Classification and Determination Model of Resistance Training Status

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ABSTRACT

An individual's training status is a key factor used to determine the volume, the intensity, and the selection of exercises for resistance training prescription. Interestingly, there are no objective parameters to assess training status, so there is ambiguity in determining the appropriate volume and other resistance training variables in this regard. Thus, the objective of this study was to propose a strategy for classification and determination of resistance training status. The following five parameters were identified and used: (a) current uninterrupted training time, (b) time of detraining, (c) previous training experience, (d) exercise technique, and (e) strength level. Moreover, 4 classification levels are proposed: beginner, intermediate, advanced, and highly advanced, which are determined by the mean score of the parameters used. The proposed model represents an important advancement in training status classification and can be used as a valid tool for training prescription and for researchers to better characterize a sample and reproduce results under the same conditions in future studies.

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INTRODUCTION

An important principle of resistance training is the progressive overload, which is defined as a progressive increase in training stimulus to promote positive responses in accordance with the desired training goals (40). As an individual becomes an advanced practitioner, a greater training stimulus, or dose, is necessary. The dose of resistance training is frequently determined by variables that make up the prescription, such as the number of sets, intensity, and frequency, among others (1,58). In addition, in the process of exercise prescription, recommendations suggest considering individual training status (1,34). The literature presents many investigations showing that the status of training affects the adaptative responses to resistance training, whereby untrained individuals are more responsive to regimented exercise (2,37,51). Moreover, Latella et al. (37) reported that, even in well-trained powerlifters, the strongest athletes showed a lower rate of strength improvement compared with those with lower strength levels. These different adaptations may be related to the alterations in anabolic intracellular signaling, muscular protein synthesis, and transcriptional responses (13,15,25,69). A recent study by Bagley et al. (6) found that the same acute resistance exercise can generate different epigenetic responses in resistance-trained and sedentary individuals, supporting the need for differential training stimuli based on subject training status.

Therefore, considering that the starting level seems to have a considerable influence on the rate of gains over time, the knowledge of the training status level may improve the ability to prescribe resistance training and to compare muscular adaptations in individuals with different training status. The American College of Sports Medicine (ACSM) recommendation (1) suggests that variables such as volume and intensity need to be applied differently according to practitioners' levels of training. Moreover, the training progression may be conducted as the practitioner gains experience (57). Furthermore, De Souza et al. (18) observed different patterns in muscular adaptations in untrained individuals, where the load variation was more

KEY WORDS:
resistance training; training status; strength; hypertrophy

effective for promoting hypertrophy after the first stage of a training program. In addition, retraining is quite a common situation in practice; thus, the subject's classification may improve the accuracy of knowing the detraining status of a practitioner. However, interestingly, there are no objective parameters to determine an individual's training status, and the estimation of points at which the individual may change their classification levels (beginner, intermediate, advanced, and highly advanced) is not well defined (11).

Some authors consider the time that the individual has consistently practiced the activity, with beginners varying from no experience up to 2 months of training, intermediate from 2 to 6 months, and advanced with at least 1 year of training (34). Another method is to consider the strength level, such as performing the bench press exercise with 120% of body mass and squat with 150% of body mass (72). Some authors have sought a complete classification and considered, in addition to the time of practice, the level of technical experience and frequency of training sessions (34). In addition, specificity also seems to be an essential factor because the individual can be physically active but not have resistance training experience (11).

The lack of consensus in determining resistance training status may lead to misclassification of individuals and ineffective exercise prescriptions. In this sense, an adequate classification and determination of training status are important for greater precision in exercise prescription, leading to safe and optimal results. In addition, the use of standardization in determining the training status of samples in scientific research can help in the execution of other studies to reproduce results under the same conditions. Thus, the objective of this article was to propose a strategy for decision making in the classification and determination of individual resistance training status. Key determinants of training status will be presented and discussed with the intent of improving the assignment of this variable in training prescription and scientific interventions.

