How the Activity Level of Caenorhabditis elegans Affects the Animal’s Life Span

Abstract

Muscles deteriorate with age, restricting mobility. It is thought that regular exercise can lessen the rate of muscle deterioration, but it is not known if it affects longevity. Using the nematode Caenorhabditis elegans, we wish to determine a relationship between exercise and the aging process. To do this, we need to find a way to induce the animals to exercise. A method of exercising C. elegans was identified by exposing them to a fluid flow. Without food, the C. elegans maintained a constant low activity level until the external flow reached a threshold velocity. Once this threshold velocity was exceeded, the C. elegans assumed a heightened activity level. The effect of food on the activity level was also examined. In the presence of food, the animals’ activity level declined since they were not actively searching for sustenance. Lastly, using different strains with mutated sensory neurons, it was
determined that an elevated activity level is caused by the animals’ cilia. This opens the way find how exercise affects mobility level as a function of age and longevity.

**Introduction and Background**

It is well known that regular exercise has many health benefits, especially as one grows older. Physical studies on adults over the age of 65 have shown that regular exercise not only strengthens muscles, but also reduces the rate of muscle degeneration which improves mobility (1-2). Increased mobility allows the elderly to be more independent and have a lesser chance of injury by falling (3). However, the molecular basis of the connection between exercise and well-being and longevity of life has not been established. It is difficult to isolate the effects of exercise on the longevity of life, given the wide array of external variables present in our environment and the variation in human lives.

Using a model organism with a short life span would facilitate controlled experiments. The nematode, Caenorhabditis elegans are a model organism often
used in medical research due to their small size, transparency, short life cycle, and availability. *C. elegans* reproduce asexually so there is little difference between generations. This reduces possible variables that can arise from animals that require a male and a female to reproduce. It is much easier to ensure activity level will be the only variable changing in an experiment with *C. elegans* than with other animals.

There are over 50 life extending mutant strains of *C. elegans*, but not as much is known about the aging process. Previous studies have shown the nematodes’ nervous system stays intact as they age, but their muscles deteriorate (4). Another study has shown that aerobic exercise can slow the decline of muscle protein metabolism (5). Exercising *C. elegans* can potentially slow the degeneration of their muscles which could lead to them living longer lives. Rats were exercised in a previous study and it was determined that exercise increased the longevity of their lives but only when food became scarce (6). This shows us that there is a possible connection between exercise and age.
Our current studies show exposing wild type C. elegans to a fluid flow will increase their activity level. There exists a threshold flow rate below which the animals maintain one level of activity and above which they maintain another (elevated) level of activity. Using this knowledge, I can exercise worms to examine whether exercise reduces the decline in their muscles and set up an experiment to determine if a heightened activity level increases the lifespan of C. elegans. My hypothesis is exercise will not only increase the longevity of the C. elegans, but it will also cause the worms to have a higher mobility rate as they age. To continue the study of fluid flow affecting the activity level of C. elegans, I will also conduct an experiment using a strain of worms deficient in mechanosensation. C. elegans have six mechanosensory neurons that detect touch (7). Using the same approach as with the wild type worms, I will determine if these mechanosensory neurons are what causes the increased activity level.
References