



## Masterclass

# Periodization and physical therapy: Bridging the gap between training and rehabilitation<sup>☆</sup>



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## ABSTRACT

*Background:* Exercise prescription and training progression for competitive athletes has evolved considerably in recent decades, as strength and conditioning coaches increasingly use periodization models to inform the development and implementation of training programs for their athletes. Similarly, exercise prescription and progression is a fundamental skill for sport physical therapists, and is necessary for balancing the physiological stresses of injury with an athlete's capacity for recovery.

*Objective:* This article will provide the sport physical therapist with an overview of periodization models and their application to rehabilitation.

*Summary:* In recent decades models for exercise prescription and progression also have evolved in theory and scope, contributing to improved rehabilitation for countless athletes, when compared to care offered to athletes of previous generations. Nonetheless, despite such advances, such models typically fail to fully bridge the gap between such rehabilitation schemes and the corresponding training models that coaches use to help athletes peak for competition. Greater knowledge of periodization models can help sport physical therapists in their evaluation, clinical reasoning skills, exercise progression, and goal setting for the sustained return of athletes to high level competition.

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## 1. Introduction

Over the last half-century, preparation for athletic endeavors has progressed in scope and complexity (Wilmore, 1988; Potteiger & Wilson, 1989b; Potteiger & Wilson, 1989a). Successful athletes and sport enthusiasts now typically train for competition with as much forethought and planning as possible (Apel, Lacey, & Kell, 2011; Buford, Rossi, Smith, & Warren, 2007; Franchini, Branco, Agostinho, Calmet, & Candau, 2014). Periodization, characterized by the dividing of the annual training plan into smaller, distinct phases as a means of separating the program into more manageable segments, represents the most sophisticated method of

preparation for competition, and in recent decades periodization has been increasingly used at all levels of athletic preparation. Whether conceptualized and directed by coaches, or by athletes themselves, competitors of all types use periodization as a means of structuring their training in a cyclic fashion, enabling them to best realize their performance capacities and goals (Bompa, 1990). Consequently, a basic understanding of the periodization process allows well-informed sport physical therapists to expedite the successful return of the athlete to competition following an injury (K. E. Wilk & Arrigo, 1993). Additionally, an understanding of periodization theory may further help athletes remain injury-free following return to training or competition. This paper examines the basic premises underlying periodization. In addition, it describes foundational elements of periodization theory and commonly used periodization paradigms as well as current challenges and controversies surrounding this topic. Finally, this paper presents case studies illustrating how periodization theory may be woven into the rehabilitation of competitive athletes. Collectively, these content topics may help sport physical therapists bridge the gaps evident between the bodies of knowledge devoted to the preparation for competition and the rehabilitation of sport injuries.

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### 1.1. The general adaptation syndrome (GAS): foundation for training, foundation for rehabilitation

Most healthcare and fitness professionals typically think of exercise as a universally positive activity, as well as having universally positive effects upon the human body. However, this viewpoint is not entirely correct. Rather, as it relates to the effects upon the human body, any physical activity is better described as a physiological stressor (Selye, 1978). In turn, stress is a state created by the specific syndrome that consists of all non-specifically induced changes within a biological system (Plowman, 2011). This generates a disruption within the body and all attempts by the body to regain its homeostatic state. Thus, when physical activity is properly dosed in individuals who possess the physiological capacity to respond acutely, homeostasis is restored. With repeated bouts of properly dosed physical activity in individuals having the physiological capacity to respond over longer time frames, adaptation occurs. Conversely, when the body's tissues and systems are overly disrupted, disease and injuries occur, and even death happens when an individual cannot respond acutely or over longer time frames.

Throughout Western civilization, people have observed and asked questions regarding these physiological workings of the body, and from the start they have created and tested theories as a means of better understanding these phenomena. Periodization theory is one such informed school of thought. At its very essence, periodization theory is a reasoned attempt to plan and distribute such training stressors to maximize and refine the growth that can come with regular physical activity, while simultaneously minimizing the potentially negative effects of the same activity.

The foundations of periodization theory and its application to athletic preparation first emerged in the late-twentieth century (Bompa, 1994). Most of the periodization theory and terminology widely used today can be traced conceptually to the work of Hans Selye, a prolific scientist who conducted many landmark studies in the area of endocrinology. More specifically, Selye conducted much important scientific work on the non-specific endocrine responses of tissues subjected to a wide variety of physiological and psychological stresses. Much of this work in endocrinology served as the inspiration for his description of the GAS, which describes the sequelae when the body is exposed to stressors, acutely and over time (Plowman, 2011).

