# Do we really study the elite endurance athlete?

## ¿Realmente estudiamos al deportista de resistencia de élite?

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In the literature on endurance sports, many investigators indicate that an elite population has been studied. To mention an example, a simple search with the terms "elite athletic OR elite athlete AND endurance", shows a total of 2060 hits without limiting the position of any of the words in the document, 4 if they are in the title and 48 if they are located in the title or abstract. Limiting the search to 2018, there are 173, zero and 5, in any place in the text, in the abstract and in the abstract and title respectively.

The narrowing of the search to endurance sports is due to the fact that this is where the highest level of physiological integration occurs. Maximum oxygen consumption ($VO_{2max}$) is a key performance parameter in endurance sports. $VO_{2max}$ is achieved when all the components of the Oxygen Delivery System (ODS)[1] are functioning at their maximum potential. Naturally, it must be recognised that this parameter is not decisive in winning an Olympic medal. However, in physiological terms, it is a paradigm of the integrated functioning of the body.

Can the athletes analysed in the various studies and investigations really be considered elite? It is our understanding that, to be considered elite, an endurance athlete must have a $VO_{2max}$ of more than 60 ml/Kg/min. Considering marathon runners to represent a paradigm of endurance athletes, the values of these come within a range of 4.15-4.30 L/min or 68.4-80.2 ml/Kg/min. Even though they are unable to actually achieve all the criteria for $VO_{2max}$, and therefore be $VO_{2peak}$, the reality is that any athlete not achieving values close to those indicated cannot be considered to be elite.

To cite an example, of the 173 hits consulted in 2018, in some of the studies the sample is not characterised, so that it can hardly be regarded as an elite population. In other studies, given that no gruelling methodology is involved, the subjects may be elite athletes, although no reference is made to the physiological characteristics. These two considerations indicate the relevance of these studies, always strictly referring to whether or not they can contribute to the knowledge regarding the maximal physiological response of the body of an elite athlete. In no event are we downplaying the importance of the objectives of each of these studies. The fact is that, in the studies consulted, there is no adequate substantiation of an elite population.

*What could be the reasons for not studying the elite athlete in an investigation?* In my opinion, these are as follows:

Generally, the investigator does not provide the trainer with useful information with regard to the athlete's performance at the time of the study nor future prospects.

On occasions, when performing certain tests proposed by the investigator, the athlete may be at an increased risk of injury.

The training conditions of an elite athlete cannot and must not be altered by an investigative study.

When a specific goal (Olympics, world championships, European championships) is at stake for an endurance athlete, then all the reasons listed above make trainers shy away from any investigation proposal. Not even those trainers with sound training in exercise physiology, therefore making the study of interest to them, will authorise their athletes to take part in investigative studies. There is no "reward" whatsoever, particularly with regard to the risks involved for their athletes in taking part in an investigative study. The trainer and athlete would be interested in "physiologically" knowing the optimal physical condition in order to understand the changes caused by training. It is necessary to bear in mind that the optimal condition is reached in a very short

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space of time (20-30 days), however the difference lies in achieving it at just the right moment.

Only two conditions can determine whether or not endurance athletes form a study population: 1) risk to their health and 2) that it could hypothetically benefit performance. For example, with regard to sports cardiology, numerous studies are made with elite athletes in order to determine possible causes of sudden death and how to prevent such causes in sport, and studies to look at the physiopathological repercussion of intensive training. In any case, neither of these two conditions indicated conflict with any of the reasons given above for which I consider that elite athletes are not a study population.

*1. The investigator does not provide the trainer with relevant information.* The most common physiological parameters for evaluating performance in endurance sports are $VO_{2max}$ and the aerobic-anaerobic transition. Two relevant questions are set out below: 1) Do elite endurance athletes show changes in these two parameters over a season or various seasons? and 2) Are the methods used to determine these two parameters sensitive enough to evaluate elite athletes?

In a review article, Benito *et al*[2] indicate that $VO_{2max}$ shows a very slight variation over a season, although it is true that the highest values are to be found when athletes are "more trained". However, account should be taken of the fact that daily intra-individual variations in the $VO_{2max}$ values can reach 4 to 15% depending on the intensity achieved and the sensitivity of the measuring devices. Therefore, the indication that a certain athlete has a high $VO_{2max}$ value is of no importance to the trainer, given that the measuring methods do not discriminate between small variations in performance through an integration parameter. The trainer obtains more information on the athlete through simpler, but more practical methods such as running speed, critical power and the lactic threshold. All these parameters can be obtained without taking unnecessary risks. Today, technological development makes it possible to perform "effort tests", called "field trials" because they are performed in the athlete's own environment. Although they are unquestionably subject to the same problems as the desktop respiratory gas exchange instruments, they can provide some responses and solutions to the questions raised by trainers.

