

Letter to editor

## Concentric and Eccentric: Muscle Contraction or Exercise?

### Dear Editor-in-Chief

This inclusion considers the use and possible misuse of the terms “Concentric and Eccentric” in three possible contexts: first, the origin of terms; second, different approaches; and third, the possible uses. To the best of our knowledge, twenty-six articles [i.e. (Barstow et al., 2002)] have been published in *Journal of Sports Science and Medicine* misusing the term “concentric/eccentric exercise” while nine [i.e. (Coombs and Garbutt, 2002)] articles have used the terms correctly. The purpose of this letter is to foster the use of the terminology 'positive/negative work' together with 'concentric/eccentric contraction' to ease references search (i.e., through key words) and comprehension.

### When these terms initially appeared and what do they mean?

The origin of the terms “Concentric and Eccentric”, were related to muscle contraction in basic physiology science. Back in “1925”, Hill defined two types of muscle contractions (Hill, 1925): isometric (muscle length does not change during contraction) and isotonic. In this latter contraction, tension remains unchanged while the muscle's length changes. There are two types of isotonic contractions: (a) concentric and (b) eccentric (Hill, 1925). In a concentric contraction, the muscle tension rises to meet the resistance, then remains stable as the muscle shortens. During eccentric contraction, the muscle lengthens as the resistance being greater than the force the muscle is producing.

### Which areas do the terms concentric/eccentric cover?

In the following years these terms “Concentric and Eccentric” were much used in scientific manuscripts in different areas: physiology, biomechanics, and neuromechanic. On *PubMed* a search concerning the years (1975 to 2012 yrs included), found  $n = 190087$  articles using the words “muscle contraction” vs.  $n = 2302/1582$  articles with “eccentric/concentric exercises”. Several authors have misused the term “concentric/eccentric work or exercise” for an exercise with displacement of the body upwards to overcome gravity (positive work) or landing (negative work). Whereas the terms “Eccentric/Concentric” are linked to a muscular behavior, we believe that this cannot be used in all contexts.

### Is it judicious to use (only) Eccentric/concentric for exercises?

From the point of view of physics, during the positive (rising/accelerating) or negative work (lowering/decelerating) (Asmussen 1953) some muscles are in eccentric mode. For instance, during concentric elbow flexion, the biceps brachii contracts concentrically, whereas the an-

tagonist muscle, the triceps brachii, contracts mildly eccentrically – to allow movement precision. Differently, during resisting at the leg-press machine, the quadriceps contracts eccentrically, whereas the biceps femoris contracts mildly concentrically – to allow movement precision. In both cases, a necessary dynamical description of the exercise – e.g. ‘there is positive/negative work’ – is missing. About the first example, it should be underlined the development of positive work, while the second example is featured by negative work.

Further, the use of these terms in both exercise and muscle contraction has created confusion (Faulkner, 2003). Considering the needs to clarify this question we propose that “positive or negative work” (Bosco et al., 1982) terms are more appropriate for describing some exercise while in another context would be more correct to use “flexion – extension” or “adduction – abduction” or “traction or pushed per multi-joint exercise” for instance (Zatsiorsky and Prilutsky, 2012).

The correct use of terms “Eccentric and concentric” can be valuable for understanding results in a journal article and deciding whether the authors’ conclusions are justified by the data. To avoid confusion, words such as positive (concentric) or negative (eccentric) exercise are preferable. They indicate the importance of the outcome and hence what was probably intended. We believe Sports Science still presents some confusion for some other concepts and we invite all our colleagues to discuss them in letters to the editors as we did in this short letter.

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### Acknowledgements

We are grateful for the advice given by Professor Luca Paolo Ardigo.

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