CONSIDERED PARAMETERS

CURRENT UNINTERRUPTED TRAINING TIME

The time of training experience, counted in months and years, is probably the most used variable to classify individual training status (6,17,27,50,60,63), often being used as the only criterion. Over time, the ability of an individual to tolerate higher training volumes is enhanced and promotes continued adaptation (21,49). Conversely, lower loads, frequency, and sets are recommended for individuals with no resistance training experience. The ACSM recommends loads corresponding to 60–70% versus 80–100% of one repetition maximum (1RM) to maximize muscular strength for novice versus advanced individuals, respectively (1,23). Other studies also suggest that advanced individuals are closer to their strength potential and may require higher training frequencies versus beginners (16,68). However, using only the time of training experience might be insufficient and generate inaccurate classifications of training status because the quality of training may differ from individual to individual.

TIME OF DETRAINING

Interruption of a training period may be related to several causes such as illness, injury, vacations, lack of time, motivation, and other factors (29,42). The magnitude of muscle loss will depend on the period of detraining; short periods of interruption, such as 3 weeks, do not inhibit the improvements in cross-sectional area and 1RM (47). Intermediate detraining periods, such as 4 to 8 months, seem to promote regression in muscle adaptations, but not returning to baseline levels (53,64). Longer detraining periods, such as 1 year, tend to cause complete loss of muscle adaptations and functional performance to baseline levels (14).

PREVIOUS TRAINING EXPERIENCE

Skeletal muscle size seems to be regulated by the balance between anabolic and catabolic signaling pathways (59). For example, 8 weeks of training can bring about hypertrophic adaptations, but a succeeding 8-week period resulted in a 5% regression of gains (39). Despite this, studies have shown a rapid retraining process in individuals with previous training histories who undergo short periods of detraining (64,67), a phenomenon commonly known as muscle memory (28). Muscle memory has been attributed to neural connections established through the training process and muscle tissue mechanisms because the number of myonuclei acquired through training seems to be maintained during a subsequent period of disuse. This may contribute to faster reattainment of previously achieved adaptations when training experience is resumed because the myonuclei acquired by a training stimulus are preserved on detraining (10). Therefore, even if the individual is not training, consideration of previous training experience can help formulate an appropriate training prescription, assuming that reattainment of previous adaptations will occur faster than those who have never trained. Previously trained individuals would also still have muscle memory to reduce the time needed to learn exercises (8).

EXERCISE TECHNIQUE

The quality and efficiency of technique in exercise execution is a factor that can influence the successfulness of a 1RM attempt. Biomechanical anomalies such as greater peak forward barbell displacement, lower backward barbell velocities, and lower resultant acceleration angles can lead to an unsuccessful power clean 1RM attempt (33). Furthermore, proper exercise technique optimizes the safety and effectiveness of the training stimulus to the associated musculature (35).

A previous study (52) showed that novice individuals performed with less reliability across four 1RM tests in bench press and back squat (separated by 48–72 hours) versus advanced individuals. In novice individuals, rapid neural adaptations can improve posture and exercise execution, resulting in progressively greater 1RM values over successive test days. The practice and repetition of a given movement improves central control mechanisms in

the performance of the task (26). This favors the learning of motor skills and the reduction of movement error, enabling the execution of more fluid motor control over time (9). For this reason, individuals with more experience in resistance training are expected to have superior coordination of joint actions when executing complex lifting movements.

STRENGTH LEVEL

The maximal number of repetitions performed at a given intensity has not been established in the context of training status, albeit advanced trainers exhibit greater absolute strength (62). Several neural mechanisms are associated with increased strength in advanced trainees, such as increased motor unit recruitment, alterations in agonist-antagonist coactivation, increases in motor unit firing rates, and changes in descending drive to the motoneurons (19,22).

Although no position stand uses relative strength levels as a reference for determining training status, some studies have used this parameter for both upper-limb (24,71,72) and lower-limb movements (44,65,72). If used in conjunction with other information, such as current uninterrupted training time, the strength level may contribute to accurately classifying an individual's training status.

