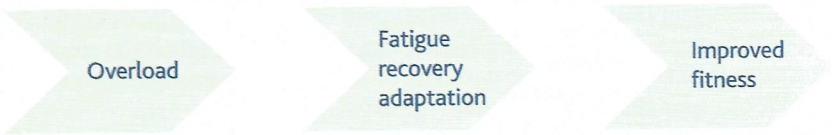


Fig. 15.1 *Essential idea of training*

When an athlete's fitness is challenged by a new training load there is a response from the body. The initial response is fatigue. When the loading stops there is a process of recovery. Recovery and adaptation take the athlete to a higher level of fitness from where they started.

The safest way to overload the body is by altering one of the three factors below. The load is changed in a slow, systematic manner to allow gradual adaptation of the body. Overload is achieved by increasing the frequency, intensity or duration of training. These terms are often referred to as the **FITT principles**.

Key terms

FITT principles: overloading by varying frequency, intensity, type and time of training.

The FITT principles of training

The FITT principles are like a set of rules that must be used in order to benefit from a fitness training programme. These four principles of fitness training are applicable to individuals exercising at low to moderate training levels and may be used to establish guidelines for both cardiorespiratory and resistance training.

Frequency

Following any form of fitness training, the body goes through a process of rebuild and repair to replenish its energy reserves consumed by the exercise. The frequency of exercise is a fine balance between providing just enough stress for the body to adapt to and allowing enough time for healing and adaptation to occur.

Frequency means how often. For most aerobic-based activities it is recommended that training should take place 4–5 times per week. For anaerobic-based activities, the recommendation is three times per week; to allow full recovery, because the adaptations take longer to achieve. Exceptions would include the explosive sports, where 5–6 sessions a week are better, with alternating hard and easy sessions.

Activity

Work in small groups and produce a presentation or poster that explains why anaerobic-based activities need more time to recover than aerobic-based activities.

Intensity

The second rule in the FITT principle relates to intensity. It defines the amount of effort that should be invested in a training programme or any one session. Like the first FITT principle – frequency – there must be a balance between finding enough intensity to overload the body (so it can adapt) but not so much that it causes overtraining.

Intensity means how hard. Measuring intensity is much more difficult than you first think. Most of the time we rely on how our body feels, or our own opinion to estimate how hard we are working. Opinions vary between people. What one person considers quite hard, another may describe as fairly easy. One way of measuring intensity is to use opinions, but we need to make those opinions standard. For this we use the Borg scale. Many performers involved in aerobic activities use their heart rate as a means of measuring performance. The intensity of a strength training programme may also be measured by the amount of weight being lifted.

Overload can be adjusted by varying the intensity at which the performer works. There are many ways of varying intensity, but the major methods involve increasing or decreasing one or more of the following:

- load
- repetitions
- range of movement
- duration of effect
- sets
- recovery
- frequency of sessions
- speed.

Activity

Work in small groups and using press-ups as the exercise; identify how each of the above parameters may be used to adjust the intensity of press-up exercises. Produce your ideas as a poster or presentation.

Type

The third component in the FITT principle dictates what type or kind of exercise you should choose to achieve the appropriate training response. There are many ways of training, but most can be grouped into the following:

- continuous
- intermittent
- circuit
- weights
- plyometrics
- mobility (see later).

Time

The final component in the FITT principle of training is time – or how long you should be exercising for. The time involved depends largely on the type of training.

For the largely aerobic training methods such as continuous, circuits and mobility, those individuals with lower fitness levels should aim to maintain their exercise programme for a minimum of 20–30 minutes. This can increase to as much as 45–60 minutes as fitness levels increase. Beyond the 45–60 minute mark there are diminished returns. For all that extra effort, the associated benefits are minimal. This also applies to many elite athletes. Beyond a certain point they run the risk of overtraining and injury. There are exceptions however – typically the ultra-long distance endurance athletes. In terms of the duration of the programme as a whole, research suggests a minimum of 6 weeks is required to see noticeable improvement and as much as a year or more before a peak in fitness is reached.

For those involved in anaerobic methods of training such as intermittent, weights and plyometrics, the common consensus for the duration of a resistance training session is no longer than 45–60 minutes. Again, intensity has a say and particularly gruelling strength sessions may last as little as 20–30 minutes.

