ± 0.2	1.0[b]	79 ± 1.0[c]
2	104 ± 1.7	4.3 ± 0.3	6.0 ± 0.5	99 ± 4.4
24	105 ± 2.1	17.1 ± 2.3	20.8 ± 0.6	159 ± 2.7

[a] Mean ± standard error, 8 animals/group.
[b] Mean of 3 surviving animals.
[c] Weight at death or sacrifice on the fifth day of experiment.

1A). Fresh and digested blood were seen in the intestinal tract. In the group fed for 2 hr/day, 1 animal developed multiple confluent gastric ulcers while an additional animal had only a few gastric lesions (Fig. 1B). The gastrointestinal tract of the remaining 6 animals was without any remarkable changes. Similarly, the 8 control animals receiving food *ad libitum* seemed to remain healthy and without any lesions in their gastrointestinal tract (Fig. 1C).

Discussion. The gastric lesions produced in the present study by restriction of feeding time to 1 hr/day resemble morphologically the "stress ulcers" reported to occur in immobilized rats (4), in fasting rats forced to run along the circumference of a cylindrical cage (5), in rats exposed to a rotational stress (6) or in food-restricted rats allowed to run in activity wheels (3). The age or size of the rats seems to be a decisive factor in the production of the gastric lesions by a simple food restriction, since in our previous studies with animals weighing about 160 g each no lesions were observed after a 2-wk period of 1 hr/day feeding schedule (3). The lack of adaptation of young animals to severe dietary restriction is also suggested by the results of Woods and Routtenberg (7) who observed that all of their 45-day-old rats kept on a 23-hr food deprivation schedule expired within 6 days.

Summary. Young male rats fed for 1 hr/day only failed to adapt to restricted food intake and died within a 4-day period. All animals in this group developed extensive gastric ulceration and gastric hemorrhage. When the daily food intake was restricted to 2 hr, none of the animals expired and only 2 showed gastric lesions; no pathologic changes

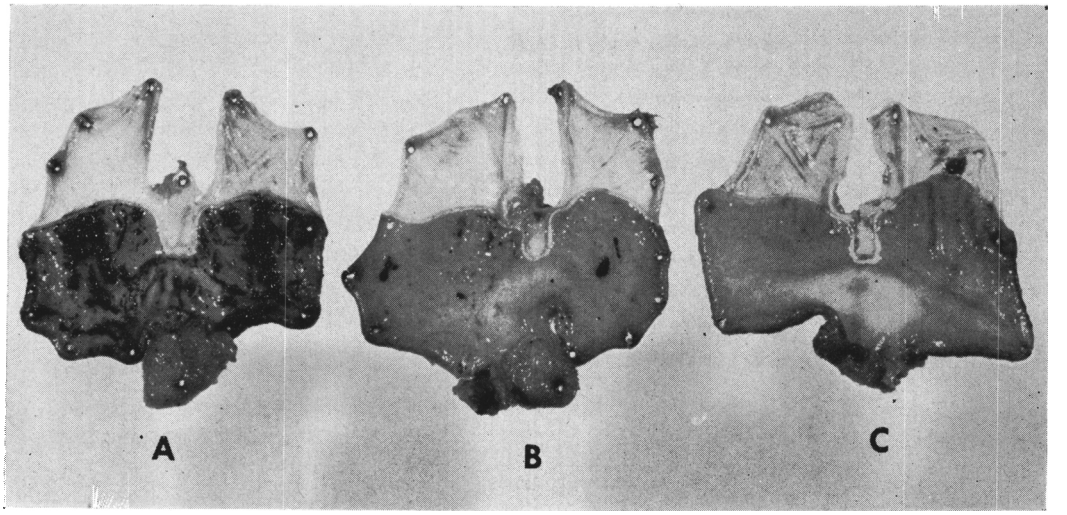

FIG. 1. Gastric lesions in young rats on restricted feeding schedule: (A) Fed 1 hr/day, all 8 animals. (B) Fed 2 hr/day, 2 animals affected. (C) Fed *ad libitum*, no gastric lesions.

were seen in rats fed *ad libitum*.

The authors appreciate the excellent technical assistance of Mr. Jack Tomlinson.

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Received June 26, 1972. P.S.E.B.M., 1972, Vol. 141.