Endurance Notes for a Bilingual Physical Education in Second Cycle of ESO

**Autor:** Martínez González-Mohíno, Daniel (Licenciado en Ciencias de la Actividad Física y del Deporte, Profesor de Educación Física en Educación Secundaria).

**Público:** Profesores Educación Física. **Materia:** Educación Física. **Idioma:** Inglés.

**Title:** Endurance Notes for a Bilingual Physical Education in Second Cycle of ESO.

**Abstract**
The proper development and maintenance of the physical condition allows a sedentary person to carry out the activities of daily life in a satisfactory way, while at the same time facilitating the enjoyment of a better quality of life in his time of leisure. In this sense, an adequate and regular physical practice that involves a significant effort has a special impact on the development of resistance with the consequent improvement and maintenance of health. This health-related approach is consistent with the practice of moderate, continuous, and frequent physical activity that we must instill in our Physical Education students.

**Keywords:** Endurance, Stamina, Intensity, Training Frequency, Heart Pulse, Recommendations, Adaptations

**Título:** Apuntes de Resistencia para una Educación Física Bilingüe en segundo ciclo de ESO.

**Resumen**
El adecuado desarrollo y mantenimiento de la condición física permite a una persona sedentaria realizar las actividades propias de la vida cotidiana de una forma satisfactoria a la vez que le va a facilitar el hecho de disfrutar en mayor medida de una mejor calidad de vida en su tiempo de ocio. En este sentido, una adecuada y regular práctica física que suponga un esfuerzo significativo tiene una especial incidencia en el desarrollo de la resistencia con la consiguiente mejora y mantenimiento de la salud a través de una práctica de actividad física moderada, continua y frecuente.

**Palabras clave:** Resistencia, Intensidad, Frecuencia de Entrenamiento, Pulso Cardíaco, Adaptaciones, Recomendaciones.

Recibido 2017-07-12; Aceptado 2017-07-17; Publicado 2017-08-25; Código PD: 086027

1. **INTRODUCTION:**

   Endurance helps your muscles to work for a long period of time.

   With it, you can do exercises for a longer period of time, no matter the intensity.

   **Examples:**
   + Cycling: In the Tour of France they ride more than 200kms over a lot of days, but they also sprint!
   + Marathon runners run for more than 2 hours at a very fast pace.
   + Swimmers in the 1500ms race.
   + Footballers need to run for 90 minutes without being tired so they can dribble and shoot.

*Endurance is also called Stamina.*
The objective of endurance training is to develop the energy production systems to meet the demands of the event.

## 2. TYPES OF ENDURANCE:

Depending on the predominant energetic way, it is classified in:

- **Aerobic Endurance**: it’s the capacity to both develop and extend an effort – low or medium intensity- for a long time with enough oxygen.

<table>
<thead>
<tr>
<th>INTENSITY</th>
<th>+ Short, medium or long length.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY SOURCE</td>
<td>+ Short length efforts: glucose.</td>
</tr>
<tr>
<td></td>
<td>+ Long length efforts: fat.</td>
</tr>
<tr>
<td>HEART RATE</td>
<td>+ From 120-140 to 170 beats per minute (bpm)</td>
</tr>
<tr>
<td>EFFORT LENGTH</td>
<td>+ Several hours.</td>
</tr>
<tr>
<td>EXAMPLE</td>
<td>+ From 5 kms races to marathons, cycling, rowing, mountain bike, long length swimming, hiking, mountain climbing, skating...</td>
</tr>
</tbody>
</table>

- **Anaerobic Endurance**: It’s the capacity to extend the maximum effort without enough oxygen. The demands for oxygen exceed the rate of supply and the muscles have to rely on the stored reserves of fuel. The muscles, being starved of oxygen, take the body into a state known as “oxygen debt”.

It can be [lactic](#) or [alactic](#). Both of them produce acidosis (excessive acid in the blood) that allows us to work very intense activities only in a short period of time due to cells cannot adequately perform their duties in an environment so acidic.

