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EDITORIAL

Exercise and oxidative stress

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The observation that muscular exercise promotes oxidative stress in humans was first reported over 30 years ago. Since then, numerous studies have confirmed that prolonged or high intensity exercise results in oxidative damage to macromolecules in both blood and skeletal muscle. Although the tissue(s) responsible for reactive oxygen species (ROS) production during exercise remains a topic of debate, compelling evidence indicates that muscular activity promotes oxidant production in contracting skeletal muscle fibres. Contraction-induced ROS generation plays an important physiological function in the regulation of both muscle force production and contraction-induced adaptive responses of muscle fibres to exercise training. Given that scientific interest in the field of exercise and oxidative stress has grown markedly during the past three decades, the goal of this special issue *of The Journal of Physiology* is to highlight research progress in several important areas of this field.

This special issue opens with a historical overview of the research progress related to exercise and oxidative stress (Powers *et al.* 2016). This chronicles the history of studies in the field of exercise and oxidative stress beginning with the discovery that cells produce radicals, followed by a decade-by-decade summary of key findings. This historical overview of research in exercise and oxidative stress is followed by seven state-of-the-art reviews on topics related to exercise and oxidative stress. A brief overview of these follows.

It has been suggested that exercise at high altitude increases radical production in contracting muscles. Quindry and colleagues (2016)) summarize the evidence supporting the concept that exercise at high altitude is associated with increased oxidative production and oxidative stress. In particular, this report dissects the human redox response to exercise at altitude using both field-based research and laboratory studies employing normobaric hypoxia. Moreover, Quindry *et al.* provide an excellent summary of oxidative stress biochemistry as assembled from studies of humans exercising at high altitude. This review focuses on an integrative approach to this interesting area of applied research.

Growing evidence demonstrates that mitochondria are central mediators of muscle health, and that aging results in impaired mitochondrial function that is predicted to contribute to age-related loss of skeletal muscle mass (i.e. sarcopenia). A thorough review by Joseph and colleagues (2016) explores the evidence that regular exercise is beneficial in prevention of age-related mitochondrial dysfunction in skeletal muscles. Specifically, these authors provide a contemporary summary of the impact of regular exercise on mitochondria biogenesis, mitochondrial dynamics (i.e. fission and fusion), and mitochondrial turnover (i.e. mitophagy) in skeletal muscle. Key gaps in our current knowledge of exercise and mitochondrial health are highlighted and will certainly lead to additional research on this important topic.

Intense exercise promotes an increase in oxidant production in skeletal muscles that has been postulated to limit performance during endurance exercise. In a succinct and well-crafted review, Michael Reid (2016) discusses the experimental evidence supporting the concept that both thiol antioxidants and nitrate supplements can improve human exercise performance. The potential mechanisms responsible for these performance effects are discussed and the report concludes with a discussion of important issues that remain unresolved.

Merry & Ristow (2016) provide a critical review of the literature regarding the controversial question: Do antioxidant supplements interfere with skeletal muscle adaptation to training? This review provides a thorough and objective treatment to this question and is an important resource for individuals interested in exercise-induced adaptations in skeletal muscles.

Cheng *et al.* (2016) discuss the mechanisms of how reactive oxygen and reactive nitrogen species influence muscle contractile machinery during exercise and during recovery from exercise. This comprehensive review provides an intricate discussion of how both ROS and reactive nitrogen species impact muscle contractile activity. Without question, this review will be important reading for those interested in skeletal muscle function during exercise.

Lawler *et al.* (2016) discuss evidence supporting the concept that exercise training results in mitochondrial adaptations that are associated with protection of cardiac and skeletal muscle against oxidative stress and ischaemia-reperfusion insults (i.e. preconditioning). The potential health consequences of exercise-induced changes in mitochondrial phenotype are discussed and the molecular adaptations responsible for this exercise-induced ‘stress resistant’ mitochondrial phenotype are also debated.

Finally, Malcolm Jackson (2016) describe recent advances in the experimental approaches to monitor ROS activity in skeletal muscles. This state-of-art review highlights the advantages and disadvantages of each technique and emphasizes the technical care that must be exercised in the choice of the method used to measure ROS activities in skeletal muscle fibres. This review is a must-read for both the expert and novice investigator interested in studying ROS activity in muscle.

This special issue of *The Journal of Physiology* will be an invaluable resource for researchers world-wide who are interested in exercise and oxidative stress. The contributing authors to this special edition are leaders in their respective areas of research and each of these reports provide depth and insight into their respective topics. Notably, each of these reviews highlights important gaps in our knowledge that remain to be filled. It is hoped that identifying these key unanswered questions will serve as a stimulus for future research.

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Additional information

Competing interests

No competing interests declared.