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Review

The use of periodization in exercise prescriptions for inactive adults: A systematic review

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ABSTRACT

Background. Periodization of exercise is a method typically used in sports training, but the impact of periodized exercise on health outcomes in untrained adults is unclear.

Purpose. This review aims to summarize existing research wherein aerobic or resistance exercise was prescribed to inactive adults using a recognized periodization method.

Methods. A search of relevant databases, conducted between January and February of 2014, yielded 21 studies published between 2000 and 2013 that assessed the impact of periodized exercise on health outcomes in untrained participants.

Results. Substantial heterogeneity existed between studies, even under the same periodization method. Compared to baseline values or non-training control groups, prescribing periodized resistance or aerobic exercise yielded significant improvements in health outcomes related to traditional and emerging risk factors for cardiovascular disease, low-back and neck/shoulder pain, disease severity, and quality of life, with mixed results for increasing bone mineral density.

Conclusions. Although it is premature to conclude that periodized exercise is superior to non-periodized exercise for improving health outcomes, periodization appears to be a feasible means of prescribing exercise to inactive adults within an intervention setting. Further research is necessary to understand the effectiveness of periodizing aerobic exercise, the psychological effects of periodization, and the feasibility of implementing flexible non-linear methods.

Contents

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Introduction

Regular exercise is a key behavior in the prevention and treatment of a variety of conditions, such as type 2 diabetes (Albright et al., 2000), hypertension (Pescatello et al., 2004), and certain types of cancer (Kushi et al., 2006). The 2008 Physical Activity Guidelines for Americans (PAGA) recommends that adults should accumulate 150 min of moderate or 75 min of vigorous aerobic exercise per week, or a combination of the two for health benefits (American College of Sports Medicine, 2013). Regarding resistance exercise, individuals should train each major muscle group at a moderate intensity at least twice per week (American College of Sports Medicine, 2013). Despite health benefits, less than 10% of adults in the United States attain the minimum amount of aerobic exercise (Tucker et al., 2011) and resistance exercise (Loustalot et al., 2013). Low adherence is often attributed to work/life issues, such as a perceived lack of time (Anderson, 2003) or feeling "too tired" (Heesch et al., 2000; Korkiakangas et al., 2011; Stutts, 2002). Thus, it is critical that researchers explore novel, effective approaches to improving exercise behavior. In this regard, much insight could be gained from approaches used in sport conditioning, where exercise prescriptions are designed to be physiologically and psychologically sustainable using periodization.

Periodization is a widely accepted organizational strategy for both aerobic and anaerobic training in athletes. The use of periodization is reported by the majority of strength professionals in Division 1 collegiate athletics (Durell et al., 2003) (93%), the National Basketball Association (Simenz et al., 2005) (90%), the National Hockey League (Ebben et al., 2004) (91%), Major League Baseball (Ebben et al., 2005) (83%) and the National Football League (Ebben and Blackard, 2001) (69%). Periodization promotes systematic variation in training specificity, intensity and volume, organized within shorter, more easily managed cycles or "periods" within an overall program (Wathan and Earle, 2008). A *macrocycle*, which constitutes the total training period (1–4 years), is divided into several *mesocycles* (lasting several weeks to several months), which are further divided into *microcycles* (lasting approximately 1 week).

Periodized training aims to promote improvements while preventing the onset of overtraining syndrome (Haff, 2004), which is characterized by physical and mental symptoms (Stone et al., 1991). Physiologically, the progressive overload, planned recovery, and variety inherent to periodization promote fitness gains while preventing physical signs of overtraining syndrome: severe fatigue, performance decrements, and injury (Kibler and Chandler, 1994; Kraemer et al., 2002; Kubukeli et al., 2002; Stone, 1990). Likewise, excessive and/or monotonous training can induce psychological symptoms, such as mood disturbances, depression, apathy, mental fatigue and emotional instability (Davis, 1995; Fry et al., 1994; Smith, 2003; Wathan and Earle, 2008). Negative psychological states are problematic as substantial evidence suggests that mood state is directly related to performance outcomes (Beedie et al., 2000) and associated with non-compliance (Stone et al., 2000).

Several non-periodized and periodized training models exist (Bompa and Haff, 2009). Non-periodized models can be uniform, linear progressive or random. Uniform workloads have little-to-no variation in volume and intensity over time. With linear progressive training, volume remains consistent or increases while intensity progressively increases. Random training allows for unsystematic changes in volume and/or intensity with no consideration beyond introducing variety. The two primary periodized models are traditional and undulating. Traditional periodization promotes wave-like progression (periods of overload interspersed with periods of recovery), typically moving from general training (high volume/low intensity) towards specific training (low volume/high intensity) (Kraemer and Ratamess, 2004). Undulating periodization allows for more frequent changes in volume and intensity, typically across a 7–10 day span (Kraemer and Fleck, 2007). Two more recently developed periodized models are flexible non-linear periodization (FNLP) and block periodization. FNLP, a more recently developed method, is similar to undulating periodization, wherein daily workload intensity and volume are based upon the participant's pre-exercise mental/physical state (i.e. "readiness") (Kraemer and Fleck, 2007). For block periodization, a high concentration of workloads is organized within a given period to target improvement in a relatively small number of variables in order to bring about a cumulative training effect over multiple blocks (Issurin, 2010). Although the bulk of published research on periodized models has focused on strength and power in trained participants, prior evidence, including a meta-analysis that analyzed over 100 studies, points to periodized programming as yielding superior fitness and performance results compared to non-periodized programs (Fry et al., 1992a,b; Rhea and Alderman, 2004).

Given the popularity and practicality of periodized training for athletes, it may be feasible and beneficial to prescribe periodized exercise to inactive adults to improve health outcomes. Currently, PAGA recommendations are often adapted into non-periodized prescriptions, consisting of linear progression and/or uniform workloads. For example, sedentary participants enrolled in behavioral weight loss programs typically begin walking shorter durations at a moderate intensity with duration increasing overtime until the target volume is reached, wherein, participants are asked to maintain the volume indefinitely (Jakicic et al., 2003, 2009; Jeffery et al., 2003). Resistance training interventions for sedentary individuals will often consist of one or more sets of 8–12 repetitions, progressively increasing resistance when more than 12 repetitions can be completed (Avila et al., 2010; Slentz et al., 2011; Straight et al., 2012). While such non-periodized programs typically result in