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Relation Between Body Weight, Growth Rate, Chronological Age and Puberty in Male and Female Rats

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Body weight, growth rate, chronological age and puberty in female and male rats from litters of 8 and 12 offsprings/mother have been studied. Age and body weight at the moment of vaginal opening (VO) and balanopreputial separation (BPS) were analyzed. Results show that animals reared in smaller groups grew faster than others. After weaning there was an increase in growth rate. VO and BPS occurred at the same age in groups with different growth rates and different body weights. In conclusion this work evidences that external signs of sexual maturation are not linked to a «critical weight» or to a «growth rate».

Key words: Puberty, Growth, Body weight.

Puberty onset is a physiological event involving multiple factors. One of them is the somatic development. The relation between development and sexual maturation have been studied principally in female rats and there is little information in males rats.

The female rat with «optimal» growth shows vaginal opening earlier and at a heavier weight than underfed animals (3). Therefore growth rate and body weight are not necesarily linked to the time of puberty onset (6, 7).

The purpose of this work is to analyze the influence of body weight and chronological age on sexual maturation in rats, using vaginal opening (v.o.) and balano-preputial separation (BPS) as external indices of pubertal development in female and male rats (5) respectively. We have studied these signs in animals with different body weights and growth rates coming from mothers with different litter size.

Material and Methods

Wistar rats were used in this study. The light cycle (12 h of light and 12 h of dark-

ness, light onset at 07.00) and T (20-23 C) were controlled. Expectant mothers were checked twice daily for delivery. Litters born on the same day were thoroughly mixed and returned to the mothers in groups of 8 or 12/mother. Only groups that remained complete at weaning were studied. After weaning (21 days of age) the rats were housed in groups of 5-6/cage and fed *ad libitum* (Sanders diet). All animals were checked every morning for vaginal opening and balano-preputial separation. Animals were weighed at delivery and every four days afterwards. Body weights were also recorded at the time of VO or BPS. Statistical analysis was done by Student's t.

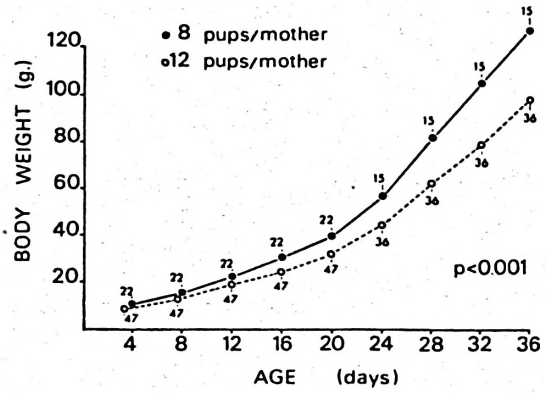

Fig. 2. *Evolution of body weight in males reared in groups of 8 or 12 litter/mother.* Each point represents x ± s.e.m.

Results

The evolution of body weight in females reared in groups of 8 or 12/mother is represented in fig. 1. Body weights were higher in the first group ($p < 0.001$) in all days studied. Differences remained after weaning. Similar differences in body weights were obtained in male rats (fig. 2). An increase in the slope of body weight after weaning was detected in all groups of animals.

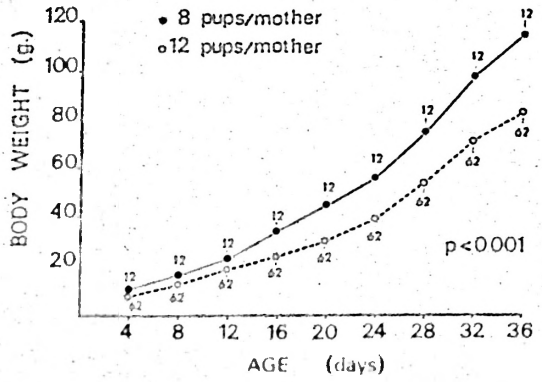

Fig. 1. *Evolution of body weight in females reared in groups of 8 or 12 litters/mother.* Each point represents x ± s.e.m.