MODEL DESCRIPTION

CURRENT UNINTERRUPTED TRAINING TIME

Training status is usually divided into novice or beginner, intermediate, and advanced (1,34). Assuming that there are different sublevels of training among advanced individuals, we propose adding highly advanced as a new level. The current uninterrupted training time frames were based on the National Strength and Conditioning Association's (NSCA) recommendations (34), which considers beginners as having no experience up to 2 months of training, intermediate from 2 to 6 months (but we used from 2 to 12 months), and advanced with at least 12 months of training. We delimited advanced individuals up to 3 years and added a classification with at least 3 years of regular training for highly advanced individuals.

Taking into account that the term "athlete" commonly refers to sports competition (4), we chose the term "highly advanced" because individuals with a lot of experience fit that classification, regardless of whether they compete in athletics or not. Bodybuilders, weightlifters, and powerlifters with many years of resistance training experience, and by participating in recent competitions, can be classified as resistance-trained athletes. In these cases, this classification seems unnecessary.

Knowing that a novice individual in resistance training is different from an individual who has had some experience with the activity but has not trained for a certain time, we think it is more appropriate to add the time of detraining as a variable that influences the training status than creating a new classification as "inactive" or "untrained."

TIME OF DETRAINING

We based the classifications on the time at which the muscular adaptations previously induced by resistance training are maintained, the magnitude of the reduction of these adaptations, and the loss of the muscular adaptations from resistance training. Therefore, the detraining time at which the individual had not yet experienced a significant loss of muscle adaptations (i.e., up to one month) was assigned as highly advanced (4 points). The period in which the gains resulting from resistance training could have been reduced (between one and 4 months) was set as the score corresponding to advanced (3 points). To score the value corresponding to the intermediate level (2 points), we considered a period where more significant regression in muscle adaptations occur (4–8 months). To score the value corresponding to beginners (1 point), we considered a period where probably all muscular adaptations are lost (a period longer than 8 months).

PREVIOUS TRAINING EXPERIENCE

The previous training experience will be considered only if the individual has interrupted the training period for some reason in the past year. The references used for this variable were the same ones used for current uninterrupted training time, up to 2 months for beginners, from 2 to 12 months for intermediate, from 12 months to 3 years for advanced, and at least 3 years for highly advanced individuals.

EXERCISE TECHNIQUE

To classify exercise technique, a beginner was considered as having no technical mastery of the exercise, an intermediate was considered as having little technical mastery of the exercise, advanced was considered as having mastered most aspects of exercise technique, and highly advanced was considered as having mastered all aspects of the exercise technique according to standardized guidelines. For upper limbs, one exercise in the push pattern and one in the pull pattern must be selected (either horizontal or vertical movements). Different implements such as barbells, dumbbells, kettlebells, machines, or body weight can be used. For lower limbs, an exercise in the squat and one in the hip hinge pattern must be used (different implements and variations such as front bar, low bar, high bar squat, Romanian deadlift, sumo, or conventional deadlift can be used). When judging technique, the following must be observed: control and fluidity of the movement; stabilization, which is the ability to appropriately fix the lumbopelvic area (i.e., core) and exhibit appropriate postural alignment at the beginning and ending positions of the exercise (32); and the ability to rotate the involved joints through the full range of motion. To demonstrate exercise technique, the exercise should be performed with a low load, at intensity up to 50% of 1RM. Furthermore, no coaching cues should be given before or during the demonstration of exercises.

