Volume 29, Number 4, pages 10–17

Keywords: linear; nonlinear; undulating; wave-like; accumulation; intensification

Cycle-Length Variants in Periodized Strength/Power Training

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summary

This article outlines different cycle-length variants used in periodized strength/power training.

Introduction

When designing resistance-training programs, the strength coach has to consider a number of variables that can be manipulated to make programs different. These include choosing (a) the exercise, (b) the repetitions, (c) the sets, (d) the resistance, (e) the speed of performing the exercise, (f) the order of exercises, and (g) the rest periods between sets and exercises (6). The Australian Strength and Conditioning Association (ASCA) also accepts that coaches may choose to use a particular, specific variant of periodization (known also as a pattern, plan, strategy, method, or model of periodization) for a training cycle (1). While there are similarities between these different variants of periodized training, the ASCA recognizes that some coaches prefer to use certain variants for certain athletes (e.g., novices vs. experienced trainers) or periods of the training year (preparation period vs. competitive period). This approach of choosing a particular variant or method for periodized strength training, popular in Australia, was largely influenced by Poliquin (39, 40) and others (2, 13–16, 25) over the past 15 years. The purpose of this article is to outline some of the particular variants of cycles within a periodized training structure that a coach may choose from when designing a cycle-length strength/power-training program.

Brief History of Periodization

For the purpose of this article, periodization of training is defined as the methodical planning and structuring of training aimed at bringing or keeping an athlete at peak sports performance. Athletes have used periodization of training since ancient times. For example some ancient Greek athletes chose to use a specific 4-day training cycle, known as the tetrad, which included daily variations in volume, intensity, and technical work (49). The concept of general and competitive training periods also seems to have been adopted by these athletes when training for the ancient Olympics or other important sports festivals (49). However, in the sports science and training literature, interest in the concept of training periodization in more modern times has been attributed to the work of the Soviet Matveyev (e.g., 30). Earlier authoritative Soviet weightlifting coaches and authors stated the need for training variation to occur throughout different training timeframes (e.g., weekly, monthly, and multi-monthly timeframes) (31, 32, 50). Different authors have differing definitions for terms used in periodized training, so to avoid confusion regarding the terms micro-, meso-, or macro-cycle, for the purposes of this article, the terms week, block, or cycle will be used to denote the different timeframes typically referred to in periodized training. While the usual definition of "week" should suffice, it must also be noted that training weeks can vary in length (e.g., 4–10 days) in some sports; the tetrad mentioned above is a prime example of a nonstandard training week. A "block" (sometimes known as a mesocycle) may be 2–5 weeks in length and a training cycle (sometimes known as a macrocycle), is the sum of a number of blocks (or mesocycles) (30, 31, 50). The training cycle, which may typically consist of 2–4 blocks of training (e.g., initially described as being hypertrophy, general strength and maximal strength blocks) (2, 23, 36–44, 46, 47), is the time frame of concern in this article.

Table 1
Nine Methods for Altering Training Load and Difficulty Within a Training Week

Method of variation	Day 1 example	Day 2 example
1. Same exercises and other variables, increase repetitions, and decrease resistance	Squat 3 × 10 at 70 kg	Squat 3 × 15 at 60 kg
2. Same exercises and other variables, increase or decrease the number of sets.	Squat 4 × 10 at 70 kg	Squat 2 × 10 at 70 kg
3. Same exercises, sets, and repetitions, reduce the lifting speed and resistance.	Squat 3 × 10 at 70 kg	Squat 3 × 10 at 50 kg (4 s/rep)
4. Same exercises and other variables, decrease rest periods and resistance	Squat 3 × 10 at 70 kg (3min/rest)	Squat 3 × 10 at 50 kg (1min/rest)
5. Same exercises and other variables, decrease resistance.	Squat 3 × 5 at 100 kg	Squat 3 × 5 at 80 kg
6. Same exercises and other variables, decrease repetitions.	Squat 3 × 5 at 100 kg	Squat 3 × 2 at 100 kg
7. Different strength exercises, but same for all other variables (same %1RM).	Squat 3 × 10 at 70 kg	Front squat 3 × 10 at 55 kg
8. Perform a strength and power version of aligned exercises on different days.	Squat 3 × 5 at 100 kg	Jump squat 3 × 5 at 50 kg
9. Perform heavier and lighter versions of aligned power exercises on different days.	Power clean 3 × 5 at 75 kg	Power snatch 3 × 5 at 60 kg

1RM = 1 repetition maximum.

