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Review

Establishing a dose-response relationship between acute resistance-exercise and the immune system: Protocol for a systematic review

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ABSTRACT

Exercise immunology research has traditionally focussed on aerobic-exercise, however it has become apparent in more recent years that resistance-exercise can also considerably affect host immunobiology. To date however, no systematic process has been used to establish a dose-response relationship between resistance-exercise and the immune system. The present systematic review was thus conducted to determine the dose-response effects of a bout of resistance-exercise on acute leukocyte counts. In accordance with the PRISMA guidelines, a systematic literature search was conducted in the electronic databases, PubMed, Web of Science, and Google Scholar, over the date range of 1989–2016. Following the PICO elements, eligibility criteria included: i) participants: healthy humans aged 18–40; ii) intervention: a single bout of resistance-exercise; iii) comparator: at least one comparator group; iv) outcome: acute measures of circulating leukocyte counts. Specific exclusion criteria were also applied. Risk of bias and quality of evidence was assessed using the PEDro scale. Due to the individual designs of the admitted studies, a qualitative analysis (systematic narrative synthesis) was employed in the present review. The results of the present review demonstrate that a single bout of resistance-exercise induces an acute monocytosis, neutrophilia, and lymphocytosis. It became apparent that the reviewed literature either does not consistently specify, or does not describe with sufficient detail, the time-course between the onset of exercise and the collection of blood. We recommend that researchers consider addressing this in future studies, and also collect blood measures during exercise to aid with comparison of temporal effects. Regarding the determination of a dose-response relationship, an acute neutrophilia, monocytosis and lymphocytosis appears to occur more rapidly and to a greater magnitude following a single bout of high-dose vs low-dose resistance-exercise. Mechanistically, exercise-induced cell trafficking changes are associated with mechanical, metabolic and endocrine factors. Physical aptitude of the host may also affect resistance-exercise-induced lymphocyte trafficking responses.

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1. Introduction

The link between the immune system and exercise in athlete health, tissue repair, and regeneration and coordination of other adaptive processes has become a prominent area of focus in the Sports Science and Medicine communities since the formation of the International Society of Exercise and Immunology (ISEI) in 1989 [1,2]. Both acute and chronic-exercise intervention studies have reported significant responses in terms of leukocyte redistribution/trafficking, activity and function [2]. The immune responses to exercise are not disorganised or random, and specific cells are redistributed for defined functional purposes [3]. Traditionally, exercise immunology research has employed aerobic-exercise, and found a general consensus that an acute bout of aerobic-exercise induces a transient neutrophilia, monocytosis and lymphocytosis [2]. Of relevance to the practice of exercise prescription, key exercise protocol variables, exercise intensity and duration/volume, have been reported to influence the redistribution of cells into the circulation associated with exercise [2,4–6].

A developing body of research is now emerging which describes the effects of resistance-exercise on host immunobiology. This literature has primarily focused on the post-exercise redistribution of leukocytes following high-dose resistance-exercise protocols [3,7,8]. Similar to aerobic-exercise, a single bout of resistance-exercise has been reported to induce an acute neutrophilia [9,10], monocytosis [11,12] and lymphocytosis [9,13]. Additionally, these changes in leukocyte trafficking appear to be regulated by the dose of resistance-exercise [3,9,14,15] in a manner analogous to that of aerobic-exercise [2]; that is, increasing the dose may affect the leukocyte response, thus a systematic examination of this dose-response notion is warranted. Despite preliminary investigation, significant basophil [13,16] and eosinophil [13,16] trafficking changes have not been found, suggesting a less substantial role may exist for these cells in response to exercise-induced stress. However, it must be noted that basophils and eosinophils have acted as investigation targets in far fewer exercise studies than other leukocytes [3,14]. Furthermore, basophils specifically have received relatively minimal attention across all subfields of experimental immunology [17].

Now that a sufficient amount of preliminary data has been reported through well conducted resistance-exercise studies, it is evident that researchers have been biased in their selection of exercise dose. Exercise dose comprises intensity (%-1RM [one-repetition maximum]), recruited muscle-mass (cross-sectional area [CSA] of active muscle), volume (sets × reps), duration (time-under-tension [s]), and rest periods (recovery between sets [s]). The existing literature is primarily composed of studies which administered varying degrees of high-dose (i.e., high-volume and or intensity, large muscle-mass) resistance-exercise [3,13,18], and thus less is known about the influence of low-dose (i.e., low-volume and or intensity, small muscle-mass) resistance-exercise on acute leukocyte counts. Few studies, such as our recent works [14,15], have examined the influence of very low-dose resistance-exercise on host immunobiology. Nonetheless, these low-dose studies also demonstrate significant acute changes to leukocyte trafficking following resistance-exercise. Whilst the functional implications of resistance-exercise induced modulation of the immune system are unclear, existing data [12–15] provide strong evidence that resistance-exercise, like aerobic-exercise, disrupts leukocyte homeostasis.

Pragmatically, exercise immunology has the potential to reveal novel and safe methods of manipulating host leukocyte activity and function. Resistance-exercise could therefore be prescribed like a pharmacological agent, and as such, establishing a dose-response relationship between resistance-exercise and the immune system will be fundamentally important. As with the field of pharmacology, which studies the minimum dose of a drug required to produce a given effect (dose-response [19]), exercise immunology must also examine the consequences of low- and micro-doses of resistance-exercise.

With regard to the central role of leukocytes in both host-defence and physiological adaptation [20–22], the primary aims of this systematic review are to: i) provide an update on the known acute leukocyte cell trafficking/redistribution responses to resistance-exercise in resistance-trained and untrained participants; ii) examine the doses of exercise which have been used in the current literature to assist in establishing a dose-response relationship between resistance-exercise and the immune system. Knowledge of this relationship could ultimately assist in enhancing the safety of exercise participation, improve exercise outcomes, and direct the way in which exercise can be prescribed to benefit an individual's health status. The secondary aim of this review is to describe the potential mechanisms underlying the acute leukocyte trafficking changes associated with a bout of resistance-exercise.