For the pushing exercises, the following points must be observed (43): (a) movement occurs in a fluid and controlled manner and a complete range of motion; (b) shoulders are held down away from the ears; and (c) head held centered and stable, spine curvatures

kept neutral, and hip, knee, and shoulders aligned. For the pulling exercises, the following criteria must be met (36,70): (a) movement occurs in a fluid and controlled manner and a complete range of motion; (b) shoulders are held down away from the ears; and (c) head held centered and stable, spine curvatures kept neutral, and movements in the trunk are avoided. For the squat pattern, the following criteria must be met (46): (a) hips are projected back and down in a controlled manner at a constant speed until the tops of the thighs are at least parallel to the ground; (b) the return to the start position occurs with shoulders and hips rising at the same constant speed; and (c) the movement is performed with the entire foot in contact with the ground, knees toward the feet, and trunk parallel to the tibia. For the hip hinge pattern, the following points should be observed (3,7): (a) implement is lifted while maintaining a straight back, with the knees and hips extending simultaneously; (b) in the initial position, the shoulders must be slightly in front of the bar, and the implement must remain close to the individual throughout the movement; and (c) the movement must end with the hips and knees completely extended.

To score the exercise technique, the number of fulfilled criteria for each exercise must be considered: if the 3 criteria are met, the score will be 4 (corresponding to highly advanced); if 2 criteria are met, the score will be 3 (corresponding to advanced); if one criterion is met, the score will be 2 (corresponding to intermediate); and if no criteria are met, the score will be 1 (corresponding to beginner). If for 2 of the exercises (e.g., deadlift and squat), the individual gets a score corresponding to a beginner (1 point), and in another 2 exercises (e.g., bench press and pull-up), the individual gets a score corresponding to advanced (3 points), the mean between the values is used as the overall score (e.g., in this case it will be 2, corresponding to an intermediate). At least one exercise for upper limbs and one exercise for lower limbs must be used, but it is also possible to use the mean score of the 4 exercises (one for each pattern) to obtain a more accurate value for the "exercise technique" parameter. If the result is between 1 and 1.9, the rating for that item will be a beginner; between 2 and 2.9 corresponds to intermediate; between 3 and 3.9 will be advanced; and 4 points will be the highly advanced level.

STRENGTH LEVEL

To assess strength levels, we suggest 4 of the main resistance exercises: bench press, pull-up, back squat, and deadlift. The initial references used for strength in advanced men were based on Willoughby (72), who considered performances in the bench press of at least 120% of body mass and the squat of at least 150% of body mass. Furthermore, considering that higher maximal loads are typically exhibited for the deadlift versus the back squat (20), a deadlift of at least 180% of body mass was stipulated for advanced individuals. Therefore, we propose that when strength is used as a variable to classify training status, highly advanced men should be able to lift more than 120% in the bench press, more than 150% in the back squat, and more than 180% in the deadlift. Advanced men should be at the following percentages of body mass: 100–120% for the bench press, 120–150% for the back squat, and 150–180% for the deadlift. For intermediate men, we propose the following percentages of body mass: 60–99.9% for the bench press, 80–119.9% for the back squat, and 100–149.9% for the deadlift. For beginner men, we propose the following percentages of body mass: below 60% for the bench press, below 80% for the back squat, and below 100% for the deadlift. Considering the differences in the strength level between sexes, and that the differences for the lower body are smaller than those for the upper body (30,45), we propose for highly advanced women more than 80% in the bench press, more than 130% in the back squat, and more than 160% in the deadlift. For advanced women, we propose the following percentages of body mass: 60–80% for the bench press, 100–130% for the back squat, and 120–160% for the deadlift. For intermediate women, we propose the following percentages: 40–59.9% for the bench press, 60–99.9% for the squat, and 80–119.9% for the deadlift. For beginner women, we propose the following percentages of body mass: below 40% for bench press, below 60% for squat, and below 80% for deadlift.

The strength references used for men in the pull-up exercise were as follows: weighted pull-up with at least 30% of body mass for highly advanced, weighted pull-up with at least 15% of body mass for advanced, perform at least one unweighted pull-up for intermediate, and individuals who are not able to perform one unweighted pull-up receive the score corresponding to beginner. Considering the greater difficulty of performing the pull-up exercise compared with men (31), the references used for women were as follows: weighted pull-up with at least 10% of body mass for highly advanced and at least one unweighted pull-up for advanced. We used the criterion to perform half pull-up, when the position of 90 degrees of flexion at the elbow is reached (54), to score corresponding to intermediate, and women who cannot perform at least half pull-up to receive the score corresponding to beginner.

