**40%The Retardation of Aging in Mice by Dietary Restriction – Longevity, Cancer, Immunity, and Lifetime Energy Intake**  
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**Introduction**  
This study investigates the affect long term calorie restriction has on aging by assessing lifespan, immune function, cancer, and other parameters.   
  
Note: These notes will focus solely on lifespan and immune function.   
  
**Methods**  
Mice were placed into 6 different conditions:  
  
*NP*: Nonpurified, no restriction diet wherein mice were allowed to consume however much and whenever they wished. Equated to about 110 kcalories a week.  
  
*N/N85*: Mice were fed a moderate protein (20% protein) diet and were fed a controlled, but “normal” calorie diet (meaning, not so much they became obese, but not starving, either); this equated to the NP diet – 25% kcalories, or about 85 kcalories (85000 calories) a week.  
  
*N/R50*: Normally fed as babies, then (as adults) restricted to 50 kcalories a week (~40% restriction from “normal/N85” condition), with a high protein (35% of kcalories) diet.   
  
*R/R50*: Restricted intake as babies, then continued restriction at 50 kcalories a week (same as N/R50) with high protein (35% of kcalories) diet.   
  
*N/R50loPro*: Same conditions as N/R50, but on a progressively lower protein diet.   
 - Mice consumed high protein (35%) from baby to 4 months old (young adult).  
 - Mice consumed moderate protein (25%) from 4 months to 12 months (adult).   
 - Mice consumed low-moderate protein (20%) from 12 months to 24 months (elderly).  
 - Mice consumed low protein (15%) from 24 months until death (dead).  
  
*N/R40*: Normally fed as babies, then (as adults) restricted to 40 kcalories a week (~52% restriction from “normal/N85” condition) with a high protein (35% of kcalories) diet.   
  
Mice were also alternate day fasted to achieve correct caloric restriction.   
  
**Results**  
*Figure 1*  
*Background*: This graph represents the body weight of all the mice on each of their diets, over their lifetime.   
*Primary Results*  
- The no restriction (NP) diet leads to massive weight increase (obesity).   
- All restrictive diets (not including N85) showed similar bodyweights over time – all reduced compared to “normal” (N85) and obese (NP).  
  
Take Away: Eating more leads to weight gain, eating less leads to less weight gain.   
  
*Figure 2*  
*Background*: This graph shows the percentage of the mouse population that survives on the Y (vertical) axis across time/age on the X (horizontal) axis.   
  
*Primary Results*:  
- Mice that consumed the most lived the shortest amount of time.   
- R50lopro mice lived much longer than “normal” (N85), but slightly less than other restricted mice.   
- The most severe caloric restriction (R40) showed the longest maximum lifespan.   
  
Take Away: Calorie restriction increases lifespan, but more so with higher protein intake.   
  
*Table 3*  
*Background*: This is merely a quantification of figure 2 showing the average increase in lifespan, but also the longest living 10% of each group and comparing them against one another.   
  
*Primary Results*:  
- Average and longest living mice lifespans were increased the most with more kcalorie restriction.  
  
Take Away: The more you restrict kcalorie intake, the longer you live.   
  
Table 7  
*Background*: This table shows 3 different immune cell activating agents (through increased cell division, mitogens – PHA, Con A, and PPD) on immune cells of N85/normal, R50, R50lopro, and R40 mice in adulthood and elderly. They also test the basal, nonactivated state (medium) of the immune cells at both age points.   
  
*Primary Results*:  
- Activation of immune cells is dampened in N85.   
- Activation of immune cells is dampened with age.   
  
Take Away: Caloric deficit leads to greater immune activation, and age decreases immune activation across the board, except with particular activators (PPD, in this case).   
  
**Conclusions**  
Calorie deficit increases lifespan>  
 - +23% longer life @ 40% kcalorie deficit vs normal.  
 - +35% longer life @ 40% kcalorie deficit vs obese. (39% longer @ 52% kcalorie deficit)  
  
The more severe the calorie deficit, the greater the increase in lifespan, but the return diminishes (5-6% longer life for 10% greater kcalorie restriction)  
  
Calorie deficit allows stronger immune activation.   
  
Aging reduces immune activation.