International Journal of Pure and Applied Zoology ISSN (Print) : 2320-9577
Volume 1, Issue 4, pp: 277-279, 2013 ISSN (Online): 2320-9585

http://www.ijpaz.com

Research Article

EFFECT OF EXERCISE ON ADULT LIFESPAN OF THE WILD TYPE STRAIN *DROSOPHILA MELANOGASTER*

L.J. Gaikwad* and R.D. Thombre

Department of Zoology, Radhabai Kale Mahila Mahavidyalaya,
Tarakpur, Ahmednagar-414001, Maharashtra, India

Article History: Received 26th September 2013; Accepted 26th October 2013; Published online 8th November 2013

ABSTRACT

Effects of physical exercise on fruit fly, *Drosophila melanogaster* were quantified in two environmental conditions. First, in the natural light-dark (NLD) cycles with fluctuating temperature and relative humidity and second, at constant temperature of 25°C, relative humidity of 65±10% and light intensity of 100 lux. It was observed that, in the NLD conditions the flies walking on a single cotton thread were subjected to an extensive physical exercise and hence they exhibited a lifespan of ~59 days while the flies walking on the double cotton threads and the double nylon threads were subjected to least degree of exercise, their lifespan was of just ~30 days. Flies maintained at 25°C, nevertheless, had entirely different life span vis-à-vis (in relation) to the characteristic of the threads. The flies walking on the double nylon threads when subjected to extensive physical exercise, they exhibited the longest lifespan of ~35 days. Whereas the flies walking on a single and double cotton threads were subjected to least degree of exercise, their lifespan was observed to be of only ~22 days. These results demonstrate that the exercise has profound influence on the lifespan of *Drosophila* which has indisputable implication in human health too. Furthermore, natural light-dark cycles with fluctuating temperature and relative humidity have life enhancing effect than the constant temperature conditions.

Keywords: *Drosophila*, lifespan, Natural light-dark cycle, physical exercise.

INTRODUCTION

Extrinsic features like quality and quantity of nutrients, temperature, stress, physical exercise, etc. are reported to affect several parameters of eukaryotic organisms. The study of functional senescence is of great importance to the design of interventions to extend quality of life in the elderly population. The most common complaint among those of advanced age is declining mobility (Cohen-Mansfield and Frank, 2008). Loss of mobility creates substantial direct and indirect health-care costs. Similarly, medical researchers are facing tremendous challenges in treating the level of obesity and its associated disorders such as diabetes and cardio-vascular diseases which ultimately leads to an increase in stress and decline in life span.

Age-related declines in physiological routine have been documented in wide variety of organisms. Earlier experiments on invertebrates have shown an increase in oxidative stress, with an associated decrease in lifespan, in animals that undergo a lifelong increase in physical activity (Yan and Sohal, 2000; Magwere *et al.*, 2006). Furthermore, numerous studies have examined age-related changes in physiological performance, particularly in human and model organisms. A common finding is that older individual exhibit decreased resistance to stresses such as high or low temperature, exercise, starvation, etc. certain vertebrates animals are dietary restricted and hence, lifelong exercise can extend mean lifespan in them but not to the maximum (Holloszy *et al.*, 1985, Holloszy, 1998).

Here we have used the cosmopolitan human commensal, *Drosophila melanogaster* as an experimenting model to determine the effects of

*Corresponding author e-mail: gaikwad.lawrence@gmail.com, Tel.: + 91 9049020524

physical exercise on the adult lifespan. We have developed a simple exercise platform on which the flies were subjected to various degrees of physical exercise. Flies were forced to climb up and down on a thread which was used as a walking substratum in an activity glass tube throughout their life. This exercise method resulted in tremendous variation in the lifespan of the flies with corresponding temperature and light.

MATERIAL AND METHODS

This work was carried out in the months of October to December 2012 in the Zoology Laboratory of Radhabai Kale Mahila Mahavidyalaya, Ahmednagar. The cultural medium used in the experiment was the standard corn meal agar cultural medium. Female line cultures of *Drosophila* were used to conduct the experiments. Flies were reared and mated to get the population of ~200 adult flies. Adult flies of F1 generation were acclimatized with the experimental conditions of LD 12:12 before the beginning of the experiment.

Effects of exercise on the life of flies were monitored on freshly enclosed flies in two sets of experiments. The first in natural light-dark (NLD) cycles with fluctuating temperature and relative humidity and the second at a constant temperature of 25°C, relative humidity of 65±10% and light intensity of 100 lux. Each experimental set up consisted of five glass tubes for vertical climbing assay and five tubes for control.