At least one exercise for upper limbs and one exercise for lower limbs must be used, but it is also possible to use the mean score of the 4 exercises to obtain a more accurate value for the "strength level" parameter. Based on the proposed criteria, if the scenario arises in which an individual scores in different categories for different exercises, then we suggest taking the mean to assess the strength level. If the mean result across 2, 3, or 4 exercises is between 1 and 1.9, the rating for that individual must be beginner; between 2 and 2.9, intermediate; between 3 and 3.9, advanced; and 4 points, highly advanced.

USAGE PROCEDURES

All parameters used are illustrated in the Figure, with their corresponding criteria synthesized in Table 1. The determination

of training status is performed using a simple scoring system according to the individual's situation, and then a mean is calculated according to the number of items used. For example, if all 5 items are used, add the score, and divide it by 5. If only 3 of the criteria are used, these items should be added and divided by 3. In some situations, the use of any of the criteria may not be applicable, e.g., when it is not possible to perform the technique or the strength tests. It is important to highlight that a minimum of 3 items in the questionnaire should be used, considering that the first 3 criteria (current uninterrupted training time, time of detraining, and previous training experience) are mandatory. If the final result is between 1 and 1.9, the individual will be classified as a beginner; if between 2 and 2.9, they will be classified as intermediate; if between 3 and 3.9, they will be classified as advanced; and if the final average is 4 points, they will be classified as highly advanced (in the latter case, the individual must receive the score corresponding to highly advanced for all items in the model).

Table 2 presents an example of an individual who had been training for less than 2 months but previously had not been training for 6 months; before that, this individual had been training for a year. They had good exercise technique, and in the strength tests lifted <60% of the body mass in the bench press, <80% in the back squat, and <100% of the body mass in the deadlift (the average score of the 3 exercises was 1). In the example, the sum of the variables was 10 (5 variables were used), and the mean value was 2, which corresponds to intermediate training status. In this case, the determination of the training status might be 100% accurate because all parameters were used. Table 3 shows a case where the individual had been training for 6 months (score 2), and for the "time of detraining" received a score of 4. Considering he had never had a detraining period since he started his routine (6 months before), the score for "previous training experience" was the same as "current uninterrupted training time" (score 2). For exercise technique, the practitioner decided to perform only the bench press and the back squat and assigned an advanced score for both exercises (score 3). The strength level was not assessed in this case. Thus, the sum of the items used was 11, and divided by the number of items considered (4) the value 2.75 was obtained, which corresponded to the intermediate classification.

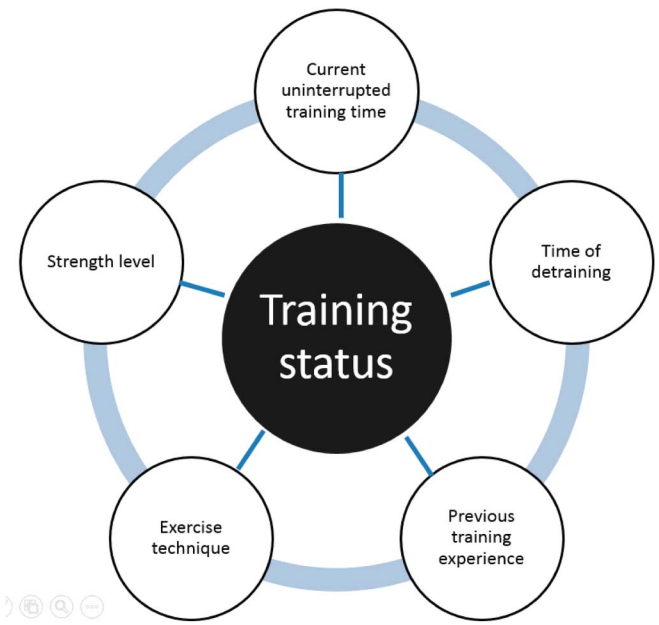

Figure. Parameters used in the model for classifying the training status.