Soviet and other former eastern bloc coaches and authors (30, 31, 50) were the main sources of information on the concept of strength training periodization until the pioneering work of Stone and colleagues introduced periodization of strength training to western literature in the early to mid-1980s (42–44). Since that time, the concept of periodization has undergone considerable study, with consequent debate concerning methods and effectiveness (7–25, 36–48, 51–53).

Wilks (52) believes the debate concerning the effectiveness of periodization (17, 19, 45, 53) can largely be attributed to the patterns or variants of periodization used, the amount of variation inherent in each model (e.g., 12, 20 vs. 21, 36, 41–44), as well as the experience of the athlete and length of the study. Therefore, rather than use a generic term, such as "periodized strength training," coaches and researchers in the future may wish to specify which variant or pattern of periodization of strength training was implemented.

Different Cycle-Length Variants or Patterns of Periodized Strength Training

While the ability to vary training sessions within a week by utilizing methods such as those outlined in Table 1 appear well known to most coaches, descriptions of different cycle-length variants of periodized strength training appear less frequently in North American literature. The ASCA has outlined a number of different cycle-length (e.g., 6–16+ weeks) variants of periodization that a strength coach may choose from, which have been identified from the literature and from analysis of current practices throughout the world (1, 2, 16, 18, 34, 37–44, 46, 47). A few examples of these variants are described in Tables 2–3. The nomenclature the ASCA uses, which is based upon the method of intensification, has been a source of some debate and concern in the National Strength and Conditioning Association (17, 22–24, 28, 29, 46, 47, 52, 53). Poliquin (40) first proposed that a training cycle whereby the intensity (% 1 repetition maximum [1RM]) is increased each week of the cycle should be designated as a linear method of intensification (see the first two examples in Table 2). This classification of "linear" is made irrespective of the fact that intensity, volume, (training impulse), workload, etc. may be manipulated in a nonlinear manner within the week by methods such as those outlined in Table 1 (e.g., heavy intensity or light intensity days, high- or low-load–volume days, etc.). "Nonlinear" intensification entails not increasing training resistances each and every week of the training cycle (e.g., with heavier and lighter weeks in intensity at certain weeks in the cycle) (1–4, 11,

Table 2
Different Variants or Patterns of Strength Training Periodization Applicable to a Primary Strength Exercise over a 12-Week Period

Week	Sets × Reps %1RM											
	1	2	3	4	5	6	7	8	9	10	11	12
Subtle linear	3×13 63%	3×12 66%	3×11 69%	3×10 72%	3×9 75%	3×8 78%	3×7 81%	3×6 84%	3×5 87%	3×4 90%	3×3 93%	3×2 96%
Block with linear intensification	4×10 60%	4×10 64%	4×10 68%	4×10 70%	4×5 78%	4×5 81%	4×5 83%	4×5 85%	3×3 88%	3×3 90%	3×3 92%	3×3 94%
Block with nonlinear intensification	4×10 64%	4×10 68%	4×10 70%	4×10 66%	4×5 80%	4×5 83%	4×5 85%	4×5 75%	3×3 90%	3×3 92%	3×3 94%	3×3 80%
Undulating	4×10 64%	4×10 68%	4×6 76%	4×6 80%	4×8 72%	4×8 76%	4×4 84%	4×4 88%	3×6 82%	3×6 85%	3×3 92%	3×3 94%
Wave-like	4×10 64%	4×8 70%	4×6 76%	4×4 82%	4×9 70%	4×7 76%	4×5 82%	4×3 88%	3×8 78%	3×6 84%	3×4 90%	3×3 94%
Accumulation/ intensification*	6×3 80%	6×4 80%	6×5 80%	6×6 80%	5×5 85%	4×4 90%	3×3 95%	2×2 100%	–	–	–	–

Note: Assume the athlete increases strength by 3–5% across the 12-week period. The accumulation/intensification* pattern typically follows only an 8-week cycle; however, some initial higher repetition training may precede this type of cycle. 1RM = 1 repetition maximum.

