Introduction

We are encouraged to exercise regularly, as exercise is beneficial for our physical and mental wellbeing: it has been shown to reduce risk of cardiovascular and respiratory disorders, lower blood pressure, and enhance mood1. However, studies have shown that elite athletes can have weakened immune systems and are more likely to develop respiratory tract infections and asthma compared to non-athletes2,3. Therefore, could exercise not be as good for us as we believe?

Aim: To determine the effect of exercise on the immune system.

Hypothesis: If a person exercises, then their immune system is weakened.

Methodology

• Healthy men rode an exercise bicycle at 50 or 80% effort (measured by VO2 max – the maximum volume of oxygen that an individual can use).
• Blood samples were obtained before and at various time points after exercise.
• Immune cells were isolated, and were counted by labelling cells of interest with fluorescence-tagged markers.
• The activity of NK cells was determined by their ability to kill tumour cells containing a dye that was released upon death.

The validity of this test relied on ensuring that each participant exercised at the same effort level, which was monitored by oxygen intake and heart activity.

Independent variable: Time point of blood collection
Dependent variable: Concentration of immune cells in the blood and killing capacity of NK cells.

As a negative control, markers that were not expected to bind cells of interest were also used. These markers did not bind/label cells of interest, therefore confirming that any marker present on the counted cells had bound specifically. (This was done as the markers are comprised of protein, which can occasionally stick to cells non-specifically, resulting in a higher cell count.)

These studies were performed under the National Statement on Ethical Conduct in Human Research. There were risks associated with handling human blood, and therefore all tests were performed in a biosafety with appropriate safety measures in place.

Results

Change in blood immune cell concentration following exercise (50% VO2 max)

- There was a 74.5% and 126.3% increase in the concentration of all immune cells and lymphocytes respectively in the blood immediately following exercise.
- As this was not consistent with weaker immunity in elite athletes, we investigated immune cells in the blood in the recovery period, after more strenuous exercise.

Change in blood immune cell concentration following exercise (80% VO2 max)

- There was an increase in number of both T and B cells immediately post exercise, however there was a sharp drop to below baseline levels of these cells during the recovery period. This is known as a biphasic response. Levels of B and T cells gradually began to increase over the course of recovery.

Discussion

There was an increase in both total immune cell, and lymphocyte counts immediately following exercise. This could be due to a recruitment of immune cells from peripheral tissues into the blood. However, during the recovery period, there was a sharp drop in the number of circulating immune cells, which slowly returned to baseline levels.

NK cell function also revealed a biphasic response to exercise, and had reduction in their ability to kill tumour cells during recovery. Collection of blood at further time points (e.g. after 24 hours) would be required to determine the length of time for the immune cell count to return to normal.

While these tests were standardised, there may have been variation in immune cell count and function between individuals. The immune system varies between people, and factors to consider are whether an individual is stressed or sick etc.

The biphasic effect of immediately enhancing and then dampening the immune system has an impact particularly on athletes who regularly train and may not wait for the immune system to return to baseline before exercising again. This could be a contributing factor to the increased susceptibility of athletes to infection during their intense training periods.

Conclusion

Immediately after exercise, there are more immune cells in circulation, and the function of NK cells is enhanced. However, during recovery, the number of immune cells and function of NK cells drop below baseline levels before gradually returning to normal. Therefore, the hypothesis was partially supported in that there is a temporary reduction in the function of the immune system following exercise, however, as it returns to normal, this is not an excuse to stop exercising in moderation!

References


Acknowledgements

I would like to acknowledge the contributions of Dr Samy Sakkal, Dr Erik Hansson, Chantelle Blyth, Jackson Fyfe, A/Prof. Nigel K Stepto, and Shadney Que from Victoria University, and Prof. Dale Godfrey, Dr Daniel Pellicci and Dr Nicholas Ghehrardi from the University of Melbourne.

Apologies for the inconvenience, but the current PDF document is not fully compatible with the format or interface of the current system. We are working on improving compatibility and will provide a more readable version shortly.