DISCUSSION

The objective of this study was to suggest a strategy for decision making in classification and determination of individual training status. Five parameters were identified and used (current uninterrupted training time, time of detraining, previous training experience, exercise technique, and strength level) and 4 classification levels were proposed (beginner, intermediate, advanced, and highly advanced) determined by the mean score of the parameters used.

Previously, the ACSM (1) classified novice as untrained individuals with no resistance training experience or those who have not been training for many years; intermediate as individuals training consistently for approximately 6 months; and advanced as individuals with years of resistance training experience. The NSCA (34) considered beginners (or untrained) as individuals with less than 2 months of training; intermediate (or moderately resistance trained) as individuals between 2 and 6 months of experience; and advanced (or well resistance trained) as individuals with at least 1 year of training practice. Although the prescription recommendations are predominantly all based on training status, the ACSM's classification is quite generic. Despite stating that the success of the training program is related to experience, good judgment, and education of the exercise professional, a more extensive process at the outset to determine training status can improve the prescriptive process. Although the NSCA's recommendations are somewhat more specific, especially at the beginner and intermediate levels, the NSCA's classification categorizes the advanced level as individuals who have trained for at least one year. Furthermore, individuals who have trained between 6 months and 1 year do not have a specific classification.

The inclusion of the "highly advanced" level in this article differs from the 2 previous classification

Table 1
Parameters and criteria used

	Beginner	Intermediate	Advanced	Highly advanced
Current uninterrupted training time	Up to 2 mo	Between 2 and 12 mo	Between 1 and 3 y	At least 3 y
Time of detraining	At least 8 mo	Between 4 and 8 mo	Between 1 and 4 mo	Currently training
Previous training experience	Up to 2 mo	Between 2 and 12 mo	Between 1 and 3 y	At least 3 y
Exercise technique	Poor	Moderate	Good	Excellent
Strength level	Up to 60% MBP Not even 1 rep MPU Up to 80% MSQ Up to 100% MDL Up to 40% FBP Not even half rep FPU Up to 60% FSQ Up to 80% FDL	Up to 100% MBP At least 1 rep MPU Up to 120% MSQ Up to 150% MDL Up to 60% FBP At least half rep FPU Up to 100% FSQ Up to 120% FDL	Up to 120% MBP At least 15% MPU Up to 150% MSQ Up to 180% MDL Up to 80% FBP At least 1 rep FPU Up to 130% FSQ Up to 160% FDL	Above 120% MPB At least 30% MPU Above 150% MSQ Above 180% MDL Above 80% FBP At least 10% FPU Above 130% FSQ Above 160% FDL

FBP = female bench press; FDL = female deadlift; FPU = female pull-up; FSQ = female back squat; MBP = male bench press; MDL = male deadlift; MPU = male pull-up; MSQ = male back squat.

schemes and is justified by the wide variety of possibilities for individuals who are in the advanced category. Although the aforementioned guidelines present prescription recommendations for beginners, intermediate, and advanced individuals (excluding the highly advanced or athletes, probably because there are not enough data in the literature to establish recommendations for these individuals), it is possible that this category needs a greater training dose to maximize neuromuscular adaptations (21,48,49).

Both classification schemes did not take into account the individual's previous training experience or the time without regular training, only considering whether the individual was currently training or not. The proposed model considers these 2 aspects, as both can determine the appropriate exercise dose. Regarding exercise technique, the NSCA's approach considered technical experience and skill in a very general way, classifying only as "none or minimal" for beginners, "basic" for intermediate, and "high" for advanced individuals, and the ACSM does not consider this aspect in determining training status.

