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Training Load

Lecture – 174

Training Load:
Definition and Types of Training Load
and
Features/Factors of Training Load

Introduction

Sports training is a scientific discipline and it works on its principles. Of all the principles of sports training, the principle of training load and administering recovery in proportion is the most important and any mistake in adhering to this principle may lead to disruptions in the path of attaining high performance.

Sports training consist of activities and movements which generally lead to fatigue. Fatigue is the direct product of load caused by physical activity or exercise. Fatigue assists in the adaptation process of a sportsperson which ultimately leads to an increase in the performance capacity. Training load therefore is of utmost importance in sports training. The training state of a sportsperson develops as a result of application of motor stimulus (movement) resulting in improvement and maintenance of performance capacity. In addition to improvement and maintenance, the training loads also facilitate stabilization of sports performance.

Sometimes loads are administered for another purpose as well that is to bring about recovery and it is because of this reason that training loads are termed as fatigue producing and non-fatigue producing loads.

Training load

The increase in performance generally is related to the achievement of adaptive changes in the organism. Adaptive changes can be achieved by repeated application of load. The way to achieve this that is the adaptive changes in the organism or individual is through a systematic repetition of the load. These repeated loads refer to as the adaptation stimulus. The principle to the adaptive changes is the axis: homeostasis followed by the adaptation stimulus (load) finally leading to adaptation of the sportsperson.

The principle of training can be reduced to a simple "dose-response' relationship. The "response" in this relationship can be measured as a change in performance or the adaptation of a physiological system. The "dose" of training, or the physiological stress associated with the training load, is more difficult to measure as there is no absolute "gold standard" which can be used in the field, making it difficult to validate procedures.

Definition

Different experts from the field of Physical Education and Sports and different Sports sciences have given different definitions of training load based on their understanding of the term; some of the definitions are detailed here under:

1. According to Dr. A.K.Uppal,

    "Physiological and psychological demands placed on the individual through a motor stimulus (movements) resulting in improvement and maintenance of performance capacity."

2. According to Dr. Hardayal Singh,

    "The process of tackling training and competition demands which cause temporary disturbance of psychic and physical state of homeostasis".

3. According to coach Jorgem in his blog,

    "Training load is the sum of the volume (duration and frequency) and training intensity (pace and power) for a specific session."

4. According to David Zahradnik,

    "If adaptation stimuli are applied properly, training can be expected to have accumulative effect. If motor activity is carried out in such a way that it evokes desirable current change of human functional activity and consequently long-term, structural and psycho-social changes, it is referred to as training load"

5. According to Polar,

    "Training load is the exertion count, that has been developed to ease and simplify the analysis of athletic training programs.

    The exertion count combines the duration and intensity of a training session into a single measurable figure that also takes the sports mode into account.

    Each training intensity (HR) is given an exertion factor by which the time spent at that HR is multiplied.

Some exercise modes or sports have their additional impact on the exertion and thus a sport factor is applied.

The exertion count is the total sum of these three components:
- The exertion count of a single training session = (exertion factor of HR zone)*(time spent in that zone)*sport factor."
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6. According to Ale Santuz,
   "Training load is nothing more than the product of the training volume and the training intensity"

7. According to Aaron Averill in his blog,
   "Training load is a complex set of mathematical models that allow us to predict fitness performance based on our workout history."

8. According to the website, polar.com
   "The training load feature makes the loads of different types of training sessions comparable with each other."

Types of Training Load

Different experts from the field have categorized the types of training load differently. According to Harre loads can be of two types **fatigue producing** and **non fatigue producing** based of the function performed by the load administered. If the load is given in order to produce fatigue to assist in the process of adaptation than such loads are termed as fatigue producing. Whereas, on the other hand if the load administered is for the purpose of accelerating the recovery process then it is known as non-fatigue producing.

According to Aaron Averill loads consists of four types categorized into effort and performance. Effort is the product of the interaction between intensity and duration whereas, performance is the difference between the fitness and fatigue of an individual.

Another categorization of training load is on the basis of the nature of the load. According to the nature of training load, it is of two types namely **outer load** and **inner load.** The outer load refers to the quality of movement, type of physical exercise, intensity and density of load of motor stimulus and the inner load (sweating, change in the colour of the skin, lack of concentration, etc.) is the reaction of a sportsperson to the outer load. In other words, outer load leads to the onset of inner load.

