

Editors

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Strength and Conditioning

**Biological Principles
and Practical Applications**



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Foreword by Sir Clive Woodward

High-level performance may seem easy to sport fans. Coaches and athletes know very well that it is very difficult to achieve. Winning does not happen in a straight line. It is the result of incredible efforts, dedication, passion, but also the result of the willingness to learn something new every day in every possible field which can help improve performance.

Strength and conditioning is fundamental for preparing athletes to perform at their best. It is also important to provide better quality of life in special populations and improve fitness. Scientific efforts in this field have improved enormously our understanding of various training methods and nutritional interventions to maximize performance. Furthermore, due to the advancement in technology, we are nowadays capable of measuring in real time many things able to inform the coach on the best way to improve the quality of the training programmes.

Winning the World Cup in 2003 was a great achievement. And in my view the quality of our strength and conditioning programme was second to none thanks to the ability of our staff to translate the latest scientific knowledge into innovative practical applications. The success of Team GB in Beijing has also been influenced by the continuous advancement of the strength and conditioning profession in the UK as well as the ability of our practitioners to continue their quest for knowledge in this fascinating field.

Now, even better and more information is available to coaches, athletes, sports scientists and sports medicine professionals willing to learn more about the field of strength and conditioning. *Strength and Conditioning: Biological Principles and Practical Applications* is a must read

for everyone serious about this field. The editors, Dr Marco Cardinale, Dr Robert

Newton and Dr Kazunori Nosaka are world leaders in this field and have collected an outstanding list of authors for all the chapters. Great scientists have produced an incredible resource to provide the reader with all the details needed to understand more about the biology of strength and conditioning and the guidance to pick the appropriate applications when designing training programmes.

When a group of sports scientific leaders from all over the world come together to produce a book about the human body and performance, the reader can be assured the material is at the leading edge of sports science. Success in sport is nowadays the result of a world class coach working with a world class athlete surrounded by the best experts possible in various fields. This does not mean the coach needs to delegate knowledge to others. A modern coach must be aware of the science to be able to challenge his/her support team and always stimulate the quest for best practice and innovation.

The book contains the latest information on many subjects including overtraining, muscle structure and function and its adaptive changes with training, hormonal regulation, nutrition, testing and training planning modalities, and most of all it provides guidance for the appropriate use of strength and conditioning with young athletes, paralympians and special populations.

I recommend that you read and use the information in this book to provide your athletes with the best chances of performing at their best.

Sir Clive Woodward
Director of Sport
British Olympic Association

Preface

In order to optimise athletic performance, athletes must be optimally trained. The science of training has evolved enormously in the last twenty years as a direct result of the large volume of research conducted on specific aspects and thanks to the development of innovative technology capable of measuring athletic performance in the lab and directly onto the field. Strength and conditioning is now a well recognised profession in many countries and professional organisations as well as academic institutions strive to educate in the best possible way strength and conditioning experts able to work not only with elite sports people but also with the general population. Strength and conditioning is now acknowledged as a critical component in the development and management of the elite athlete as well as broad application of the health and fitness regime of the general public, special populations and the elderly. Strength and conditioning it is in fact one of the main ways to improve health and human performance for everyone.

The challenge for everyone is to determine the appropriate type of training not only in terms of exercises and drills used, but most of all, to identify and understand the biological consequences of various training stimuli. Understanding how to apply the correct modality of exercise, the correct volume and intensity and the correct timing of various interventions is it in fact the “holy grail” of strength and conditioning. The only way to define it is therefore to understand more and more about the biological principles that govern human adaptations to such stimuli, as well as ways to measure and monitor specific adaptations to be able to prescribe the most effective and safe way of exercising. Modern advancements in molecular biology are now helping us understand with much greater insight how muscle adapts to various training and nutritional regimes. Technology solutions help us in measuring many aspects of

human performance as it happens. We now have more advanced capabilities for prescribing “evidence-based” strength and conditioning programmes to everyone, from the general population to the elite athlete. Our aim with this book is to collect all the most relevant and up to date information on this topic as written by World leaders in this field and provide a comprehensive resource for everyone interested in understanding more about this fascinating field.

We have structured the book to provide a continuum of information to facilitate its use in educational settings as well as a key reference for strength and conditioning professionals and the interested lay public. In Section 1 we present the biological aspects of strength and conditioning. How muscles, bones and tendons work, how neural impulses allow muscle activity, how genetics and bioenergetics affect muscle function and how the cardiorespiratory system works. In section 2 we present the latest information on how various systems respond and adapt to various strength and conditioning paradigms to provide a better understanding of the implications of strength and conditioning programmes on human physiology. Section 3 provides a detailed description of various modalities to measure and monitor the effectiveness of strength and conditioning programmes as well as identifying ways for improving strength and conditioning programme prescriptions. Section 4 provides the latest information on practical applications and nutritional considerations to maximise the effectiveness of strength and conditioning programmes. Finally section 5 provides the latest guidelines to use strength and conditioning in various populations with the safest and most effective progressions.

The way the material has been presented varies among the chapters. We wanted our contributors to present their area of expertise for a varied audience ranging from sports

scientists to coaches to postgraduate students. Authors from many countries have contributed to this book and whatever the style has been, we are confident the material can catch the attention of every reader.

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The editors would like to thank Nicola Mc Girr, Izzy Canning, Fiona Woods, Gill Whitley the wonderful people in the John Wiley & Sons, Ltd. for the continuous support, guidance and help to make this book happen.

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Robert Newton acknowledges the fantastic collaborators that he has had the honour to work with over the past three decades and the dedicated and hardworking students and postdocs that he has been privileged to mentor. Thank you, my dear wife Lisa and daughter Talani for all your support and patience through my obsession with research and teaching.

Ken Nosaka appreciates the opportunity to make this book with many authors, Marco, Rob, and the wonderful people in the John Wiley & Sons, Ltd. I have experienced how challenging it is to edit a book and to make an ideal book, but it was a good lesson. Because of many commitments, I have a limited time with my wife Kaoru and daughter Cocolo. I am so sorry, but your support and understanding are really appreciated, and would like to tell you that you make my life valuable.

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Section 1

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