Critical Systematic Review : Linear and Nonlinear What Is A Training Periodization Model?

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Abstract: Periodization is an interesting study for the world of sports, especially achievement sports because in periodization there are plans that are made hierarchically and must be passed from phase to phase. This study aims to conduct a literature review study with a type of critical systematic review. This is done on the basis of the author's doubts regarding the terms exercise periodization, and linear and nonlinear concepts. On the basis of these problems, the author conducts a literature review so that it is expected to provide reflective results. The term exercise periodization can be agreed upon as a macro management and organization by considering nutrition and recovery so that exercise gets optimal results, While the linear concept is programming that is carried out progressively related to intensity and volume but can only be used in the short term so that negative things do not happen in performance. Then the concept of nonlinear is programming with intensity and volume settings more often in each meso or micro. It is hoped that this knowledge will benefit practitioners, coaches, athletes, and subsequent researchers. The limitation is that the inclusion criteria for literature selection are not mentioned, and the literature used is relatively small so it cannot generalize the results well. Research methods are less comprehensive, data analysis techniques are just synthesizing and evaluating. Further research is expected to improve this research to make it more perfect.
Keywords: systematic review, periodization, training

INTRODUCTION

Periodization is an interesting study for the world of sports, especially achievement sports because in periodization there are plans that are made hierarchically and must be passed from phase to phase (Kraemer &; Beeler, 2018). The theory of exercise periodization was already proposed by Leonid Matveyev who offered a general concept for exercise planning (Kraemer & Beeler, 2018). The good news is that exercise periodization has gone global so it has been used in sports planning (González-Ravé et al., 2022). Surely we as practitioners and academics of sports have heard what linear and nonlinear periodization is.

Often we encounter linear and nonlinear concepts in the periodization of sports training into an annual exercise periodization. A study from Mattocks (2016) states that linear periodization is an exercise program that divides different cycles including macrocycles of 9-12 months,

mesocycles of 3-4 months, and micro cycles of 1-4 weeks with intensity settings increased and exercise volume lowered progressively.

In addition, nonlinear periodization is characterized by more frequent changes in intensity such as daily and weekly (Mattocks et al, 2016). Lorenz & Morrison's (2015) linear periodization is a periodization model that focuses on changes in exercise volume and intensity. Non-linear can be called wavy periodization, this concept focuses on changing the volume and load of exercise as often as possible (daily, and weekly) with the aim of minimizing excessive fatigue levels (Mattocks et al, 2016). Some previous studies have agreed on this concept.

This reaps the pros and cons that classical or traditional periodization is called linear periodization assuming that the exercise intensity setting will increase gradually and the volume will decrease progressively at each change of exercise period. In addition, undulating periodization is perceived as nonlinear periodization with reference that volume and intensity settings can be changed in each micro and meso. The author's statement is supported by Alfonso (2020) that linear and nonlinear terminology is still misinterpreted and has not been well defined. In line with other studies most misconceptions are related to the basic definition, basic concepts, mechanisms, and practical implementation of the periodization of training (Stone et al., 2021). Then linear and nonlinear is what kind of concepts?

This issue is very sexy and interesting with the aim of compiling scientific evidence related to periodization and programming in sports (Fisher & Csapo, 2021). The purpose of this paper is to review the available evidence regarding exercise periodization terms and linear and nonlinear terms to produce a reflective review (Mujika et al., 2018).

METHOD

This research method is a literature study with a type of critical systematic review. A critical systematic review is reviewing the literature to obtain meaningful results and conclusions. Data collection techniques through document analysis in the form of books, ebooks, and relevant articles related to exercise periodization. The data collection criteria are original research and literature review research. The databases used are scopus.com, web of Science, ScienceDirect, onlinelibrary.wiley.com, google scholar, springer.com, semanticscholar.org, Mdpi.com, lww.com, pubmed.ncbi.nlm.nih.gov. The keywords for searching the literature are "exercise periodization, linear periodization, nonlinear periodization, block periodization, undulating periodization, classical periodization, and traditional periodization of various sports".