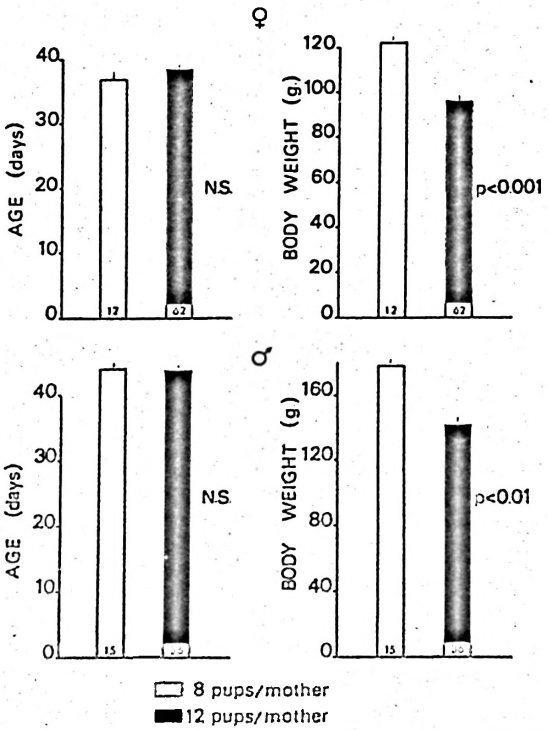

Fig. 3. *Age (days) and body weight (g) at vaginal opening in females and at balanopreputial separation in males reared in groups of 8 or 12 litters/mother.* Each bar represents x ± s.e.m.

Vaginal Opening or Balano-preputial separation occurred at the same age in both animals reared in groups of 8 or 12/mother, but differences in body weight were observed (fig. 3).

Discussion

Animals with more litter-mates showed a reduced growing rate and weight gain than those coming from mothers with less pups. The differences in body weight observed were also maintained after weaning. After separating the pups from the mother an increase in growth rate was detected in all groups. Similar results were found by OJEDA and JAMESSON (6) who tried to correlate this fact with an increase in GH levels. With a similar experimental design than ours, KENNEDY and MITRA (3) obtained more clear cut differences in body weight than those shown in this paper: Our data show at 20 days of age an average weight of 40.5 g in females reared in groups of 8, whereas those reared in groups of 12 reached only 30.2 g. In Kennedy's experiment the weight of «optimally» fed rats was 42 g at 20 days, while those with retarded growth reached only 16 g.

KENNEDY and MITRA (3) reported that females with «optimal» growth showed earlier puberty onset. Therefore, our results showed that vaginal opening or balano-preputial separation is reached at the same age but with different body weights in animals with different growth rates. The apparent contradiction in the results could be due to the more dramatic effects on growth rate obtained in their animals.

In conclusion our results suggested that external signs of sexual maturation (vaginal opening or balano-preputial separation) are not necesarily linked to a «critical weight» or to a defined «growth rate». It is possible that the relation between somatic development and puberty can be mediated by another factor different of «body weight» or «growth rate», perhaps FSH or GH secretion. Female rats underfed from birth through replacement for 12 h/day of the lactating mother by a nipple-ligated mother present delay in development, ovarian weight and changes in FSH secretion (8). Delayed puberty in animals fed a low-valine diet is also accompanied by alteration in the control of FSH (2). On the other hand, a close relation between development, GH and puberty have been suggested (1) and maternal deprivation was associated with delay in development, vaginal opening and decline in immunoreactive growth hormone in the serum of rat pups (4).

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Resumen

Se estudia en rata la tasa de crecimiento corporal, el peso y la edad a la que se presenta la apertura vaginal y la separación balanoprepucial, usados como signos externos de pubertad, en hembras y machos procedentes de camadas con 8 o 12 crías/madre. La tasa de crecimiento es mayor en animales procedentes de camadas constituidas por 8 crías. La edad a la que se produce la apertura vaginal o la separación balanoprepucial es la misma en animales procedentes de distintas camadas, aunque el peso a que se presentan es inferior en los animales procedentes de camadas constituidas por 12 animales. Estos resultados parecen indicar que, en la rata, los signos externos de pubertad guardan mayor relación con la edad cronológica que con el peso corporal o la tasa de crecimiento.

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