Note: Guidelines were changed from 5000 characters to 2-pages

Project Description

Significance & Aims: Exercise training has wide-ranging effects on the human body including adaptations to muscle, the circulatory system, metabolism, and it has been shown to modulate the immune system.[1–4] The current project focuses on physical activity's role in activating and promoting the immune system, which has the potential to explain some of exercise's health benefits. While the function of the immune system in the context of exercise and its response to acute physical activity has been investigated previously[5-7], it remains unknown how a long-term history of exercise training influences the immune system. Thus, this project aims to characterize the immune system in long-term trained humans to identify potential mechanisms behind the health benefits that accompany long-term exercise. In order to accomplish this, the BURST scholar ([redacted]) will perform supervised research to:

1. Investigate the influence of long-term training on immune cell gene expression and cytokine expression.
2. Examine immune cell function, activation and gene expression following an immune challenge.

Methods: Blood samples have been collected from 36 research subjects (n=12 endurance-trained individuals; n=12 resistance-trained individuals; n=12 untrained controls). RNA sequencing has been performed on immune cells and blood plasma has been investigated for expressed cytokines. As part of Aim 1, [redacted] will use bioinformatics methods to analyze the data and identify differential gene expression. As part of Aim 2, [redacted] will examine immune cells in whole blood that are experimentally confronted with an immune challenge as previously described.[8]

Suitability for student with no prior research training: This project is ideal for a student with limited to no research training because there are two independent projects embedded within the plan. Aim 1 is a low stakes project because it has a high likelihood of succeeding as it is a data analysis project using methods that I am well acquainted with. I have experience guiding students through these types of bioinformatics research projects as part of my NSF-IRES program (which is now over). Through this program, I successfully worked with 18 students over the past 3 years, many of whom had no research experience. In tandem with Aim 1, [redacted] will work on Aim 2 which involves wet lab methods. Making progress on projects involving wet lab procedures can be more difficult for students, but it is still important to provide this training. As such, since Aim 1 has a high chance of success, Aim 2 would provide [redacted] with a wet lab experience without risking the overall success of the research experience.

BURST Student Support

Through my role as the PI for an NSF-IRES program, I have learned how to properly train students for summer research projects, mentor them throughout the project and provide useful professional development opportunities to advance their careers. Accordingly, [redacted] will be trained before the summer to develop her coding skills and biological knowledge. Additionally, since this work will take place at the Karolinska Institute (KI) in Stockholm, a portion of these training sessions will be dedicated to preparing [redacted] to live abroad. [redacted] will participate in these activities along with another student, [redacted], who will be working in the lab at KI on a separate project should his STAR application be accepted. It is my hope that both students will be accepted so they have peer support in Sweden. [redacted] will also be assigned bioinformatic coding tutorials during this time.

Upon arriving in Sweden, [redacted] will be directly supervised by me for the 10 week project from 6/3-8/9. Additionally, [redacted] will be mentored by other members of the research group in

Sweden. [redacted] plans to pursue a Ph.D. so I will run a professional development workshop series for her throughout the summer to make sure she is ready to apply to and succeed in graduate school. Following the summer program, [redacted] will present her work at the Biomedical Engineering Society annual meeting.

Logistics

Prior to arriving in Sweden, [redacted] and I will meet weekly for 90 minutes for 8 weeks to help prepare her for the research experience. As part of these preparatory meetings, [redacted] and I will create an individual development plan to align our expectations for the project. Upon first arriving in Sweden, [redacted] and I will meet at the beginning of each day for 30 minutes to discuss her progress from the previous day as well as her plan for the coming day. Once [redacted] develops her independence throughout the summer, the daily meetings will be replaced with 1 hour weekly meetings to discuss data and research directions. I will also be available for questions throughout the day. Additionally, I will run a professional development workshop series (see Project Timeline) and [redacted] will attend research group meetings during the summer.

References: [1]Kurgan, N. et al. Front. Physiol. 10 (2019); [2]Kenny, G. P. & Mcginn, R. J. Appl. Physiol. 122 (2017); [3]Gliemann, L. et al. Curr. Opin. Physiol. 10 (2019); [4]Simpson, R. J. et al. Progress in Mol Biol and Trans Sci (2015); [5]Cornish, S. M.et al. Curr. Osteoporos. Rep. 18 (2020); [6]Malm, C. et al. J. Physiol. 59 (2000); [7]Peake, J. M. et al. J. Appl. Physiol. 122 (2017); [8]Piasecka, B. et al. Proc. Natl. Acad. Sci. 115 (2018).