RESULTS

Based on the analysis of documents through the screening stage, relevant articles were found as a result of discussing and concluding this literature study. To be clearer, the data is presented in the table below as follows:

Table 1. The results of 18 documents in the form of original articles and review literature

No	Nama Penulis	Judul
1	(González-Ravé et al., 2022)	Reverse periodization for improving sports performance: a systematic review.
2	(Fisher & Csapo, 2021)	Periodization and Programming in Sports
3	(Mujika et al., 2018)	An integrated, multifactorial approach to periodization for optimal performance in individual and team sports. International journal of sports physiology and performance,
4	(Marques Junior, 2020)	Periodization models used in the current sport
5	(Stone et al., 2021)	Periodization and block periodization in sports: emphasis on strength-power training—a provocative and challenging narrative
6	(Jos Afonso et al., 2020)	Towards a de facto Nonlinear Periodization : Extending Nonlinearity from Programming to Periodizing
7	(Ernandes et al., 2012)	Comparison Between Nonlinear And Linear Periodized Resistance Training: Hypertrophic And Strength Effects
8	(Yu et al., 2014)	Effects of combined linear and nonlinear periodic training on physical fitness and competition times in finswimmers
9	(Fleck, 2011)	non-linear periodization for general fitness & athletes
10	(Pitta et al., 2019)	Comparison of the Effects of Linear and Non-Linear Resistance Training Periodization on Morphofunctional Capacity of Subjects with Different Fitness Levels: A Systematic Review
11	(Kraemer et al., 2015)	Nonlinear periodization: Insights for use in collegiate and professional American football resistance training programs
12	(Loturco & Nakamura, 2016)	Training periodization: an obsolete methodology?
13	(José Afonso et al., 2019)	A Systematic Review of Meta-Analyses Comparing Periodized and Non-periodized
14	(Kataoka et al., 2021)	Periodization: Variation in the Definition and Discrepancies in Study Design
15	(Kiely, 2018)	Periodization Theory: Confronting an Inconvenient Truth
16	(Suchomel et al., 2021)	Training for Muscular Strength: Methods for Monitoring and Adjusting Training Intensity
17	(Cunanan et al., 2018)	The General Adaptation Syndrome: A Foundation for the Concept of Periodization
18	(Haff & Triplett, 2016)	Essentials of Strength Training and Conditioning, 4th Edition

DISCUSSION

The terms linear and nonlinear in periodization and exercise programs are an interesting study. Various literature that has been read related to the term periodization, linear and nonlinear terms still occur inconsistently, so the author is intrigued to study more deeply related to this. Mujika gave a concept that periodization to optimize training performance must be integrated, resulting in a recovery periodization, dietary periodization, psychological periodization, skill periodization and training periodization (Mujika et al., 2018). In addition, Loturco and Nakamura discussed the concept of training periodization stating that the studies compiled have not been able to resolve the debate and controversy of the conceptual periodization (Loturco & Nakamura, 2016).

The concept of periodization originated with Matveyev to monitor Soviet athletes to prepare for the 1952-1966 Olympics (González-Ravé et al., 2022). However, Mujika's study of Matveyev's concept of periodization has long been unacceptable to the present concept, and there is a "cardinal error" that certainly loosens the theoretical and practical concept of periodization of training (Mujika et al., 2018). Kiely's study followed by Mujika on the concept of present-day periodization has the opportunity to improve the concept of exercise periodization with present-day knowledge scientifically and progressively implemented (Mujika et al., 2018). In line with other studies, philosophical periodization with the current stress theory provides an opportunity to improve exercise plans and provide scientific studies and implementation progressively (Kiely, 2018).

The concept of periodization today has the characteristics of regulating individual training loads with physiological adaptation monitoring, specific motor capacity training as the main modality, the use of gradual change time and the effects of exercise as a benchmark for determining training sessions, paying more attention to details related to training techniques and tactics that have a high risk of injury (Marques Junior, 2020). An important point in the application of training periodization is rest management and recovery (Kraemer et al., 2015). For example understanding the techniques and mechanisms of stress in physiology (tissue damage, adrenal stress, mental fatigue), is very important in team sports as well as in individuals (Kraemer et al., 2015)

The concept of periodization is the macro management of a planned annual exercise program (González-Ravé et al., 2022). Periodization is a micro arrangement of timelines, and fitness periods and is cyclical (Stone et al., 2021). Then programming is concerned with setting the dose of exercise and selecting the type of exercise (Stone et al., 2021). While other studies state

that periodization is the division of exercise programs into more systematically focused periods, structured to maximize key competition and long-term development (Fisher & Csapo, 2021).