The GAS consists of three stages, each having distinct characteristics and traits (Plowman, 2011). The first stage described by Selye is the Alarm Reaction, in which the body responds non-specifically to the disruption to homeostasis. The second stage in this model is the Stage of Resistance; the stress is relatively mild and advantageous, and in this stage the body can adjust. The final stage is the Stage of Exhaustion. In this stage, the body cannot adjust. The stress becomes chronic or the adaptation to the stressor is lost.

Decades ago, sport scientists – initially in Eastern Europe and then on a broader global basis – first took note of the GAS and began applying its potential lessons to athletic training and competition (Bompa, 1994; Plowman, 2011). An overview of the GAS and its application to athletic preparation is described as follows. The fatigue of physical activity is temporary and reversible if the training load is appropriate; accordingly, factors such as proper exercise technique, rest, and nutrition are keys to ensuring that an athlete can recover from the stress of any given training bout. This describes the first stage within the GAS. However, an overarching goal of effective training is to strive to not only restore homeostasis, but to encourage “supercompensation” or increased capacities of physiological and psychological attributes such as muscular energy stores, strength of muscle, bone and other connective tissues, greater muscular endurance, less anxiety during physical activity

and so on. This describes the second stage within the GAS. When applying these axioms to athletic preparation, the goal of all training is to alternate the individual athlete between Stages I and II within the GAS. Stage III is to be avoided, if at all possible, as the athlete's performance will likely regress, he or she will be more susceptible to injury, and the like. It was within this context, then, that the annual training calendar, or periodization, emerged as sport scientists and coaches aimed to divide the annual training plan into smaller, distinct phases (Bompa, 1994). The goal was to separate the training program into more manageable components, facilitating not only the monitoring of individual athletes but also of the relative merits and shortcomings of the training regimens as well.

Sport scientists were not the only professionals to apply the lessons of the GAS to their work (Csermely, Korcsmaros, & Sulyok, 2007; Gellman & Turner, 2013; Lovallo, 2005). More specifically, physicians and other licensed healthcare professionals also saw Selye's theory as quite helpful in explaining many conditions among the individuals under their care. To illustrate, many of the chronic diseases seen in contemporary Western society are manifestations of the Stage of Exhaustion of the GAS, in which the tissue or system has become overly fatigued and/or lost its ability to adapt to the stresses regularly placed upon it (Csermely et al., 2007). Conditions such as congestive heart failure, kidney failure, herniated disks, torn rotator cuffs, ruptured anterior cruciate ligaments (ACL), and psychological depression are but a few examples of diseases or injuries that may arise out of the third stage of the GAS (Gellman & Turner, 2013). As this model directly relates to sport physical therapy, rehabilitation specialists have long acknowledged that therapeutic doses of stress must be re-applied to tissues following injury or surgery in order to take the tissues first to the Alarm Stage of the GAS, with the goals of progressing the damaged tissue to the Stage of Resistance and simultaneously avoiding the Stage of Exhaustion. This process is common physiologically with athletic preparation, and through it injured or surgically-repaired tissues are gradually strengthened as needed to help restore a patient's functional abilities.

In summary, physiological stress is a significant byproduct of athletic training and competition. It is also a fundamental component of therapeutic exercise used in sport physical therapy. If such physiological stressors are not manipulated correctly in either scenario, it may adversely affect an athlete's training and performance, or it may negatively impact a patient's recovery of function following injury or disease. Periodization theory and annual training calendars thus play an important role in helping the athlete manage the various physiological and psychological stressors associated with training and competition (Bompa, 1994). These principles similarly may be of great benefit when integrated into the rehabilitation of injured athletes.

### 1.2. Foundational training concepts: basis for conditioning and sport-specific development, and for therapeutic exercise prescription

High-level athletic performance hinges upon an individual's physiological adaptation to exercise, psychological adjustment to training, and the neurological development of sport specific skills necessary for a high degree of *sport readiness*, *sport form*, or *competitive fitness* as it has been described in the literature (Bompa, 1994; Plowman, 2011). The duration of the respective training phases depends on the time necessary to improve the level of performance from an athlete's baseline capacities. Moreover, the higher the level of sport readiness an athlete may obtain, the shorter duration he or she may maintain such a peak (Apel et al., 2011). Consequently, the annual training calendar, or periodization, emerges as the main method for calculating the length of each

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