13–15, 25, 39–43). For the purposes of this article, if a variant does not entail increasing % 1 repetion maximum (1RM) or resistance each week, then it is not a linear intensification variant (1, 2, 16–18). This can be clearly seen in the two examples of variants of block periodization provided in Table 3, which are distinguished by either linear or nonlinear intensification across 12 weeks. Figure 1 illustrates graphically differences between linear and nonlinear intensification (subtle linear, block [nonlinear], wave-like, and undulating periodized variants), while Figure 2 provides a more comparative example of training impulse (repetition-volume × relative intensity, %1RM) between the subtle linear, block (linear intensification), block (nonlinear intensification), and wave-like periodized variants. When using this method of description, it should be noted that it is the method of intensification across the length of the cycle that is being refered to, not the progression across the overall training year. A training year may contain a number of cycles such that overall the yearly progression

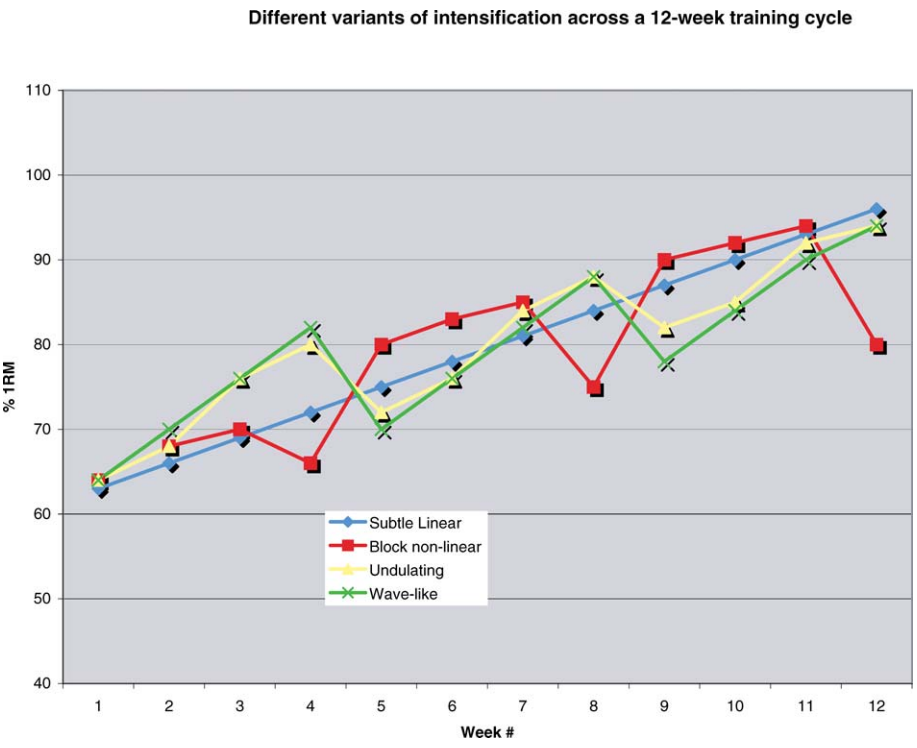

Figure 1. Graphic display of differences in the method of intensification (% 1 repetition maximum [1RM]) across a 12-week cycle between a subtle linear, block (nonlinear), wave-like, and undulating periodized variants outlined in Table 2.

