**Effects of Stress on Lymphoid Organs and Blood Leukocytes of Rats**

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Does chronic stress affect lives even after the stress has ceased? Many of us (particularly college students) experience chronic stress for years. We all know chronic stress can wreak havoc on our lives, but will it continue to do so even after the stress has stopped? In a recent study, adult female rats were placed in an environment of high physical stress for twelve weeks. A significant decrease was found in the body weight, lymphoid organs, total leukocytes, and an increase in apoptotic cells in lymphoid organs of the rats. After four weeks of removed stress, no significant increase in any of the recorded subjects were found. Long term chronic stress may not be reversible, or the four week recovery period was not long enough. Stress can also be challenging to keep scientifically constant. Just like in people, one cannot predict what will stress a rat. One can keep everything constant, but cannot directly control the exact amount of stress a rat is feeling.

**Introduction**

The effects of chronic stress were studied on adult female rats by inflicting stress of restraint and forced swimming. The rats were placed in an open-ended glass cylindrical restraint for one hour and then released. After four hours had passed from the restraint, rats were forced to swim for 15 minutes every day. After the twelve weeks of daily stress, sixteen hours after the last stressor, five rats from the stress and control group were euthanatized. The euthanized rats from the stress group will be referred to as the stress rats. The remaining rats continued to live in a controlled environment with no stressors will be referred to as the recovery group. After total completion of the experiment, rats were weighed, blood was drawn, and axillary lymphoid organs were removed/weighed and stored until apoptosis tests were conducted. Female hormones are known to interfere with immune response, so the experiment was designed around the beginning and ending of the cycle in both the control and experimental rats.

The body weight and relative weight of the thymus were significantly lower in the recovery group, while the relative weight of the spleen and axillary lymph nodes did not differ from the control group. However, the relative weight of the spleen was significantly higher in the recovery group compared to the stress group while the thymus was significantly lower. The relative weight of the axillary lymph nodes did not significantly differ from the recovery and stress group. The total count of leukocytes expressed a significant decrease in the stress group as compared to the control group while the recovery group, excluding neutrophils, did not differ from the stress group and were actually lower than the control group. While the neutrophil count was lower in the control group and higher in the stress group, they were not of significant values. In the apoptosis analysis, the majority of cells were healthy in the control group, while the stress and recovery group were mostly apoptotic. The average number of healthy splenocytes, thymocytes, and cells of the axillary lymphnodes was significantly lower in the stress group than the control. This means that the stress group had less healthy, functioning cells than that of the control group.

**Recent Progress**

While this particular topic is not currently popular for testing, there was a similar experiment conducted in 2016 focusing on hypothalamic-pituitary-adrenal axis. In this experiment, male rats were exposed to a battery of constant daily stressors and recorded results without a recovery period. It was found that hypothalamic-pituitary-adrenal axis was increased. This experiment similarly found that body weight of the stressed rats had decreased by 15% and pituitary and thyroid weight had decreased by 11% and 8%, respectively.

**Discussion**

It is evident that stress, particularly chronic, has a major physiological impact on bodies. This study shows the inability of the body to recuperate even four weeks after the chronic stress has ended. The study showed that long-term chronic stress is correlated with the destruction of immune cells in the blood as well as the lymphoid organs that continues even after the stress has ceased. A limitation found in this study was the “absence of histological photographs of lymphoid organs because it was not

possible to detect histological alterations by light microscopy in sections of organs stained with haematoxylin–eosin, whereas apoptosis could be clearly demonstrated by fluorescent microscopy”.

There have been similar studies conducted with all male rats while this study was all female rats. Perhaps a study involving both male and female rats would have interesting results. An extended study, perhaps even going as long as a year on the chronic stress would also produce interesting results.

This experiment did lack pretesting of the rats for stress. In the previous experiment on male rats, each rat was tested for its ability to respond to stress. Some rats, just like people, are able to handle stress better than others. To keep as much constant as possible on such a broad subject like stress, the rats should have been tested before the experiment.

**References**

*Effects of long-term chronic stress on the lymphoid organs and blood leukocytes of the rat (Rattus norvegicus),* S. Divyashree, H.N. Sarjan, and H.N. Yajurvedi, 2015, NRC Research, Canadian Jounral of Zoology, Pages 1-5

*Sensitization of the Hypothalamic-Pituitary-Adrenal Axis in a Male Rat Chronic Stress Model,* [Alier J. Franco](javascript:;), [Chun Chen](javascript:;), [Tyler Scullen](javascript:;), [Andrea Zsombok](javascript:;), [Ahmed A. Salahudeen](javascript:;), [Shi Di](javascript:;), [James P. Herman](javascript:;), [Jeffrey G. Tasker](javascript:;), April 2016, Endocrine Society, Oxford Academic, Pages 1-8