In addition, the terms linear and non-linear periodization appeared. While other studies state that exercise periodization there are several models, namely traditional, block, and inverted (González-Ravé et al., 2022). A study of reverse periodization applied to swimming sports to determine physical performance, with the results that reverse periodization is no more effective than other periodizations to improve physical performance (González-Ravé et al., 2022). In conclusion, reverse periodization needs a comprehensive study and increased experimental research (González-Ravé et al., 2022).

The study used inclusion criteria, one of which involved at least 8 weeks of intervention. This means that the treatment is carried out for 2 months, while the concept of exercise periodization is the management of the entire exercise and certainly takes not only 2 months. In line with recent studies that periodization there is a thorough planning for macro management (Jos Afonso et al., 2020). Yet other concepts have emerged with the terms linear and nonlinear periodization. This needs special attention so that there are no misconceptions that result in errors (Jos Afonso et al., 2020)

The concept of linear periodization is applied in a relatively high and low-intensity exercise volume at the beginning of exercise, then gradually through a certain cycle the volume will decrease and the intensity increases (Ernandes et al., 2012). The concept of nonlinear periodization is the regulation of intensity and volume more frequently from one session to the next (Ernandes et al., 2012). Ernandes et al compared linear and nonlinear periodization using the treatment for 12 weeks with the results of both improving physical ability (Ernandes et al., 2012).

The study further states that linear training is a traditional method to gradually increase muscle strength by setting the intensity of low-volume and high-intensity or low-intensity high-volume exercise on a specific schedule (Yu et al., 2014). Nonlinear training is a method that regulates intensity and volume on a weekly basis (Yu et al., 2014). Yu et al's study used a combination of linear and nonlinear periodically conducted for 12 weeks with the results of improving the physical fitness of swimmers (Yu et al., 2014)

Other evidence states that periodization is a long-term program, the periodization model that is often encountered is classical, linear, or traditional with a high volume setting at the beginning of the periodization and intensity increases progressively in each phase, or intensity increases sequentially by reducing the volume of exercise to about four weeks (Fleck, 2011; Pitta et al., 2019).

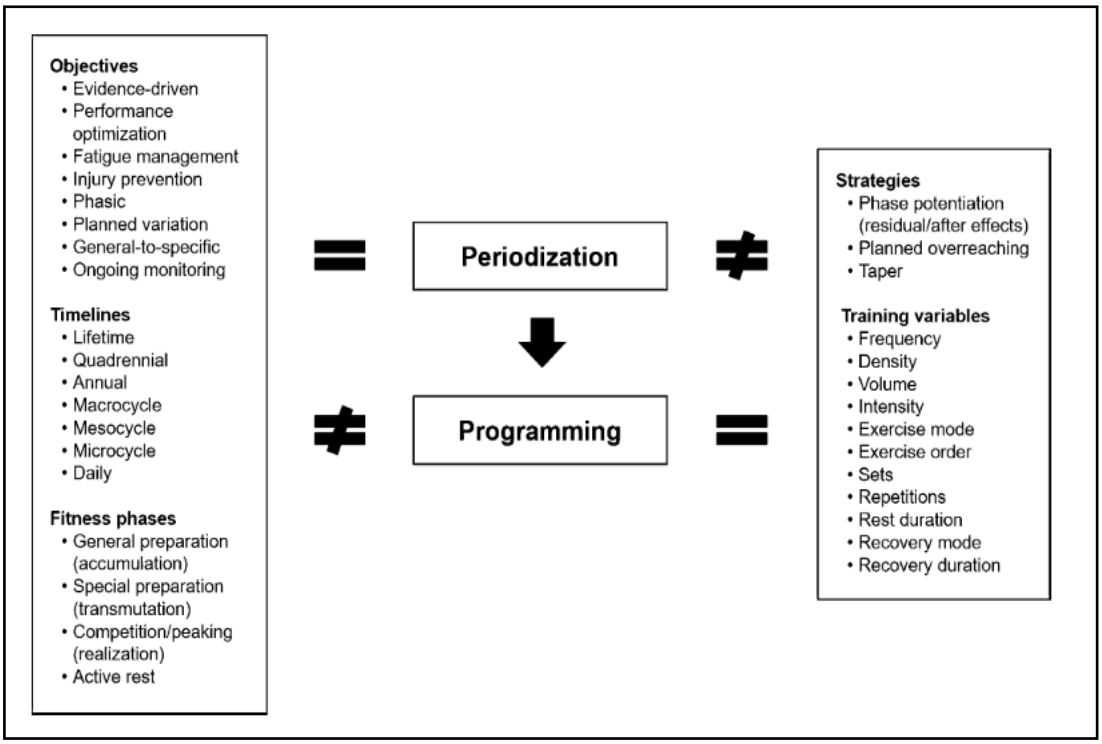
Nonlinear periodization, intensity, and volume settings are changed more often, besides nonlinear can be called daily periodization (Fleck, 2011; Pitta et al., 2019).

