PERIODISATION:

PREVENTING OVER-TRAINING AI

Periodisation is the manipulation of a training programme to bring about optimal (peak) performance at a predefined time point. Periodisation was first introduced in the 1950s following the observation that focusing on a small number of key competitions was far more effective than preparing an athlete for a year-round competition programme. This article provides an overview of the principles and main considerations of producing a periodisation programme.

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Periodisation is based on the principles of multilateral development, specialisation, variety and long-term planning. The first three focus on the optimisation of physiological performance, whereas long-term planning allows the athlete, coach and support staff to implement strategies to target long-term goals.

There are a number of periodisation models employed in sport ranging from simply alternating hard and easy sessions to highly complex models employing micro, meso and macro-cycles. Further, periodisation employs single through to multi-tapering models that elicit peak performance for a single competition or for multiple annual events.

PRINCIPLES OF TRAINING

Whilst the fundamentals of training principles are beyond the scope of the present article they are fundamental to the understanding of periodisation. In brief, the principles of training are compartmentalised into the following categories:

1. overload
2. progression
3. specificity
4. individuality
5. reversibility
6. recovery.

Overload

Overload refers to the intensity, duration and frequency of the training stimulus. Training has to be sufficient in its intensity, duration and frequency for adaptive changes in structural, physiological, neural, psychological and endocrine functions to take place. Optimising overload will elicit the desired adaptive response while insufficient overload results in limited or no adaptive response. In contrast, excessive overload can lead to injury or over-training (see later).

Progression

In order to maintain adaptation the overload stimulus needs to be progressive (see fig. 2). The rate of progression is important, too slow and limited adaptation and boredom will ensue, too fast and injury and over-training may result.

Specificity

In order to optimise the adaptive response, training should reflect the demands of competition in terms of skill, muscle group and energy system ie. specificity. However it is important to avoid over-use injuries and staleness, particularly in young athletes, and therefore cross-training, which reduces specificity, may be a valuable tool in the coach's armoury.

Recovery and reversibility

Recovery is a key element to the design of a training programme, however, it is perhaps the most difficult to optimise or balance when combined with the concepts of progressive overload and reversibility. Reversibility refers to the loss of physiologic adaptation associated with a reduction or removal of the training stimulus. This concept underpins the structure of a tapering/peaking phase to a periodised model and represents one of the most difficult areas for a coach (1).

In addition to performance, prolonged de-training during rest periods following major competitions, may significantly compromise the regaining of performance and as such structured recovery plans are crucial.

ND MAXIMISING PERFORMANCE

Individuality

When designing a training programme it is important to recognise that factors specific to the individual eg. genetics, may also have an affect on the response to training (2).

PERIODISATION

Training results in a set response which is characterised by a training stimulus. This leads to an alteration in homeostasis that manifests itself as fatigue. Then following a period of recovery, adaptation takes place. This process is termed the supercompensation cycle (see Figure 1). To elicit a continued supercompensation, the training programme must be specific, individualised and progressive in its overload, incorporating an optimal amount of recovery. These concepts need to be pulled together to bring about a taper/peak at precisely the right time. The complexities of this task are drawn together in the process of periodisation.

Periodisation is first divided into a number of key phases:

- preparation
- competition
- transition.

These phases are further characterised by training cycles of varying durations and objectives termed:

- macro-cycles
- meso-cycles
- micro-cycles.

KEY PHASES

Preparation phase

The preparation phase is the longest phase of the annual cycle. Commonly this phase may be sub-divided into a number of training periods lasting 4-10 weeks. These periods of training tend to progress from general to highly specific training with the primary aim of preparing the athlete for the transition phase. It is common and desirable for coaches and sports scientists to monitor progress through established laboratory or field-testing during the preparation phase.

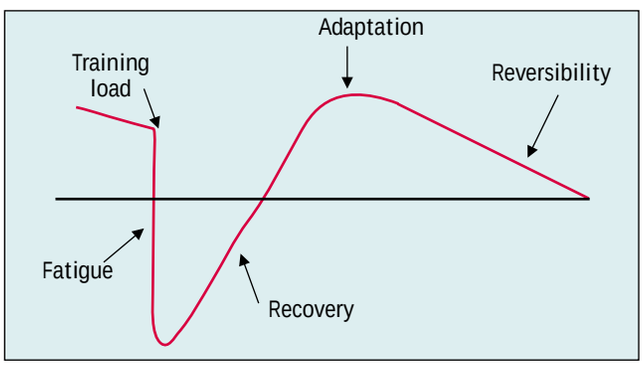

Figure 1: The super-compensation model

Competition phase

The competition phase is structured around the competition calendar and may be simple or complex in nature. This period is the most delicate period of the training cycle and requires very close collaboration between athlete, coach and support staff to ensure optimal performance and avoid injury and illness. This phase usually lasts 3-4 months, however it may be longer, and can involve single- or multi-taper/peak models.