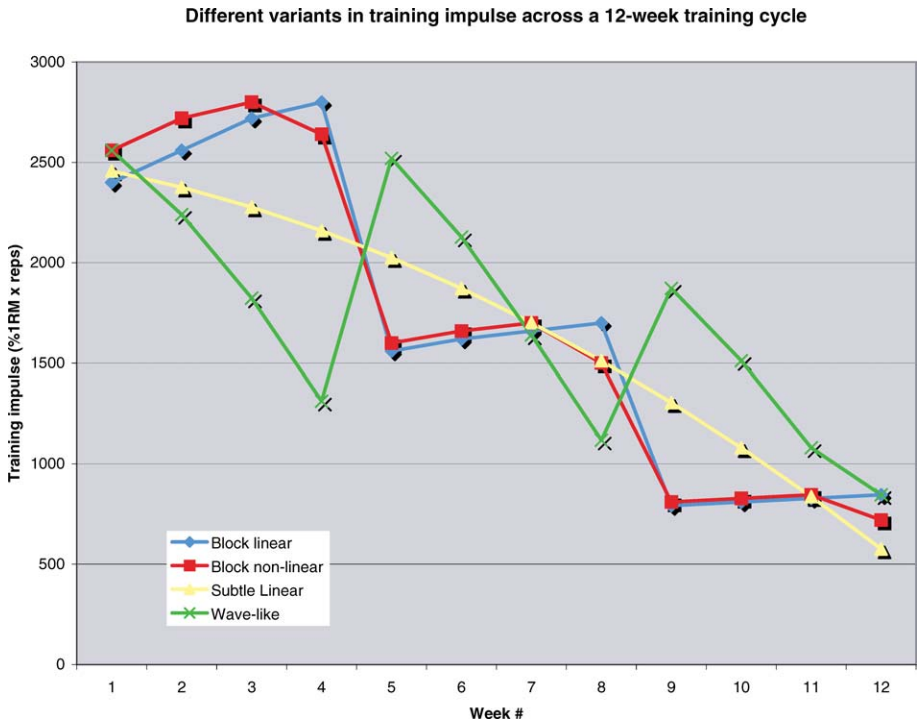

Figure 2. Graphic display of differences in training impulse (total repetitions per exercise × %1 repetition maximum [1RM] relative intensity) across a 12-week cycle between the subtle linear, block (linear intensification), block (nonlinear intensification), and wave-like periodized variants outlined in Table 2. Note the subtle linear pattern entails a straight decline in training impulse across the 12 weeks as compared to the more varied patterns for the other methods.

is clearly nonlinear, but this does not affect the description of the cycle-length pattern of progression.

By looking at week 3 from each of the specific variants in Tables 2 and 3, it can be seen that there are different prescriptions of sets, repetitions and resistances, despite all being examples of periodized strength training. Great diversity exists in periodized strength training, and coaches may wish to choose the variant(s) that they feel most appropriate to their circumstances (level of the athlete, period of the year, etc.).

Comparisons Between Different Cycle-Length Patterns of Progression

A paucity of data exists concerning comparisons upon the effects of different cycle-length patterns of progression as most research has tended to compare some form of periodized training to nonperiodized training (36, 42–44) or to preintervention data (i.e., comparing pre- and post-training scores in muscular functioning in response to a specific periodized training pattern) (3, 4, 7–9). Baker et al. (12) found that a block pattern with linear progression and an undulatory pattern of progression (changing repetition demands after every 2 weeks) provided similar benefits in maximal strength across 12 weeks. Rhea et al. (41) found that a program that alternated training volumes and intensities within a week was more effective than a block method with linear intensification and no within-week variation. No other data has been found that directly compares different progression patterns of cycle-length periodized strength training in order to gauge the relative effectiveness of one pattern against another.

Possible Reasons for a Lack of Comparative Data

Given that resistance-training objectives can vary for different athletes (e.g., hypertrophy of muscle, maximal power, absolute strength are different objectives requiring somewhat different training prescriptions), it is not known why research into the relative merits of different patterns of periodized progression has been so limited. The references contain many articles outlining debate and theory concerning periodization but it appears little of this theory has been tested, unless against nonperiodized training. It is of interest to note that Stone et al. (48) stated that the demise of sport science in the United States is in part attributable to Institutional Review Boards and academics not being "conceptually familiar with sports science." This then reduces what they call "monitoring studies," examples of which would be the analysis of the effects of different periodized variants/patterns of progression upon muscular functioning and sports performance. They also state that "politically correct" views of the academics may partly regulate research away from studies that investigate sports performance, to which comparative periodized strength-training studies belong. For whatever reason, the level of research regarding the merits of different periodization variants/patterns has not equated with the overall theoretical literature on periodization.

When and Why a Coach May Choose Different Cycle-Length Variants of Periodized Strength/Power Training

Given these deficiencies in the literature, the ASCA has made some generalizations regarding when and why a coach may choose different cycle-length variants of periodized strength/power training. These generalizations have

Table 3
In-Season Model of Periodization Using Wave-Like Variants According to Exercise Classification as Primary Strength or Power or Assistant Strength or Power Exercises (7, 10)

Week	Sets × Reps %1RM							
	1	2	3	4	5	6	7	8
Primary strength (SQ, BP, PU)	3 × 8 66%	8-6-5 66-72-77%	6-5-3 72-77-82%	5-3-2 77-82-87%	8-6-5 70-75-80%	6-5-3 75-80-85%	5-3-2 80-85-90%	2-1-1 85-90-95%
Assistant strength	2 × 10 65%	2 × 8 70%	2 × 6 75%	2 × 5 80%	2 × 8 75%	2 × 6 80%	2 × 5 85%	2 × 5 87%
Core power (PC, J, BT JS)	3 × 5 65%	3 × 5 70%	5-4-3 70-75-80%	4-3-2 75-80-85%	3 × 5 75%	5-4-3 75-80-85%	4-3-2 80-85-90%	3-2-2 85-90-95%
Assistant power	3 × 6 65%	3 × 6 70%	3 × 5 75%	3 × 4 80%	3 × 6 75%	3 × 5 80%	3 × 4 85%	3 × 3 90%