Features/Factors of Training Load

Loading is a process of applying the training load which has been devised in advance repeatedly in time. The aim of loading is reaching cumulative training effect. Cumulative training effect arises in the form of supercompensation (supercompensation is understood as increase in the energy resources of the organism as a consequence of previous exercise load, that is in terms of intensity and size.

According to Aaron Averill in his blog, there are four components of training load:

1. Every workout that the sportsperson or athlete gets involved in takes effort. In the same way a longer more intense workout will burn more calories, a harder workout will result in a higher Effort score.
2. Each workout or the workouts makes the sportsperson or athlete stronger and increases the fitness based on the amount of effort they took. Simply stated: Higher Effort = Higher Fitness. Fitness improvement lasts over a few weeks, but slowly diminishes or goes away without continued effort.
3. Similarly, the sportspersons or athletes workouts will also make him tired and increase his fatigue. Fatigue tends to decrease much quicker than fitness; that is in several days instead of several weeks, depending on the condition of the athlete.
4. The sportsperson's or athlete's performance is a positive balance of fitness and fatigue. Higher fitness and lower fatigue leads to maximum performance.

In order to better understand training load there are two concepts/features that are covered by Aaron Averill, they are:
- **Effort:** Measuring the amount of effect a single workout has on our body.
- **Performance:** Predicting performance changes over time from a series of workouts.

Effort:

Step 1: To predict performance calculate an effort for each workout. In concept effort is simple:
Effort = Intensity X Duration

According to this system the athlete can score 2 points per minute (120 per hour) at maximal effort. For example a 40 minute workout could score a maximum of 80 points. By simple math you can see how a short, high intensity workout (such as intervals) could score similar to a longer easy workout (such as a LSD run).

Of course the sportsperson or the athlete is never going to be at maximal effort for an entire workout - this is where the GPS watch and other sensors come in:

1. In case of a cyclist and use a power meter, the effort is scored on power zones.
2. If you use a heart rate monitor, the effort will be based on the resting and maximum heart rate, and the zones.
3. If the athlete has only a GPS, then the effort is scored on his speed/pace zones, adjusted for any hills the athlete was running.
4. For indoor endurance workouts or those without a GPS route, the effort is scored on the average time in speed/pace zones.

5. Finally if an athlete is just doing a manual workout, then the value chosen by the individual for the perceived intensity of the workout.

Performance:

After we've calculated the effort scores for the athlete's entire workout history, Step 2 is to predict one's fitness performance. The performance model is based on the work that Eric Banister started way back in 1975 and has been verified by dozens of studies.

The model starts with an assumption that a workout has both a positive and negative effect. The positive effect is called "fitness" and the negative effect is called "fatigue". Fitness and fatigue are combined to provide "performance" - a prediction of how well you will do in an endurance event such as a race.

In the model both fatigue and fitness spike after a workout. Fatigue quickly drops off, while fitness drops off more slowly, creating a space of time where your fitness gains outweigh your fatigue, until both reach equilibrium again. This space represents your performance potential:

Performance = (Fitness - Fatigue)

To bring this back to the real world imagine an athlete's or a sportsperson's ideal pre-race taper.

The sportsperson has been putting on serious miles all season long, and so his fitness is high, but so is his fatigue. As the athlete or sportsperson begins to taper, the long-term fitness gains remain, but the fatigue drops with the drop in workout effort. As a result, the athlete sees a performance peak that (ideally) happens 7-10 days after the taper starts.

Dr. A.K.Uppal in his book "Scientific Basis of Sports Conditioning" has emphasized that administration of training load is very essential for the attainment of high performance, hence it is very essential for the coach to formulate a training plan that follows all the principles of sports training, and the principle of ensuring results in particular. There are various factors that affect the performance of a sportsperson. The performance improvement depends on the response of individual sportspersons to the given training program. The factors of training load can be studied under the two types of load that is the outer load and the inner load.

➢ The **outer load** is concrete in nature; it can be modified by the experts according to the training state, training age, anatomical age, chronological age, physiological and psychological state of the sportsperson or the athlete. The outer load always precedes the inner load. It includes the following factors:
   • Quality of movement,
   • Type of physical exercise,
   • Intensity of load (intensity and density) and
   • Volume of load (duration and frequency).
➢ Inner load is the response of the sportsperson to the given outer load, it is abstract. More specifically inner load is a product of the outer load. It is very essential to monitor the inner load as well so as to bring about maximum benefit of the outer load and also it

assists in prevention of unnecessary complications that may arise as a result of overload or wrongly calculated outer load.

