Emotional and Behavioral Reactions in Experimental Animals with Alimentary Obesity

V. G. Selyatitskaya and O. I. Kuzminova

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Mature male rats with alimentary obesity developing from the first days of postnatal ontogeny were characterized by reduced tolerance of the food reaction to external inhibition, increased motor and exploratory activity, and reduced emotional reactivity in the open field test.

Key Words: *alimentary obesity; early ontogeny; emotional and behavioral activity*

The percent of obese individuals among adults and children progressively increases during the recent decades in all developed countries. Excess body weight is most often caused by life-style factors and alimentary behavior. It should be noted that adults with alimentary and constitutional obesity are often characterized by emotional instability and emotiogenic alimentary behavior, when psychological discomfort becomes a stimulus to food intake, which manifests in hyperphagic reaction to various stress factors [1,3].

If obesity develops from the childhood, it is characterized by more dynamic body weight gain and is more often associated with somatic pathologies, than in cases with disease debut in adult age. Overfeeding in early childhood leads to not only adipocyte enlargement, but also to their proliferation [7-9], and then body weight loss is not accompanied by a decrease in the number of adipocytes. This considerably complicates the problem of reducing excess body weight in adults who experienced this kind of biosocial imprinting at the early stages of ontogeny. Little is known about emotional and behavioral reactions in alimentary behavior in individuals with obesity developing at the early stages of ontogeny.

Research Center of Clinical and Experimental Medicine, Siberian Division of the Russian Academy of Medical Sciences, Novosibirsk, Russia. ***Address for correspondence:*** ccem@soramn.ru. V. G. Selyatitskaya

Our previous experiments on rats demonstrated that reduced litter size, increased fat content in the ration of lactating females, and feeding high-fat ration by growing progeny induce alimentary obesity (AO) in mature rats. AO in these animals is characterized by enlargement of fat depots and reduced sensitivity of the peripheral tissues to insulin [4].

Here we studied emotional and behavioral characteristics as possible factors involved into body weight regulation in mature rats with AO developing from the first days of postnatal ontogeny.

MATERIALS AND METHODS

Experiments were performed on Wistar rats. For obtaining experimental obese male rats, on day 1 after birth all newborn females and some males were removed from the litter and only 3-4 male pups were retained. Female rats received porcine fat (100 g/kg food) throughout the lactation period; the food was given *ad libitum*. The pups were separated from mothers at the age of 25-28 days. The high-fat ration was given throughout the entire experimental period. For obtaining control rats, the litters were reduced to 8 pups and standard vivarium ration was given.

Emotional and behavioral activity was evaluated in 14 experimental and 13 control males at the age of 4-5 months (body weight 332±14 and

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TABLE 1. Resistance of AR to External Inhibition in Control Animals and Rats with AO (*M*±*m*)

Group	Resistance, %		
	in the whole group	in subgroups	
		with increased resistance	with reduced resistance
Control	96.2±18.4	145.2±16.8	39.0±14.0
	(*n*=13)	(*n*=7)	(*n*=6)
Experimental	48.6±11.8*	171.4	39.1±7.6
	(*n*=14)	(*n*=1)	(*n*=13)

Note. Here and in Table 2: *$p<0.05$ compared to the control.

244±10 g, respectively). One month before and during testing, the rats were maintained in individual cages with free access to food and water. The food was given at 16.00 p.m. for maintaining the natural rhythm of organism functioning.

Emotional activity was evaluated by the open field test (OF) [6]. To this end, we used a white area with a diameter of 120 cm divided into 25 sections and surrounded by a 30-cm wall. The test was performed in a dark room, the OF was illuminated with a 100-W bulb; the duration of testing was 5 min. The rat was placed in the center of OF. For evaluation of motor and exploratory activity, the number of crossed squares (horizontal activity) and rearing postures (vertical activity) were determined individually for each rat. Emotional and autonomic reactions were evaluated by the number and duration of grooming acts and by the number of defecation boluses. OF testing was performed.

The test for resistance of alimentary reaction (AR) to external inhibition was performed at 16.00 p.m. During the first 3 days, we determined the amount of food consumed in home cage over 5 min immediately after it was supplied. On day 4, the rat was transferred into a new cage directly before feeding; the cage was transferred into another room with bright illumination, which is considered as a mild emotional stress [2]. The amount of food consumed over 5 min was determined again. The ratio of food consumption under conditions of emotional stress and in home cage was calculated [2]. If this ratio was >100%, the rats were referred to the subgroup with increased and if it was <100% to the subgroup with reduced resistance of AR to external inhibition.

The data were processed statistically using nonparametric Mann—Whitney test (for comparison of the means) and Fisher exact test for comparison of qualitative signs.

RESULTS

The resistance of AR to external inhibition under conditions of emotional stress in rats with AO was 2-fold lower than in controls (Table 1). Division of animals into subgroups with increased and reduced resistance of AR under conditions of emotional stress relative to the initial values revealed considerable heterogeneity of the control group by this parameter. Increased resistance of AR under conditions of emotional stress was observed in 54% rats, and reduced resistance in others.

Individual differences in physiological reactions to various stress factors are typical of laboratory rats [2,5]. In this context, it is interesting that rats with AO was practically homogenous by this parameter: 13 of 14 rats demonstrated reduced resistance of AR under conditions of emotional stress and in only one rat this parameter was increased. The differences between the control and experimental groups by the number of animals with increased and reduced resistance of AR under conditions of emotional stress were significant ($p<0.01$).

Animals with AO demonstrated higher motor and exploratory activity in OF and higher number of grooming acts. This behavioral act plays an im-

TABLE 2. Emotional and Behavioral Reactions in OF Test in Control Animals and Rats with AO (*M*±*m*)

Group	Number of crossed squares	Number of grooming acts	Grooming duration	Number of boluses
Control (*n*=13)	65.9±3.2	6.9±0.7	33.9±4.8	2.3±0.8
Experimental (*n*=14)	77.4±4.3*	3.9±0.8*	23.6±4.1	2.9±0.7

portant role in the recovery of emotional and behavioral homeostasis disturbed by stress and changes in grooming duration are associated with shifts in neuroendocrine mechanisms of regulation of behavioral reactions in animals [6]. The animals of the control and experimental groups did not differ by the number of defecation boluses (Table 2), which attests to the absence of differences in autonomic manifestations of emotional reactivity.

The results suggest that fat-enriched ration from the first days of postnatal ontogeny is a modifying factor narrowing the range of emotional and behavioral activity in adult animals. The data on reduced sensitivity to emotional stress and resistance of AR to external inhibition in experimental rats suggest that AO developing at the early stages of postnatal ontogeny is characterized by hypophagic, rather than hyperphagic reaction to emotional stress in adult animals. Hence, excess body weight in adults with AO developing from the early stages of ontogeny is maintained due to sustained metabolic disturbances, but not due to peculiar alimentary behavior.

Our findings demonstrate high significance of the factor of high caloric content of food and overfeeding in the early ontogeny not only for the formation of AO in adults, but also changes in their individual emotional and behavioral reactivity.

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