Note: For squats, reduce intensity by about 10% 1 repetition maximum (1RM) (third set may be optional for squats). Assistant strength and power exercises can be performed for 2 or 3 sets. Assistant power exercises include pull variations (e.g., pulls to waist, high pulls, power shrugs), push press and power press/throwing variations, loaded jumping exercises, etc. 1RM = 1 repetition maximum strength, BP = bench press, PU = pull-ups, SQ = squats, PC = power clean from hang, J = jerks, JS = jump squats, BT = bench throws.

been made mainly based upon the practical experiences of their elite coaches aligned with findings from the literature where possible.

Subtle Linear-Intensification Patterns of Progression

As these types of variants are characterized by fairly equivalent and small regular increments in training intensity each week (e.g., by ≤5% 1RM each week), it is thought that these types of variants may be suited to novice and less-experienced athletes who have not performed much periodized resistance training (1, 2, 13, 51, 52). This is due to the fact that other variants are characterized by more pronounced alterations in intensity that may not be as easily managed by less-experienced athletes whose exercise technique may deteriorate under such situations (1, 6, 37). Hence, the subtle variations in intensity (and workload) enable a more stable technique acquisition/refinement environment (37). Consequently these types of models may be best suited for lower-level or less-experienced athletes, irrespective of the training period (preparation or competitive period) (1, 6).

Block or Step Patterns of Progression

The block or step patterns generally entail a training cycle being divided into 3 steps of repetition and intensity demands, each respectively signifying a hypertrophy block (a traditional term, though now this block may also be referred to as a consolidated strength-endurance block or muscle training block), basic strength/power block, and peak-strength/power block (1, 2, 13, 22–24, 28, 29, 36–38, 41–44, 46, 47). As detailed in Table 2, the intensity progression could be linear or nonlinear. As compared to subtle linear progressions, sharper drops in volume and rises in intensity when changing blocks characterize the block variants. These pronounced changes in volume and intensity may provide a beneficial stimulatory shock to experienced athletes and allow for a delayed training effect (42, 43, 51), but the pronounced intensity changes may be too severe for less-experienced athletes to cope with (physiologically and exercise technique-wise) (6, 37). Consequently, the ASCA has recommended that these variants are generally recommended for use with more experienced athletes who possess stable-exercise technique and predictable strength levels and who seem to benefit from the marked variation inherent in these models (1). These types of variants can be seen as a progression from the subtle linear variants (1). Aside from competitive lifters, the block variants are generally used for the preparation period as high-volume blocks of strength training are often not compatible with in-season training in a number of sports (1). The coach will also need to choose a linear or a nonlinear intensity progression when implementing this variant.

Undulatory Patterns of Progression

The undulatory variant in Table 2 is characterized by 2-week changes in repetition demands and concomitant alterations in intensity, which sees an undulatory progression in intensity as training reverts from lower-intensity 2-week phases to higher-intensity 2-week phases back and forth throughout the cycle (12, 39). It is not to be confused with simple within-week undulation of training (41) (see Table 1).

These changes that typically occur after a 2-week timeframe are generally greater (in workload, intensification) than for subtle linear methods but less pronounced that block variants. Accordingly, this type of variant may be beneficial as a progression for athletes who have habituated to subtle linear methods of intensity progression or for athletes who favor alternating 2-week phases of hypertrophy-oriented (e.g., 3–4 sets × 8–12 repetitions) training with 2-week phases of general strength training (3–4 sets × 4–6 repetitions) on a continual basis.

Wave-Like Patterns of Progression

The distinguishing difference between the undulatory and wave-like variants is the number of weeks that contain the variation. If the repetitions do not change until after every 2-weeks, then it is an undulatory model, as compared to every week for a true wave-like model used by a nonlifter (1). This means that there are fewer variations in volume, intensity, and load-volume in an undulatory pattern as compared to a wave-like pattern.