The factors/features of training load are explained briefly below:

Outer load: The outer load is concrete it is visible to the athlete as well as the trainer; the outer load is primarily responsible in bringing about an improvement in the performance of the athlete. The loads administered under proper supervision for prolonged periods of time leads to the process of adaptation which is essential to bring about considerable improvements in the performance of the trainee or athlete. The factors of outer load are discussed as under:

- **Quality of Movement:** The quality of movement has direct bearing on training load. In the process of technical and tactical perfection, the quality of movement is an important factor of load. When movements are simple, the quality of movement does not have much relevance to load but as the degree of difficulty increases, load also gets increased considerably. Since quality of movement is a subjective factor, hence the correct and reliable measurement of quality of movement is a very difficult task and the coach has to rely on subjective observation alone but, according to a pre-determined and accepted scale applicable to selected parameters of movement execution. However the quality of movement can be better studied and analyzed by the incorporation of the new devices and technologies that have been developed in the recent past along with the assistance of the sports scientists namely the kinesiologist for the same.

- **Physical Exercise:** Physical exercise forms the structure of load. It is as important for the training program as air is for life. Different exercises have different effects and a definite purpose in the training program. According to their effects the physical exercises have been classified as general, special/specific and competitive exercises. Each exercise, depending upon the body parts involved, the co-ordination required, the apparatus or implements involved and the opportunities used, produces a different type of load and hence exerts a different effect on the performance capacity of the sportsperson as well.

  The classification of the exercise is necessary to identify the rate of specificity of exercise with each exercise. It indicates how and to what extent exercise is similar to the final design of sports activities. Specificity relates to the sequence of implementing certain muscle groups, the velocity of movements, the effort exerted, the duration of muscle tension, movement frequency, its direction and movement.

  The exercises are distinguished into the following types:

  a. Competitive exercises: are fully consistent with the design competition (e.g., an attack hit in volleyball)

  b. Special exercises: assume higher, up to a high degree of compliance with the content and structure of sport specialization. They represent different parts and sub-variants of the final design and is used to improve the athletic performance factors (physical, tactics).

c. Generally non specific/General exercises: are those which are not related to the given sport specialization. They aim at the general development of the athletes.

- **Intensity of Load (Load Intensity):** The intensity of load represents the degree of effort made by the sportsperson while executing any movement or exercise. The degree of effort is always considered in relation to time and is equated with the amount of force or energy spent in relation to time. Intensity is on the outside manifested as movement velocity, movement frequency, size of resistance being overcome; and is related to the way of performance energy coverage. The intensity of load is further sub-divided into the following two parts:
  - Intensity of stimulus: It can be described by speed in motor stimulus namely cyclic exercise, amount of load during muscle strength exercise, the pace of bout or a game and frequency of movement (skipping). The intensity of stimulus is always expressed in percentage in relation to the maximum possible intensity (100%). Calculated or appropriate load influences the pace of development and the stability of the adaptation process. While fixing the intensity of stimulus the morphological adaptations, technical level, tactical skills, psychological condition, health and functional state of the sportsperson should be taken into consideration. It has been established beyond doubt that doing exercises with different intensities leads to different physiological and training effects. Exercises with maximum intensity leads to development of speed, maximum strength, explosive strength and speed endurance whereas lower intensity facilitates active recovery. Hence both low as well as high intensity of stimulus have their own merits.
  - Density of Stimulus: Density of stimulus refers to the duration of recovery phases between two motor stimuli and sets of motor stimuli. It is the ratio between the phase of load and the phase of recovery. The density of stimulus is determined by the task of the training session e.g. lifting time in strength training exercise (weight training), distance run in a running activity (interval running) etc.. Along with intensity optimum density of stimulus guarantees efficiency of loading and also helps to prevent premature exhaustion.
- **Volume of Stimulus (Load Volume):** The volume of training load is the total amount of work done while performing an exercise or movement in a training session. It has a very decisive effect on the improvement of performance. It has also been realized that the total volume of load over longer periods (months or a year) has direct and positive relationship with performance improvement. Volume of load can further be sub-divided into duration of stimulus (movement duration) and frequency of stimulus (movement frequency). Volume of stimulus or load volume in training can also be termed as the product of duration of stimulus (movement duration) and frequency of stimulus (movement frequency). For optimum effect of load to be achieved a meticulously calculated load volume should be ensured. The above mentioned sub-divisions are discussed below.