Transition phase

The transition phase is a regeneration phase at the end of the annual cycle lasting 3-6 weeks and is characterised by a decrease in training loads. Care is required in this phase to avoid excessive de-training and loss of conditioning.

TRAINING CYCLES

Macro-cycles commonly last between 2-3 months and a year, however they can be used to plan for longer periods eg. an Olympic cycle (4 years). The macro-cycles are sub-divided into smaller blocks called meso-cycles, lasting 4-10 weeks. Micro-cycles represent the shortest period of planning usually lasting 1 week (weekly training programme). Each micro-cycle is constructed according to the objective of the training and can be repeated more than once in a period for the required training elements to be improved and performance to be enhanced. It is crucial to monitor training

load during each micro-cycle to allow for supercompensation and optimal adaptation. Establishing training load is beyond the scope of the article and for further information refer to an article by Taha and Thomas (3).

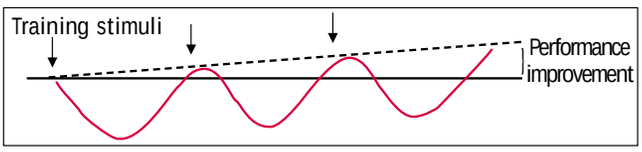

Figure 2. Progression of adaptive response

TRAINING FATIGUE AND OVER-REACHING

Fatigue as a result of training lasting 1-2 days and characterised by muscle soreness, insomnia and increased allergic response is termed 'training fatigue'. A reduction in training volume, which allows recovery, will reverse training fatigue within 24 hours. When intense training sessions are undertaken during the period of training fatigue, without an appropriate recovery, a state of 'overreaching' ensues. Over-reaching is a temporary state lasting from a few days to two weeks. Coaches will often deliberately induce a state of 'over-reaching' to enhance the training effect. Caution is warranted, however, when adopting these techniques if 'unexplained underperformance syndrome' is to be avoided (4).

UNEXPLAINED UNDERPERFORMANCE SYNDROME (UPS)

The term unexplained underperformance syndrome (UPS) is used to describe a reduction in physical performance coupled with chronic and unexplained fatigue for a period of greater than 2 weeks despite rest and in the absence of any medical condition. UPS has been termed 'overtraining', 'overtraining syndrome', 'burnout', 'staleness', 'chronic fatigue' and 'post-viral fatigue'. UPS is a clinically complex condition of indeterminate cause with a range of individually varying symptoms and signs (see boxes 1 and 2). UPS is more common in endurance-trained individuals with a prevalence of around 10%, however it does occur in sprint/power trained athletes. While the cause of UPS is associated with an imbalance of training and recovery it is not solely associated with over-training. Other factors include various stressors outside of training. The treatment for UPS is complex and multi-factorial and focuses on the removal or modulation of underpinning stressors and a restructuring of training to allow a slow progression in training volume often lasting 2-6 months (5).

BOX 2. SIGNS OF UPS

- Increased normal resting heart rates by 5-10 beats per minute
- Increased resting blood pressure
- Raised resting lactic acid concentrations
- Decreased maximal lactic acid levels following intensive physical exercise
- Following specific exercise/training routines, the heart may take 2-3 times longer than normal to return to resting levels
- Decreased ability by the body to utilise oxygen during maximal exercise
- Muscle damage
- Menstrual irregularities, even cessation of menstruation
- Susceptibility to infections, especially of the skin and upper respiratory tract
- Increased rates of allergies & minor scratches may heal more slowly.

BOX 1. SYMPTOMS OF UPS

- Constant fatigue
- Poor performance
- Excessive sweating
- Inability to recover optimally following intensive exercise
- Loss of desire and enthusiasm for exercise training (feelings of helplessness)
- Breakdown of technique
- Poor concentration
- Loss of appetite and loss of body weight
- Disturbed sleep often with nightmares or vivid dreams
- Increased susceptibility to injuries
- Increased anxiety and irritability.

SUMMARY

Optimising performance at a single time point is an exceptionally difficult task. Periodisation is a complex manipulation of an athlete's training programme into preparation, competition and transition phases employing macro- meso- and micro-cycles to assist in the process of performance enhancement. The success of periodisation is a delicate balance between training load and recovery. Excessive load and insufficient recovery can lead to injury and illness that, in the case of UPS, can be career ending. An interdisciplinary model with close collaboration between athlete, coach and support staff offers the best possible to chance to avoid injury and illness and optimise performance.

THE AUTHOR

Dr Greg Whyte is the national director of science and innovation for the English Institute of Sport. Greg completed an MSc in human performance in the US before returning to the UK to complete a PhD. He was appointed research manager at the British Olympic Medical Committee and has worked as consultant physiologist to many Olympic and professional sports. He has published extensively in the field of sport science and medicine.

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