Measuring intensity

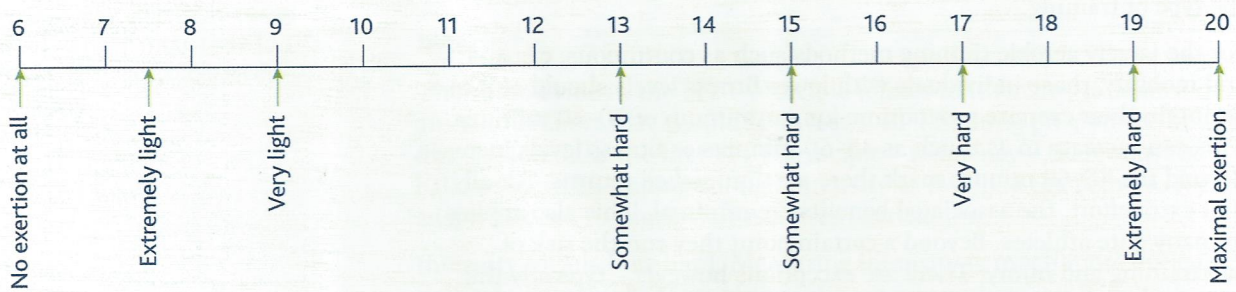
Borg scale

The Borg scale is a simple rating of how hard the performer thinks their body is working, or Rating of Perceived Exertion (RPE). It is used by many coaches to assess an athlete's level of intensity during training or testing sessions. It is based on the physical sensations a person experiences during physical activity, including increased heart rate, increased respiration or breathing rate, increased sweating, and muscle fatigue. Although this is a subjective measure, a person's exertion rating may provide a fairly good estimate of the actual heart rate during physical activity.

Most coaches tend to agree that perceived exertion ratings between 12 to 14 on the Borg scale suggests that physical activity is being performed at a moderate level of intensity. During activity, you can use the Borg scale to assign numbers to how you feel. Such self-monitoring can help you adjust the intensity of the activity by speeding up or slowing down your movements.

Through experience of monitoring how your body feels, it becomes easier to know when to adjust your intensity. For example, a performer who wants to engage in moderate-intensity activity would aim for a Borg scale level of 'somewhat hard' (12–14). If he describes his muscle fatigue and breathing as 'very light' (9 on the Borg scale) he would want to increase his intensity. On the other hand, if he felt his exertion was 'extremely hard' (19 on the Borg scale) he would need to slow down his movements to achieve the moderate-intensity range.

Research has shown a high correlation between a person's perceived exertion rating times 10 and the actual heart rate during physical activity. So a person's exertion rating may provide a fairly good estimate of the actual heart rate during activity. For example, if a person's rating of perceived exertion (RPE) is 12, then $12 \times 10 = 120$; so the heart rate should be approximately 120 beats per minute. Note that this calculation is only an approximation of heart rate, and the actual heart rate can vary quite a bit depending on age and physical condition.



9 corresponds to 'very light' exercise. For a healthy person, this would be the equivalent of walking slowly at his or her own pace for some minutes:
13 on the scale is 'somewhat hard' exercise, this would correspond to working hard but it still feels OK to continue.
17 'very hard' is very strenuous. A healthy person can still go on, but he or she really has to push him- or herself. It feels very heavy, and the person is very tired.
19 on the scale is an extremely strenuous exercise level. For most people this is the most strenuous exercise they have ever experienced.

Fig. 15.2 *Borg scale*

Heart rate

One way of monitoring physical activity intensity is to determine whether a person's pulse or heart rate is within their target zone during physical activity. It is based on knowing your maximum heart rate and then being advised or shown a heart rate training zone, in which to keep your heart rate while you are exercising.

The simplest but least accurate way of calculating your maximum heart rate is using the formula:

$$\text{Max. heart rate} = 220 - \text{age}$$

For example, for a 16-year-old person, the estimated maximum age-related heart rate would be calculated as 220 – 16 years = 204 beats per minute (bpm).

For moderate-intensity physical activity, a person's target heart rate should be 50 to 70 per cent of his or her maximum heart rate. For the above example 50 per cent and 70 per cent levels would be:

- 50% level: 204 × 0.50 = 102 bpm, and
- 70% level: 204 × 0.70 = 143 bpm.

Thus, moderate-intensity physical activity for a 16-year-old person will require that the heart rate remains between 102 and 143 bpm during physical activity.

