# Differential Effects of Fat or Energy Intake in Males and Females

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## INTRODUCTION

The pathology of obesity produces many diseases. It has a far ranging negative effect on health including some type of cancers, non-alcoholic fatty liver disease(NAFLD), diabetes and many other diseases that are related with obesity. The aim of this study was two folds: i) to analyze the data that was collected (in a mice model study) in another university to observe the differences in the tissue morphology (liver, pancreas, adipose) in male and female mice when exposed to high fat diet for a period of 6 months; ii) to summarize the recently published results related to obesity in humans in respect to different sexes, ethnic and socio-economic groups. Within 3 months animals in VHFD showed signs of NAFLD and with longer treatment the liver showed deposition of lipid droplets in hepatocytes, which leads to non- alcoholic steatohepatitis (NASH) subsequently cirrhosis and hepatocellular carcinoma. Morphometric analyses of pancreas showed robust signs of inflammation, increase in pancreatic islets size and number in both obese male and female. Adipose tissue showed signs of hypertrophy than hyperplasia. The effect of high fat was more pronounced in male than female mice. We also found from many published articles that in the U.S. the prevalence of obesity is high among African Americans, Mexican Americans and Native Americans and different factors are involved such as socioeconomic status. Interestingly, the prevalence of obesity in women has been seen with the onset of menopause due to the metabolic changes and hormone fluctuations. Moreover, children and parents from low income and uneducated family have less access to many facilities and generally less aware about diseases and health outcomes.

## MATERIAL AND METHODS

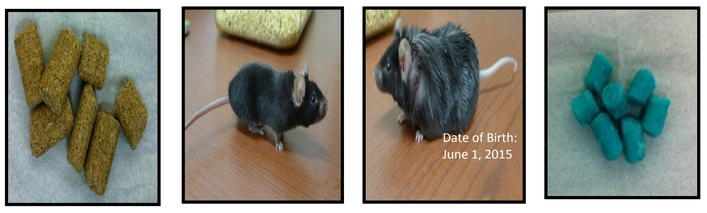
**Animals:** Control male mice (5), Very High Fat (VHFD) fed male mice (15) followed 2 weeks diet course; Control male mice (5), VHFD fed male mice (15) followed 3 months diet course and Control male mice(5), VHFD fed male mice (15) followed 6 months diet course were housed in a colony room, with a partially revised light cycle of 14:10 (lights on 2300h and off at 1300h). Food and water were available *ad libitum*. All animals studies were conducted in accordance with Guide for the Care and Use of the Laboratory Animals, using protocols approved by the Institutional Animal Care and Use Committee at Adelphi University.

**Body weights**: The WT control (n=6) mice were fed with a normal diet (ND) from Pico Lab (Rodent Diet 20 5053) which consisted of 24.65 kcal% protein, 13.21 kcal% fat, and 62.14 kcal% carbohydrates. The WT experimental (n=8) mice were fed with a very high fat rodent diet (VHFD) from Research Diets (D12492) which consisted of 60 kcal% fat, 20 kcal% protein, and 20 kcal% carbohydrates. Body weights were recorded with a digital electronic balance over a period of 7 months.

**Food consumption**: A quantified amount of food (ND and VHFD) was given on a particular day of the week and the remaining uneaten food was weighed every week. The amount of food consumption was calculated by subtracting the amount of food given from the amount of food remaining in the cage. Caloric intake was calculated using the values provided by the supplier (ND, kcal/gm= 3.07, VHFD, kcal/gm= 5.24). The physiological fuel value (kcal/gm) was equivalent to the sum of decimal fractions of fat, protein and carbohydrate multiplied by 9, 4 and 4 kcal/gm respectively.

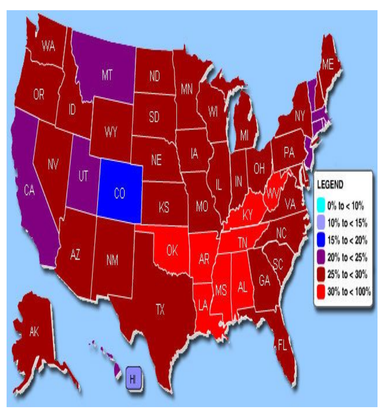
**Organ weights & Histopathology:** After decapitation, Viscera was opened and *in situ* examination was done. Pancreas, liver, adipose tissue were collected and weighed by trimming excess fat around it. Organ slices(5mm thickness) were stored in 1ml of formaldehyde solution. All the tissues were subjected to standard histological procedures and examined under a light microscope. All biopsies were done by Cross Island Laboratories, LI for biopsy.