Preparation of walking substratum

Activity glass tubes of about 15 cm long and 0.7 cm diameter was taken into consideration. In the glass tube we provided cotton threads (double, single) and nylon threads (double, single) as a medium of walking substratum. One end of the tube was filled with 10 gm culture medium while the other end was plugged with cotton.

An individual adult was introduced in the glass tube, one adult per tube and subjected to exercise by allowing them to ascend and descend in the tube. Physical parameters like grip on the substrate, the location of the food, inner diameter of the tube and texture of the surface were tested in the context of the lifespan of the fly. All the activity tubes were positioned vertically so the fly could climb up i.e. the negative geotaxis to reach the food source. These arrangements allowed a continuous recording of activities for one week. After one week, the flies were transferred to the fresh tubes with fresh culture medium. The same procedure was continued throughout the lifespan of the flies and the final results were derived and recorded.

RESULTS

The effects of exercise on the lifespan of the wild type strain of *D. melanogaster* were determined. The results are summarized in the tables as follows. Table:1 shows the effect of exercise on the lifespan of *D. melanogaster* at a constant temperature of 25°C with 65±10% humidity and light intensity at 100 lux while table:2 shows the effect of exercise on the lifespan in natural dark-light [NLD] cycles with fluctuating temperature and relative humidity. In the NLD conditions, we observed that the flies walking on the single cotton thread revealed a longest life span of 59 days, whereas in case of double cotton threads and the double nylon threads their lifespan was shorter i.e. ~30 days. In case of 25°C the results show an entirely different lifespan in relation to the characteristic of threads used. The flies walking on the double nylon thread exhibited a longest lifespan of ~35 days as compared to the double cotton thread and single cotton thread i.e. ~22 days.

Table 1. Effect of exercise on adult life span of the wild type strain *Drosophila melanogaster* at constant temperature of 25°C and 100 lux light intensity.

Sr.No.	Thread Used	Life span
1	Single cotton thread	22 ± 3 days
2	Double cotton thread	22 ± 4 days
3	Double nylon thread	35 ± 2 days

Table 2. Effect of exercise on the lifespan of *Drosophila melanogaster* in NLD conditions.

Sr.No.	Thread Used	Life span
1	Single cotton thread	59 ± 4 days
2	Double cotton thread	30 ± 6 days
3	Double nylon thread	30 ± 2 days

These results demonstrated that the exercise has profound influence on the lifespan of *D. melanogaster* which has indisputable implication in human health too. Furthermore, the natural light-dark cycles with fluctuating temperature and relative humidity have enhancing effects than the constant temperature.

DISCUSSIONS

Controlled programs of exercise have proved a wide scale of physiological profit to aging humans and other animals. But most vertebrate studies, including those with humans as subjects, have employed cross-sectional study designs, due to the high cost and expense of doing longitudinal studies on long-lived species. Here we provided a simple exercise platform for the fruit flies by subjecting them to walk on the threads in an activity glass tubes. Early experiments on insects as a model utilized continuous flying activity to observe the effects of exercise. Under these conditions, exercise was shown to increase oxidative stress, as well as resulting oxidative damage and decrease in lifespan (Yan and Sohal, 2000). Furthermore, several significant physiological changes have been reported in some vertebrates and similar changes are seen in *Drosophila* during exercise training which justifies the fly as a model system for further study of exercise-based anti-aging mechanisms.

CONCLUSION

The ability to model exercise-training in *Drosophila* opens the door to many researchers for dissecting the response of various organ systems to exercise during the aging process. The relationship of exercise and aging to other environmental factors, such as global metabolism, diet and genetics can be reasonably explored using this model using both longitudinal and cross-sectional study designs.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests associated with this article.

REFERENCES

Cohen-Mansfield, J. and Frank, J., 2008. Relationship between perceived needs and assessed needs for services in community-dwelling older persons. *Gerontologist,* 48: 505–516.

Holloszy, J.O., 1998. Longevity of exercising male rats: effect of an antioxidant supplemented diet. *Mech. Ageing. Dev.,* 100: 211–219.

Holloszy, J.O., Smith, E.K., Vining, M., Adams, S., 1985. Effect of voluntary exercise on longevity of rats. *J. Appl. Physiol.,* 59: 826–31.

Magwere, T., Pamplona, R., Miwa, S., Martinez-Diaz, P., Portero-Otin, M., Brand M. D. and Partridge, L. 2006. Flight activity, mortality rates, and lipoxidative damage in *Drosophila*. *J. Gerontol. A Biol. Sci. Med. Sci.,* 61: 136–145.

Yan, L.J., Sohal, R.S., 2000. Prevention of flight activity prolongs the life span of the housefly, *Musca domestica*, and attenuates the age-associated oxidative damamge to specific mitochondrial proteins. *Free Radic. Biol. Med.,* 29: 1143–1150.