Wave-like patterns derive from the sport of weightlifting, where earlier Soviet coaches advised that weekly volume-load should be presented in a wave-like fashion over a month (e.g., the monthly 100% total is distributed 35–36%, 26–28%, 21–23%, and 13–18% per week, or 42–44%, 32–33%, 22–26% for a 3-week month) (11, 31, 32, 50). Even the order that each of these weekly workloads is to be presented is not constant, and the earlier Soviet coaches provided examples of different orders that the workloads could be presented (11, 31, 32, 50). Again, the coach has to choose which workload order of the wave (i.e., which variation of the wave-like pattern) would best suit their lifters (31, 32, 50).

The wave-like patterns have been adapted for use by nonlifters by mainly using the number of repetitions per set to alter weekly volume-load (2–4, 10, 40), although additional sets can obviously affect volume-load (34). In a basic wave-like pattern, the repetitions decrease weekly (with concomitant rises in intensity) for 3–4 weeks, whereby the general pattern is then repeated but at slightly higher intensities/lower repetitions as the athlete comes to the peaking phase (2–4, 7–10, 25, 34, 40). A number of studies show that the wave-like variants are effective in maintaining or even increasing strength and power in both elite and moderately experienced athletes during long in-season periods (3, 7, 9), though case studies also reported good results with its use in during-preparation periods (3, 4, 40).

Accumulation/Intensification Patterns of Progression

Many introductory resistance-training programs can be loosely defined as, or based upon, the processes of accumulation/intensification. For example, an athlete may be prescribed a resistance they can lift for 3 × 10 repetitions, and they do not increase the resistance (intensify training) until they have managed to perform 3 × 12 repetitions (i.e., they have accumulated volume) with that constant resistance. Therefore, these types of introductory programs are based upon the athlete accumulating training volume (volume load) at a steady or designated resistance before training resistances are increased and the volume is reduced (intensification). This most basic type of accumulation/intensification used by beginners (e.g., continually training within a narrow specified range of repetitions such as 3 × 10–12, etc.) does not really embrace the concept of periodization and is not to be considered a periodized variant.

Table 2 details a certain example of the accumulation/intensification pattern that is a distinct cycle-length periodized variant. This program may be more familiar to coaches as the "Russian squat cycle" (although it was actually developed in the now separate country of Belarus) and was taken from the sport of weightlifting (54). The original proponents stated that this particular variant was best suited to increasing maximal squat strength during the preparation period, presumably due to the high workloads involved (54). Clearly this variant of accumulation/intensification was designed for competitive lifters and advanced athletes and may be less applicable to the vast majority of athletes or exercises due to its high intensities and workloads (1). However, modifications such as more moderate volumes and intensities (e.g., accumulation × week 1 = 70%/3×9, week 2 = 70%/3×10, week 3 = 70%/3×11, week 4 = 70%/3×12; intensification × week 5 = 80%/3×7, week 6 = 84%/3×6, week 7 = 88/3×5, week 8 = 92%/3×4) may make it more suitable to a wider range of athletes to use.

Integrating Different Models?

As described above, choosing a specific cycle-length variant/pattern of periodization may entail choosing a designated training variable configuration. Coaches may find that some variants/patterns work well with certain athletes (e.g., novice athletes and subtle linear-intensification patterns of progression) or certain times of the year (e.g., wave-like patterns and in-season periods). Another method is to prescribe patterns according to exercise classification. For example, Australian National Team Powerlifting Coach Wilks proposed a block variant with linear intensity progressions for the 3 key powerlifts (but with large within-week variation in %1RM resistance and hence workload) and an undulatory approach for the assistance exercises (alternating between sets of 10 or sets of 6 repetitions every 2–3 weeks) (51). Baker and Newton reported changes in upper body strength and power for elite, professional strength-power athletes across a 4-year period, using different periodized training variants according to times of the year and exercise classifications (10).

Accordingly a coach may ascribe to a philosophy of variant choice being determined by exercise classification, the training age/state of the athletes involved as well as the training period (general or competitive periods). The overall periodized structure may reflect the integration of a number of different cycle-length variants.

Conclusions

Coaches can choose a cycle-length variant or pattern of presenting overload that largely determines the sets, repetitions, relative intensity, and so on to be used during each week of the cycle. Little consideration has been given to the effects that different variants or patterns of progression of periodized overload have upon strength, power, size, and so on for different levels of athletes at different times of the training year. Hopefully this presentation of different variants of cycle-length periodized overload may provoke further research by academics or experimentation by coaches in a bid to determine the relative merits of this type of cycle-length training variation. ♦

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