## NORMAL DIET VS. VERY HIGH FAT DIET
(NORMAL and OBESE MOUSE)




**Wild Type with Normal Food (Control)** | **Wild Type with VHFD(Experimental)**

## OBESITY TRENDS



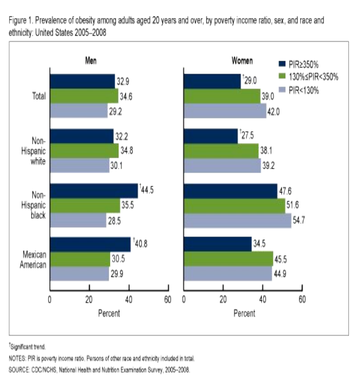




Figure 1. Prevalence of obesity among adults aged 20 years and over, by poverty income ratio, sex, and race and ethnicity: United States 2005–2008

†Significant trend.
NOTES: PIR is poverty income ratio. Persons of other race and ethnicity included in total.
SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2005–2008.

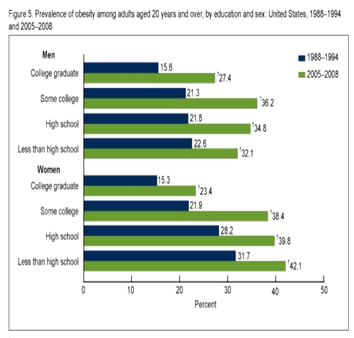
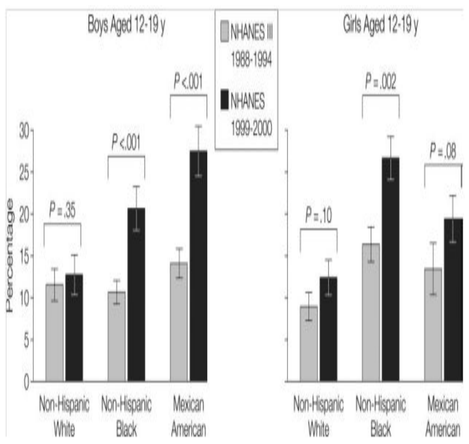



Figure 5. Prevalence of obesity among adults aged 20 years and over, by education and sex: United States, 1988–1994 and 2005–2008

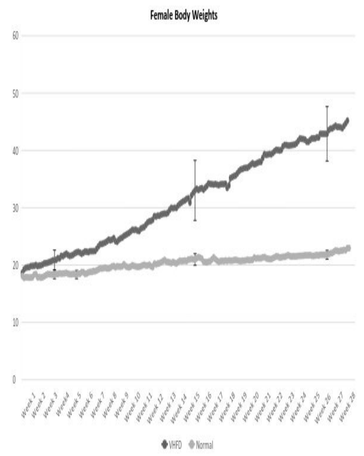
†Significant increase.
SOURCES: CDC/NCHS, National Health and Nutrition Examination Survey, 1988–1994 and 2005–2008.

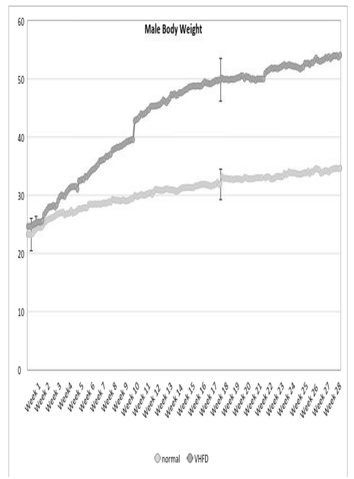
## OBESITY: BOYS vs. GIRLS




Study at Yale University School Of Medicine
288:17281–732, 2002, ©2002, American Medical Association