For vigorous-intensity physical activity, a person's target heart rate should be 70 to 85 per cent of his or her maximum heart rate. To calculate this range, follow the same formula as used above, except change '50 and 70%' to '70 and 85%'. Thus for a 16-year-old person, the 70 per cent and 85 per cent levels would be:

- 70% level: 204 × 0.70 = 143 bpm
- 85% level: 204 × 0.85 = 173 bpm.

Thus, vigorous-intensity physical activity for a 16-year-old person will require that the heart rate remains between 143 and 173 bpm during physical activity. Most performers who use this method tend to wear a heart rate monitor which is more convenient and accurate than taking your own pulse rate. Target heart rate training zones are available where most calculations have been done for you – see Figure 15.3.

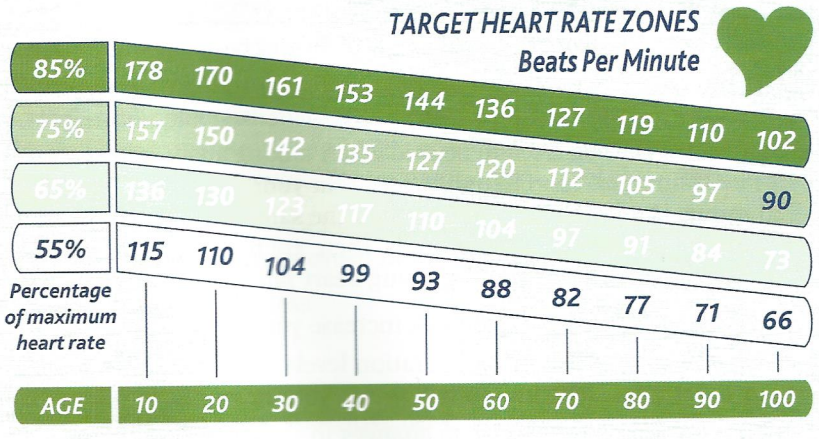


Fig. 15.3 *Target heart rate*

Another method for calculating target heart rate zones is the Karvonen method. This method uses your heart rate range, which is your maximum heart rate minus your resting heart rate. So for our 16-year-old who has a resting heart rate of 74 and a maximum heart rate of 204; their heart rate range is 204 – 74 = 130. This value is then used in the following formula to find the appropriate heart rate for any intensity level. The formula is:

(Heart rate range × Intensity %) + (resting heart rate).

So if the 16-year-old were required to work at 50% intensity they would need to get their heart rate up to: (130 × 50%) + 74 = 139 bpm.

To work at 70% intensity would need to get their heart rate up to: (130 × 70%) + 74 = 165 bpm.

To keep things simple, many coaches use five zones or training intensities:

1. Easy/Recovery = 60–70%
2. Moderate endurance = 71–80%
3. Hill work = 81–85%
4. Race pace for endurance athletes = 86–90%
5. Speed/racing (short distances) = 91–100%.

So now you have all the information to calculate the lower and upper heart rate limits for each zone. The following table summarises the calculations.

Table 15.1 *Table summarising calculations of heart rate training zones using Karvonen method*

Zone	Formula	Calculated HRs
1	Lower limit = HRR × 0.6 + RHR Upper limit = HRR × 0.7 + RHR	Lower = _____ bpm Upper = _____ bpm
2	Lower limit = HRR × 0.71 + RHR Upper limit = HRR × 0.8 + RHR	Lower = _____ bpm Upper = _____ bpm
3	Lower limit = HRR × 0.81 + RHR Upper limit = HRR × 0.85 + RHR	Lower = _____ bpm Upper = _____ bpm
4	Lower limit = HRR × 0.86 + RHR Upper limit = HRR × 0.9 + RHR	Lower = _____ bpm Upper = _____ bpm
5	Lower limit = HRR × 0.91 + RHR Upper limit = HRR × 1.0 + RHR	Lower = _____ bpm Upper = _____ bpm

HR – heart rate HRR – heart rate reserve RHR – resting heart rate bpm – beats per minute

Some words of caution need to be said when talking about heart rates and heart rate training zones. Firstly the idea that your maximum heart rate is 220 minus is a generalisation, in much the same way as saying that everybody is the same height. Secondly, there are many factors that affect both your resting heart rate and training heart rate:

- Stress (work, emotional, etc.) will increase your heart rate.
- What you eat and especially hydration levels will also greatly influence your heart rate. Dehydration will rocket your heart rate.
- Increasing temperatures due to changes in the weather will also increase heart rate until your body adapts to it; usually 7 to 12 days.