### Alactic vs. Lactic

<table>
<thead>
<tr>
<th></th>
<th>Alactic</th>
<th>Lactic</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTENSITY</td>
<td>+ Maximum intensity.</td>
<td>+ Submaximum.</td>
</tr>
<tr>
<td>TIME</td>
<td>+ 3-20 seconds in a repeated way.</td>
<td>+ From 20-40 seconds to 2 minutes approximately.</td>
</tr>
<tr>
<td>ENERGY SOURCE</td>
<td>+ Adenosine Triphosphate (ATP*) and Creatine Phospate (CP***)</td>
<td>+ CP and Muscle Glycogen.</td>
</tr>
<tr>
<td>HEART RATE</td>
<td>+ Not maximum heart rates allowed.</td>
<td>+ Maximum heart rates.</td>
</tr>
<tr>
<td>EFFORT LENGTH</td>
<td>+ From 5-6 seconds to 25-20 seconds.</td>
<td>+ From 30 seconds to 2 minutes.</td>
</tr>
<tr>
<td>EXAMPLE</td>
<td>+ 50 or 100 meters race.</td>
<td>+ 400 meters races.</td>
</tr>
</tbody>
</table>

* ATP is a fundamental nucleotide in cellular energy.
** CP is the main source to replenish ATP.

During Anaerobic activity, your muscles don’t have enough oxygen.

These exercises are shorter but have a very high intensity (sprints, jumps, throwings...).

With anaerobic endurance, you can do these exercises faster and get tired later.
If we extend the effort and intensity, then the lactic anaerobic system starts working (400 meters athletics or 200 meters swimming) where we only burn carbohydrate (muscle glycogen).

If we even extend the intensity and the period of time and so we start Aerobic activity, you start burning carbohydrates, then fat and if it is necessary, proteins.

3. METHODS TO TRAIN ENDURANCE:

<table>
<thead>
<tr>
<th>METHOD</th>
<th>OBJECTIVE</th>
<th>CHARACTERISTICS</th>
<th>EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CROSS (continuous</td>
<td>Improve general endurance</td>
<td>- Mix walking &amp; jogging.</td>
<td>Jogging for 6 minutes followed by 2 minutes</td>
</tr>
<tr>
<td>method)</td>
<td></td>
<td>- Flatlands: field, parks.</td>
<td>walking.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Heart race: 120-140 bpm.</td>
<td></td>
</tr>
<tr>
<td>CONTINUOUS</td>
<td>Improve the aerobic endurance</td>
<td>- Keep same speed.</td>
<td>6 Kms running at 6 min per Km speed.</td>
</tr>
<tr>
<td>RUNNING (continuous</td>
<td></td>
<td>- At the beginning, flatland to avoid muscles</td>
<td></td>
</tr>
<tr>
<td>method)</td>
<td></td>
<td>tiredness.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Gradually introduce light slopes to increase</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>effort.</td>
<td></td>
</tr>
<tr>
<td>FARTLECK (continuous</td>
<td>Develop both aerobic and</td>
<td>- Mixing speeds and distances.</td>
<td>Mixing 300 &amp; 600 meters low-medium intensity</td>
</tr>
<tr>
<td>method)</td>
<td>anaerobic endurance</td>
<td>- Different lands: flat, slopes (up and down.)</td>
<td>with 30-40 meters at 180 bpm.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Heart rate: 130-160 bpm (even 180</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>bpm).</td>
<td></td>
</tr>
<tr>
<td>INTERVAL</td>
<td>Improve both aerobic and anaerobic</td>
<td>- Repetition methods.</td>
<td>2 sets of 4 repetitions of 300 meters race with</td>
</tr>
<tr>
<td>TRAINING (fractional</td>
<td>endurance.</td>
<td>- 100-400 meters (shorter for beginners).</td>
<td>90% intensity, resting 90</td>
</tr>
<tr>
<td>method)</td>
<td></td>
<td>- 70%-90% maximum heart rate; from 120-140 to 180</td>
<td>seconds between repetitions and 4 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>bpm at the end of the race).</td>
<td>between sets.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- At the end of each set you must recover</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(120bpm).</td>
<td></td>
</tr>
</tbody>
</table>

4. ENDURANCE TRAINING FREQUENCY:

To improve the endurance, you can do exercises using big groups of muscles for a long period of time (20-60 minutes) at a medium intensity for around 3-5 days per week.

5. WORKING ENDURANCE WITH PULSE:

The Karvonen method factors in resting heart rate ($HR_{rest}$) to calculate target heart rate (THR) zone, using a range of 50–90% intensity:

$$THR = \left((HR_{max} - HR_{rest}) \times \%\text{ intensity}\right) + HR_{rest}$$

To know your heart rate (HR) you can use a heart rate monitor that can measure your rate. Modern heart rate monitors usually comprise two elements: a chest strap transmitter and a wrist receiver (which usually doubles as a watch).