On the other hand, as indicated by Benito *et al*[2], the aerobic-anaerobic transition experiences a considerable fluctuation between the different training stages. In a review made by these authors, the ventilatory threshold 1 (VT1) ranged from 0.5% to 22% and ventilatory threshold 2 (VT2) from 2.5 to 12.8%. A greater variation was found in the lactic threshold (0% to 36.8%). These differences are attributed to the different process designation of the aerobic-anaerobic transition and to the methodology used to determine it. With regard to this review, particular mention should be made of the work conducted with professional cyclists3. The variation experienced between different periods measured was less than 2%. The relevant point of this doctoral thesis was that no significant differences were found between the optimal physical condition and that of a few months earlier, although there was a significant difference in relation to the situation at the start of the season.

*2. Increased probability of injury and adaptation of the investigative study to the schedule* Related to the argument above, elite athletes and trainers cannot risk injury by doing, for example, a maximal effort test. Thus, although there are treadmills adapted to athletes, none of these meet two obvious requirements: 1) assurance that an inadequate stride cannot cause an injury of varying severity and 2) the treadmill biomechanics differ considerably from what is performed in the field; in the first case, the supports are to prevent the runner from going backwards while, in reality, the supports are for moving forwards. From a neurophysiological point of view, in other words, the control of movement, there is a huge gulf.

To this problem, we need to add the specificity of the endurance sport. Swimming is the paradigm of specificity. A "specific ergometer" has been developed solely for swimming, known as the swimming flume. However, regardless of the high financial cost of this device, the biomechanical problem of the treadmill is even more evident. It is therefore not surprising that athletes do not maximise their performance when doing a given test and perform tests that are clearly submaximal. When an athlete undergoes an annual sports physical, which includes the effort test with an a respiratory gas exchange analysis, from the point of view of evaluating performance, it should be questioned whether the data provided are relevant to the athlete and his/her trainer when applying such data to training.

Any proposal to conduct an investigation on elite athletes will inevitably have to adapt to the seasonal schedule. So, for example, an athlete whose schedule includes training at altitude at a moderate training load, cannot undergo a study in which high intensity training is proposed. Likewise, when an athlete is in optimal physical condition, it is not advisable to conduct a maximum effort test. Therefore limited "physiological" data are available for athletes in optimal or very good condition.

To sum up, only under exceptional circumstances are the elite athlete population really the subject of an investigative study. From a physiological point of view, the scientific measuring instruments are not precise enough to characterise not only the Olympic or world champion but also any finalist. On the other hand, in methodological terms, once an elite athlete is in top condition, it is complicated to conduct an investigation. Moreover, the risk of injury or altering the schedule makes it practically unfeasible to "conduct a test with the elite". In summary, two examples have been engraved on my mind.

The extraordinary athlete Kenenisa Bekele did an impressive 10,000m race, at a high pace (13 min 40 sec at 5,000) but he was able to do the final kilometre in impressive time (2 min 30 sec). While watching the race on TV, I asked myself "where would he get the energy from to do this impressive change of pace? My next immediate thought was that, assuming that I had the utopian opportunity to study him "to do an effort test on him, even simulated at 10,000 would serve no purpose": It would neither clarify my doubts, nor would he or his trainer gain anything from it, by reducing my information to the banality that he was very good.

On the other hand, on one occasion I had the opportunity to evaluate a cyclist, who went on to win the Tour de France twice. I saw him when he was young, just 16. I can still recall the conversational remarks of his trainer - discoverer at the time. "Javier this boy is grand reserve". What "physiological" basis did the trainer have for affirming the cyclist's potential, if he hadn't even performed the effort test? Naturally, I could make no "physiological" contribution to back-up his trainer's "prediction". Logically, once he had become an elite athlete, I had no chance to make another assessment.

## Bibliography


1. Calderón Montero FJ. *Análisis integrado de la respuesta del organismo al ejercicio. Fisiología humana. Aplicación a la Actividad Física*. Madrid. Editorial Médica Panamericana. Madrid; 2018. p 389-97.
2. Benito PJ, Peinado AB, Díaz Molina V, Lorenzo Capellá I, Calderón FJ. Evolución de los parámetros ergoespirométricos con el entrenamiento en deportistas. *Arch Med Dep.* 2007;122:464-75.
3. Pardo Gil FJ. Evolución de los parámetros fisiológicos en ciclistas profesionales a lo largo de una temporada (Tesis Doctoral. Universidad Politécnica de Madrid) 2002. Disponible en: https://dialnet.unirioja.es/servlet/tesis?codigo=185718



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