Although the ACSM and NSCA did not consider strength levels to determine training status, some studies have used current uninterrupted training time in addition to the strength level as an inclusion criterion for advanced individuals. Stone et al. (65) conducted a study in which the sample had to be able to lift at least 110 kg and 130% of the body mass in the back squat exercise. Matuszak et al. (44) used a stricter criterion of relative strength, establishing 150% of body mass in the back squat and experience of at least 2 years with this exercise.

Table 2
Example 1

	Beginner (1 point)	Intermediate (2 points)	Advanced (3 points)	Highly advanced (4 points)
Current uninterrupted training time	1			
Time of detraining		2		
Previous training experience			3	
Exercise technique			3	
Strength level	1			
Total				10
Mean				**2**

The bold value indicates the classification for training status.

Table 3
Example 2

	Beginner (1 point)	Intermediate (2 points)	Advanced (3 points)	Highly advanced (4 points)
Current uninterrupted training time		2		
Time of detraining				4
Previous training experience		2		
Exercise technique			3	
Strength level				
Total				11
Mean				**2.75**

The bold value indicates the classification for training status

Similarly, Willoughby (72) and recently Aube et al. (5) also used a cutoff point of 150% of body mass in the back squat, in addition to at least 3 years of experience with free weights. For upper limbs, one study required at least 3 years of experience and being able to lift 100% of body weight in the bench press (24). Weir et al. (71) established 125% of body mass in the bench press and 2 years of experience, and Willoughby (72) established 120% of body mass in the bench press and 3 years of experience with this exercise. It is important to note that the references used in this study and in the aforementioned studies are for most resistance training practitioners, and not for athletes. In a variety of sports that require the performance of fast movements (e.g., jumping, running, and changing direction), strong athletes can squat 2.0 to 2.5× their body mass (66). Professional powerlifters can reach even greater intensities, e.g., 270%, 174%, and almost 320% of body mass for back squat, bench press, and deadlift, respectively (38).

Considering that the metrics for resistance training are more likely to be applied successfully if they are simple to implement and easy to calculate (61), the present proposal sought to use basic resistance training parameters and a simple calculation procedure, using 3 quick questions to be acquired (How long have you been training? How long have you been without training? How long have you been training before you quit?) and at least 4 tests (2 technique tests and 2 strength tests). The current proposal has some limitations, such as the possibility that an advanced individual may not have consistent experience with free-weight lifts. Furthermore, heavier individuals may have a disadvantage because their body mass is not added in the sum of the total load lifted in certain exercises (squat and deadlift), and also considering that different body proportions can interfere with strength performance (41), there is not a linear relationship between the maximum load lifted and body mass among athletes of different weight categories (12). Moreover, heavier individuals also have a disadvantage in the pull-up exercise (54). Another limitation would be applying the model to older individuals, who may have the prerequisites to be considered advanced practitioners but are at a disadvantage in terms of strength level. Therefore, practitioners still must use some subjectivity in determining training status aside from objective criteria.

In addition, the training status is a fundamental parameter for the training prescription, but it must be combined with other aspects such as individual preferences and the training volume previously performed by the practitioner to increase the precision of resistance training effects and better explore individual adaptative responses (55,56). Scarpelli et al. (56) showed that individualization in the training volume prescription (performing 1.2 times the number of sets each participant was performing before the commencement of the experimental protocol) promoted greater gains in muscle cross-sectional area compared with the group that performed a standardized volume. Although this information is not part of the proposed model, this and other information must be acquired in the anamnesis, so the training prescription is more accurate and results in the long-term program adherence and achieving of the individual's goals.

PRACTICAL APPLICATIONS

Considering that resistance training prescription is based on the individual's conditioning level, the proposed model represents an important and necessary advance in the classification and determination of training status. Therefore, it can be a useful support tool for practitioners' decision making in training prescription practice. Moreover, researchers can better detail a sample and reproduce results under the same conditions in future studies.

Conflicts of Interest and Source of Funding: The authors report no conflicts of interest and no source of funding.

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