

## *Abstract*

The adult female rats fed with high calorie diet (HCD) developed obesity. These females were mated with normal males and were fed with HCD during pregnancy and lactation. A significant decrease in litter size and weight, a significant increase in weight/pup and mortality rate were found in HCD rats compared to controls fed with normal diet (ND). The offspring of HCD mothers (OHCDM), both males and females, fed with HCD after weaning showed obese condition compared to offspring of control mothers (OCM). The effect of obesity on testicular and ovarian development during pre-pubertal and pubertal periods and reproductive performance of adults were studied in OHCDM and OCM.

The age at first appearance of different stages of maturation of male germ cells did not differ in OCM and OHCDM, because the seminiferous tubules of both the groups showed first appearance of spermatogonia, leptotene spermatocytes, zygotene spermatocytes, pachytene spermatocytes, round spermatids and elongated spermatids on post natal days (PND) 7, 13, 17, 24, 36 and day of preputial separation respectively. These age intervals correspond with land marks of spermatogenic progress. However there was a significant decrease in counts of round and elongated spermatids and epididymal sperm count coupled with significant decrease and increase in serum levels of testosterone and leptin respectively in OHCDM compared to OCM. In addition, OHCDM also showed a significant increase in percentage of defective spermatozoa. The results for the first time show that obese condition in pre-pubertal rats does not affect the age dependent appearance of germ cells according to developmental hierarchy whereas it does interfere with spermatid formation resulting

in reduced sperm count which may be due to deficiency of testosterone mediated by hyperleptinemia. Further, decreased sperm count and increase in percentage of defective spermatozoa indicate a poor semen quality in OHCDM.

The female OHCDM were autopsied on postnatal day 1, 4, 7, 15, 21, 28 and day of vaginal opening. These age points correspond with land marks of ovarian follicular development wherein primordial follicles develop into pre-ovulatory follicles and ovulate first time. The obesity did not affect the chronicle of follicle development, because, age at first appearance of different categories of follicles was similar in OCM and OHCDM i.e. naked oocytes appeared on PND 1, primordial on PND 4, primary and pre-antral on PND 7, antral on PND 15 and pre-ovulatory on day of vaginal opening in both the groups. However, mean number of healthy and atretic follicles of all categories and that of corpora lutea was higher in OHCDM than OCM. In addition, serum concentrations of estrogen and leptin were significantly higher and onset of puberty was at a significantly earlier age in OHCDM than OCM. The results reveal that pre-natal and post-natal exposure to HCD results in recruitment of more number of follicles for growth and atresia. It is suggested that this phenomenon might cause early exhaustion of ovarian follicles and lead to early cessation of reproductive life of females.

Some of male and female OHCDM continued to receive HCD up to PND 100 and then mated with males and females of control mothers in different combinations, viz., ND♂ x ND♀, ND♂ x HCD♀, HCD♂ x ND♀, HCD♂ x HCD♀ to test the reproductive performance. There was 100% fertility in all the groups. However, there was a significant and drastic decrease in litter size and litter weight in ND♂ x HCD♀,

HCD♂ x ND♀ and HCD ♂x HCD♀ groups when compared to ND♂ x ND♀ group. The weight/ pup was significantly higher in ND♂ x HCD♀ and HCD ♂x HCD♀ than ND♂ x ND♀, and that of HCD♂ x ND♀ group did not significantly differ from ND♂ x ND♀. Mortality was not observed in ND♂ x ND♀ group, whereas it was 31.6%, 15.0% and 32.76 % in ND♂ x HCD♀, HCD♂ x ND♀ and HCD ♂x HCD♀ groups respectively. The results indicate a poor reproductive performance in HCD fed rats. The fact that despite 100% fertility, a decrease in reproductive outcome indicates effects of obesity on post-conception survival of fetus.

Overall, the study first time reveals that obese condition during pre-pubertal period adversely affects not only gonadal functions but also reproductive performance in rats.