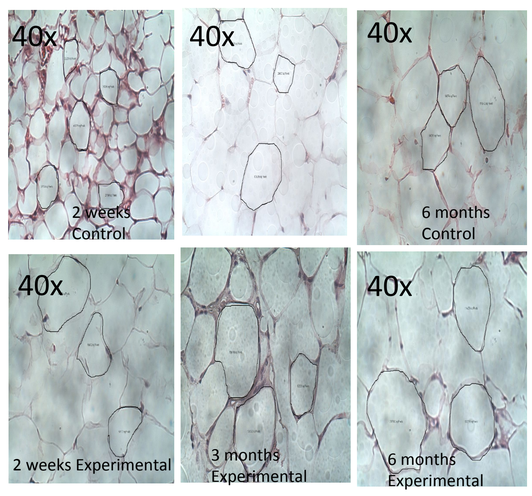
## CHANGES IN BODY WEIGHT WITH HIGH FAT



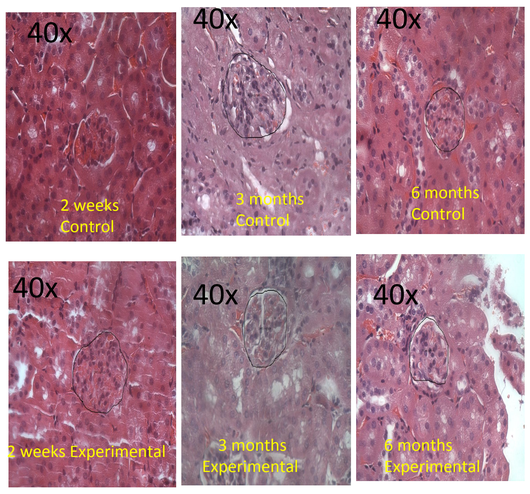




## MICROPHOTOGRAPHS (BIOPSY) OF CELLULAR MORPHOLOGY (MALE & FEMALE MICE)

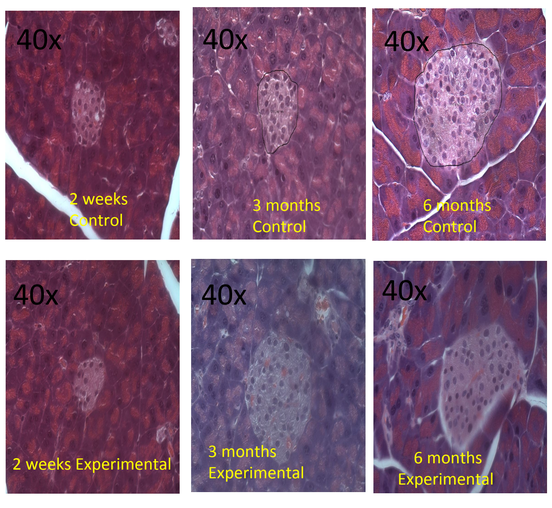
### Adipose Tissue (Male)



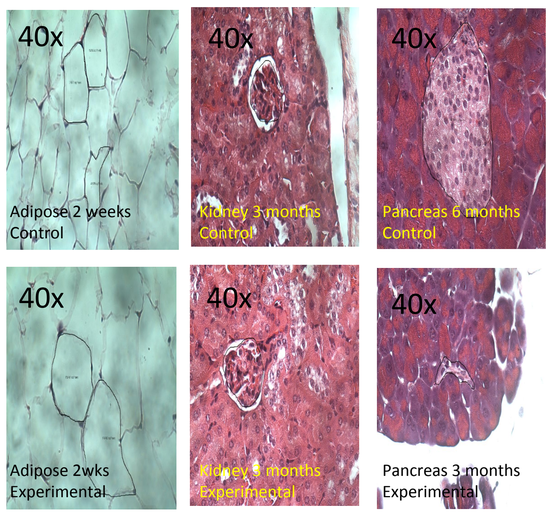

### Kidney Tissue – Glomerulus (Male)




### Pancreas (Male)




### Adipose, Pancreas and Kidney Tissue (Female)




## FACTS AROUND THE WORLD

- Students who were in a high socioeconomic standing were more significantly less likely to be obese than students from low socioeconomic background.
- Hispanic girls in low socio-economic class ages 10-13 were more likely to be obese than Hispanic girls in higher socioeconomic class.
- There was only a slight difference in African American girls and boys across different classes, and particularly in the 7th grade (age 12).
- Caucasian boys showed no significant difference in obesity rates among the socioeconomic classes.
- A year long study in Japan showed that the tendency of weight gain has increased as the vegetable consumption among men has decreased; therefore the study confirmed that vegetable intake was inversely associated with the risk of a body weight.
- A study in Korea showed that the prevalence of obesity in women has been seen with the onset of menopause due to the metabolic changes and hormone fluctuations. Women are at higher risk of obesity during menopause because of the increase in body fat. Postmenopausal women develop abdominal obesity even without weight change.
- Obesity prevalence in childhood has tripled in the last decade. The cost of low-nutrient, fats and sweets cost 30% more than 20 years ago, whereas, the cost of fresh and healthier food has increased by 100%. Certain advertisements are targeted to specific groups and globalization has promoted food marketing.

Possible Prevention: Some prevention of obesity includes educating the community, health care workers, bringing awareness about obesity outcomes, reinforcement of lifestyles changes and giving comprehensive knowledge about food and its effect.

References:
1. Associations between socioeconomic status and obesity in diverse, young adolescents: variation across race/ethnicity, and gender. Fradkin, C. et. al. Health Psychology, Vol 34; 2015
2. Cohort study examining the association between vegetable consumption and weight gain in a single year among Japanese employees at a manufacturing company
Kimi S., Nobuko M., Yukari T., and Hiromi I. Asia Pac J Clin Nutr Vol 24(4); 2015
3. The Effects of Combined Exercise on Health-Related Fitness, Endotoxin, and Immune Function of Postmenopausal Women with Abdominal Obesity. Sung-Mo P., Yi-Sub K., and Jin-Goo J. Journal of Immunology Research, Vol 2015; 2015 [http://dx.doi.org/10.1155/2015/830567]

## SUMMARY AND DISCUSSION

1)There was a statistically significant increase in body weight when mice were fed with VHFD.
2) Male mice that were fed with a normal diet consumed more food than mice fed with VHFD. Female mice that were fed VHFD consumed the same amount of food as ND female mice.
3) In both male and female mice, VHFD had increase caloric and fat intake when compared to ND mice. The increase in body weight was contributed by the quality of food (fat) than the quantity of food.
4) There was a significant increase in adipocyte area in male and female mice that were fed VHFD compared to ND mice.
5) There was a significant increase in Islet of Langerhans area in females that were fed VHFD, but no significant difference in islets of Langerhans of males.
6)There was no significant difference in glomerulus area of male or female fed VHFD or ND.

## ACKNOWLEDGEMENT

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