Traditional periodization is also called linear periodization because of the gradual increase in the intensity of the mesocycle, but it is also mentioned that linear periodization contains nonlinear periodization in the regulation of intensity and volume of exercise (Haff & Triplett, 2016). In addition, nonlinear periodization is more suitable to be called undulating and undulating periodization on a daily basis, this concept can be interpreted as nonlinear because the rise and fall of the load is often done(Haff & Triplett, 2016)

Ernandes et al above use the terms linear and nonlinear periodization carried out for only 12 weeks. This is not in line with the philosophy of periodization, which is to carry out macro exercise management. That is, when using the term periodization, the carried out must include the whole. While the research from Yu et al used linear and nonlinear training. The author agrees with Haff & Triplett's statement that linear periodization contains nonlinear elements and variations because there are intensity and volume settings very often, but the author disagrees when the concept is defined by periodization because previous studies also stated so.

The author agrees more when linear and nonlinear as exercise programming and in the exercise program there is a regulation of the exercise load. In line with the scientific evidence from Suchomel et al that linear loading with guidelines to increase exercise load progressively related to intensity and volume(Suchomel et al., 2021). In addition, linear loads can only be used with short mesos or micro, when linear loads are carried out over long periods of time or extended from months and years will cause negatives on the athlete's ability such as stagnant performance (Suchomel et al., 2021).

Programming is a micro-management concept. This includes exercise variables such as training load density, exercise sequence, and variety, volume settings including sets, reps, and frequency and intensity settings (Cunanan et al., 2018; Suchomel et al., 2021). Therefore, the essence of programming is to set the appropriate training factors to manage fatigue and maximize long-term adaptation (Cunanan et al., 2018). Kataoka et al also support this point that periodization is the description of macro concepts in the context of annual plans and programming is more about micro concepts and practice sessions (Figure 1) (Kataoka et al., 2021).



Picture 1. Basic Concepts of Training Periodization and Programming (Cunanan et al., 2018)

. In a review of some of the literature, the author can understand that exercise periodization is a macro management and organization that considers nutrition and recovery well. Classical periodization or often referred to as traditional periodization which is often applied contains training programs with nonlinear training loads while undulating and nonlinear periodizations are different things by definition so undulating periodization is an annual periodization in which the periodization contains programming nonlinearly because changes can be made in micro cycles and training sessions.

Then the linear concept is programming with load management that is carried out progressively in the short term and should not be used in the long term so it will cause overtraining. In line with previous studies that the concept of programming linearly became the initial concept in compiling the exercise periodization (Jos Afonso et al., 2020). Research that discusses long-term exercise periodization with a competitive and homogeneous sample of athletes is still minimally revealed as a research topic (Jos Afonso et al., 2020), Only a study related to short-term effects such as linear and nonlinear comparisons was found and even then it was still not appropriate regarding the application of the term. An experimental study is needed to see the effects of macro or meso exercise. Finally, hopefully, this analysis will provide an understanding of the terms

periodization of training and programming in a linear and nonlinear manner, especially in the realm of performance sports

CONCLUSIONS

Based on the results of the critical literature review that has been described, the author can conclude that the definition of periodization training is macro management or organization by considering elements of good nutrition and recovery. In addition, linear and nonlinear programming in which there is a training load related to volume and intensity regulation. Explicitly linear is programming progressively with volume and intensity settings but this programming can only be applied in the short term so as not to occur stagnant ability and overtraining, While nonlinear is programming with intensity and volume settings that are done more often in every meso and micro. Therefore the hope is to provide benefits for practitioners, coaches, athletes, and researchers next. However, it is important to note the limitations of this paper, limitations are that the inclusion criteria for literature selection are not mentioned, and the literature used is relatively small so it cannot generalize the results well. Research methods are less comprehensive, data analysis techniques are just synthesizing and evaluating. Further research is expected to improve this research to make it more perfect.

Conflict of Interest

All authors state there is no conflict of interest.

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