If you do not know the maximum HR, subtract the subject’s age to 220.
Pulse thresholds table as job objective pursued in the work of Endurance:

- **Very light and soft intensity: 50-60%**: it should be avoided training with less than 50% of the maximum pulse, because it does not improve the physical condition of a person; however it is very useful for recovery or regenerative work, to warm up or to cool down.

- **Moderate intensity: 60-70%**: it is an area for the groundwork of physical fitness or AEROBIC THRESHOLD, highly recommended for people who are new to the sport and want to start building a good physical shape (especially for people who want to lose fat and start in the sport). It is also used in the athletes early season to start settling aerobic base or as specific work for long-term tests.

- **Moderate or high intensity: 70-80%**: this kind of work seeks cardiac performance and efficiency working (using less energy for performing an effort). The body improves its ability to carry oxygen in the blood and this improves endurance.

  Recommended for preparatory training periods to test medium-long term where a large aerobic base is established.

  It is also an area of very effective fat burning. Although the percentage of fat burned with a high pulse is lower, the total calories expenditure is higher, because the body continues burning calories for a while after finishing training to restore normally in the body.

  Bear it in mind if you have a good physical fitness and want to lose weight.

- **Hard intensity: 80-90%**: this is already a threshold (ANAEROBIC THRESHOLD) where fatigue and tiredness has manifestly appeared. It is already a hard training. The body improves its ability to work with acidosis.

  Moreover, the training is anaerobic, I mean, muscles need more oxygen than the body can bring through the blood.

  In principle, the body needs more of a recovery day long if you train in this heart rate zone. The aim is to increase performance and be able to work at a high intensity over time. But it also increases the thickness of the heart wall (interesting from the point of view of health) in addition to spend large amounts of energy (calories) per unit of time.

- **Maximum current: 90-100%**: it is the maximum effort that our organs and muscles can afford. It is an anaerobic workout, that because of its hardness, it can only be applied in very short periods of time.

  Acidosis will work its most, so it is only recommended for workouts that are trying to increase performance, speed or recovery from intense exercise.

  So, for instance, a young lady who is 25 and wants to lose weight (moderate-high intensity), with 65 resting heart rate, you would do the following:

  Step 1: 220 - 25 = 195 (Only if you do not know what the maximum bpm is).

  Step 2: 195-65 = 130

  Step 3: 70% of 130 = 91
Step 4: 80% of 130 = 104
Step 5: 91 + 65 = 156
Step 6: 104 + 65 = 169

Her fitness work (aerobic endurance) should perform in a range between 156 and 169 beats per minute.

6. ASPECTS TO CONSIDER OR RECOMMENDATIONS IN ENDURANCE WORK:

- We always work first aerobic endurance and based on this, anaerobic resistance will be developed.
- It can be worked with attractive formulas like running in company, varied places or resource utilization (mp3, heart rate monitors ...).
- Respect the work intensity (principle of individualization).
- It is important to maintain continuity in working with a gradual increase of effort. Go from little to much.
- Hydrate adequately before, during and after training especially on hot days. From a 2% loss of body water may cause a decrease in performance that could progressively increase to reach a collapse and even sudden death.
- In activities that exceed one hour training, it is advisable to take foods rich in carbohydrates: bananas, nuts, dried fruit (raisins, apricots ...) to avoid the dreaded "sloth", whose symptoms include dizziness, weakness, loss of balance and coordination, unconsciousness.
- There are other fun and motivating exercises to improve aerobic besides race activities such as swimming, walking, cycling, rowing, skating, skiing, etc.

7. ADAPTATIONS AND OTHER POSITIVE EFFECTS OF ENDURANCE WORK

- About the sport:
  + Aerobic endurance is the basis of any training or physical activity.
  + The development of stamina ensures an improvement in the ability to maintain medium or high effort over much longer time and a greater and more effective recovery.

- On health:
  + It delays and decreases the chance of occurrence of cardio-respiratory and musculoskeletal diseases.
  + It's the best and quickest way to lose weight.
  + It has benefits on the cardiorespiratory system: increases the capacity of the heart, increases the volume and thickness of the walls of the heart, increases vascularization (capillary rise), decreases resting heart rate, increase the body's defenses, decrease body fat, increase the transport capacity of nutrients and O₂...
  + It has psychological benefits, helps us to be in a good mood, reducing stress, anxiety and depression, improving self-awareness, concentration...
  + It is cheap and simple, it is to everyone. It does not require large facilities.
  + Healthy lifestyle in general, for instance, you will sleep and rest better causing with that a vitality increasing.