- <u>Duration of stimulus:</u> The duration of stimulus represents the time of influence of one stimulus or a set of stimuli e.g. lifting time in strength training exercise (weight training), distance run in a running activity (100m, 400m, 1500m, etc.), total time of a sport (90 mins in football, 70 mins in hockey, etc.). The duration of stimulus can be fixed or is already set as per the rules and regulations of the general, special or competitive variable that is to be developed. Duration of stimulus is also referred to as movement duration, as it is the duration of a single repetition or movement.
- <u>Frequency of Stimulus:</u> Frequency of movement or movement frequency is the number of times an exercise or a movement is repeated. The frequency of stimulus depends upon the intensity of load. It works inversely to intensity, if the intensity in high the frequency will be low and vice versa. The frequency of training varies from individual to individual, depending on the training age and level of sports performance sportspersons can be categorized into beginners, advanced and top level sportspersons. The frequency of training for a beginner ranges in between 3-5 training units per week, an advanced sportsperson requires to train 6-8 times in a week and a top performance sportsperson trains 9-12 times a week.

The volume of exercise expresses the quantity of load. Volume as mentioned above can be expressed in time, which is the duration of exercise or the number of repetitions of an exercise respectively. In training practice, the volume of load is expressed with general and specific training indicators.

General training indicators are used in all sports disciplines in a similar way. They are for example the number of training hours, number of training units or the number of training days.

Specific training indicators are based on the contents of a specific sports discipline. They are for example the number of kilometers covered by running within II intensity zone, number of technically correctly carried out javelin throws, number of sets played in basic set up in volleyball or the number of kilometers covered by cycling uphill, etc.

Outer load is a potent factor that ensures the affectivity of a training program. The intensity of load or load intensity and the intensity of volume or load volume are the building blocks on which the whole process of training entirely depends. Depending on the training age, training state, chronological age, anatomical age, physiological functioning, psychological will and many other factors that need to be considered in order to calculate the intensity of load or load intensity which is a difficult task for a coach as there are no objective means to calculate the exact intensity and density of stimulus. However, as compared to load intensity the load volume is comparatively easier to access.

Inner Load

The last factor of training load that influences the training program to a large and considerable extent is the load that develops physiologically as well as psychologically created due to the load administered during training. As discussed earlier the training loads are termed as both fatigue producing as well as non-fatigue producing. The coach has to systematically monitor the four important features of training load namely intensity of load, density of load, duration of load and frequency of stimulus so as to produce maximum training effect on the sportsperson. Inner load is a very important factor that is ignored most of the time and not paid the required amount of attention. But, it is important for the coach to understand the role of the symptoms that results as a result of the load administered or outer load. During the training session, the coach should be very vigilant and observant of the symptoms of inner load (sweating, change in colour of skin, visible fatigue, loss of concentration, lack of co-ordination etc.). he should also take the help of the other sports scientists to meticulously monitor the changes in the physiological functioning and psychological state of the athlete. The inner load not only helps to control the outer load but also plays an indispensible role in determining the effectiveness of the training load. Observing the inner load also helps the coach in ascertaining whether his training load and recovery are in proper proportion or not. Warming up and limbering down are also loads but they are non-fatigue producing loads as warming up prepares the body for physical activity whereas limbering down is done for accelerating the recovery process or speedy recovery.

If the loads administered are below the potential of the individual than that can be observed by the appearance of the inner load and hence the loads are increased as per the potential of the concerned athlete and vice versa. Lower loads may lead to a decline or stagnation of the sports performance of the athlete however in case the loads are much higher than it becomes overload for the athlete, the results of which may be drastic ranging from minor to major injuries, fatigue, and even loss of interest on the part of the sportsperson on not getting the desired results.

Conclusion

Sports training, as we know is a scientific discipline that thrives to improve the performance standard of a sportsperson in order to achieve optimum performance. Achievement of optimum performance is entirely dependent on the proper calculation and implementation of the training program. On the other hand, it is also evident that for a training program to be effective the training load needs to be calculated and administered appropriately for an individual/sportsperson. Hence all that has been discussed earlier need to be kept in mind while preparing a training program as the training state of a sportsperson improves if he trains more frequently, provided the intensity of load as well as volume of load are effective.