SHORT COMMUNICATION

Exercising to enhance the efficacy of COVID-19 vaccines

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Introduction

Vaccination is the best and the most cost-effective strategy for tackling infectious diseases and their complications.[1] A successful vaccine elicits a strong and durable immune response in the body to protect against illness.

According to The U.S. Food and Drug Administration (2020), any candidate for a Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) vaccine will be approved if it decreases Coronavirus-19 Disease (COVID-19) cases by at least 50% in comparison to placebo (i.e., 50% efficacy). Based on the preliminary reports, the efficacy level of Pfizer– BioNTech and Moderna vaccines are ~95%.[2] The speed with which these vaccines have been developed is highly impressive.[3] Vaccine development is dependent on various factors related to the nature of the vaccine, but also characteristics of vaccine recipients and people at risk of illness. Stress, rampant during the pandemic, can not only reduce vaccine efficacy but also promote more immediate and transient side effects, such as fatigue and low mood. However, many of these factors are modifiable and thus may be important intervention targets as the world prepares for widespread immunization.

Exercise and Immunogenicity

Physical activity promotes a strong immune system and better vaccine responses. Physically fit elderly people had better antibody immune responses, but not cell-mediated immune responses, to tetanus and influenza virus vaccines compared with their less-fit peers.[4] Accelerometer data was collected from elderly Chinese women in Singapore. It showed that women who walked more (> 18,509 steps/day) for two weeks after an influenza virus vaccination possessed greater innate immune activation two days after vaccination, larger adaptive immune responses 1 week after vaccination, and greater antibody responses after a second vaccination than their less-active peers (< 10,927 steps per day).[5]

In another study, it was observed that elite athletes possessed specifically more immune cells for influenza after receiving an influenza vaccine in comparison to other adults who were healthy.[6] In another study, it was observed that adults who were regular trainers possessed an increased antibody response compared to healthy adults who did not train well.[7] If constant exercise is done after vaccination, then it is considered to prolong increased protection.

Researchers found that “acute bouts” of exercise, such as work outs prior to vaccination, can accelerate better function of the immune system.[8] A systematic review of 20 studies showed that regular exercise and vaccination are important factors in developing the body’s response towards vaccines.[9]

Exercising on the day of the vaccine may offer benefits as well, though there is not much proof.[10] Eccentric exercise shows benefits to vaccine response. It increases the antibody responses in women and enhances the cell-mediated response in men. Further exploration is needed to study the eccentric exercise of the muscle at the site of vaccine

administration as a possible behavioral adjuvant to vaccination.[11]

Several studies in young healthy adults show that acute exercise can boost both antibody and cell-mediated responses to vaccine antigens.[12] Exercise-induced enhancement appears to be most visible in strains with weaker control responses, indicating a possible ceiling effect with stronger responses showing no further enhancement.[13] During six months of follow-up, acute exercise reduced vaccine reactions but had no effect on either antibody responses or the development of influenza-like symptoms. Being active close to the time of a vaccination — such as influenza or human papillomavirus (HPV), has been found to reduce the risk of suffering from adverse reactions to the injection.[14]

Edwards *et al.* observed the greater immune response to low-dose pneumococcal vaccine in those who exercised simply with 15 minutes of moderate resistance band exercise; the exercise task was performed in sets of 30 seconds of exercise followed by 30 seconds of rest.[15] Participants performed three exercises in a row: lateral raise, upright row, and chest press. Each movement was performed with instruction and encouragement to perform "as many as you can." Participants alternated movements and performed each 5 times, completing 15 minutes of exercise. Resistance band strength was adjusted to remain challenging while still allowing for 30 seconds of exercise.

Exercise for COVID-19 Vaccines

According to a February *Lancet* study, people who engage in "moderate-intensity exercise before vaccination" have higher rates of efficacy and more antibodies to COVID-19 vaccines. However, the evidence was never fully conclusive because other studies found no discernible difference.[16]

Exercise as an adjuvant provides an avenue that could potentially improve the protective efficacy of vaccination programs in at-risk, immune-compromised populations or even provide a route for dose sparing or a reduction in booster requirement. Critically, this behavioral approach avoids costly clinical trials, is inexpensive and simple to administer, is well understood and accepted by the general public, and has no side effects other than mild muscle soreness. Of course, correlation between exercise capacity and immune function could be due to pre-existing health status. Thus, it appears timely to investigate the possibility of using acute exercise as an adjuvant, especially in at-risk populations.

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