

Response to Letter to the Editor re: "Half-time and high-speed running in the second half of soccer"

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We thank Drs Lovell and Weston for their correspondence [4], and the Editor for the opportunity to respond to their letter. There appear to be a couple of substantive issues arising from their letter and several minor comments.

Firstly, our results are not "unique" and the implication by Drs Lovell and Weston seems unwarranted. We have directly validated the GPS equipment used in the study (which is clearly stated and referenced in the original manuscript [6]) and referenced other studies which found no difference in the distance completed by high-speed running when the first 15 minutes of each half of match play were compared in top class and moderate standard male players ([5] please see Figure 3), and female players competing at international and domestic level ([1], please see Figure 1). Whilst the pacing, in terms of changes in speeds of running across the 15 minute periods of the matches, is potentially influenced by tactics and playing experience as well as the large variation between matches [2], it is unlikely that this explains the lack of difference in high speed running.

Lovell and Weston also question the "validity" of using the first portion of a football match (be it of 5 or 15 minutes duration) as an appropriate comparison period given its "intense and frenetic nature" ([4], second paragraph). Their use of the word validity implies there is some accepted 'gold standard' or criterion approach; this is factually misleading. While there may be debate, and the two pieces of correspondence published here may be indicative of this, the question is: What portion of a match should be used to compare or normalise against?

Given that players are at their least fatigued and, if they have completed a pre-match warm up sufficiently close to kick-off, likely to be experiencing the benefits associated with elevated muscle temperature (see discussion paragraph 5), utilising the activity characteristics of the first 5/15 min of the first half to compare other portions of the match against would seem theoretically sound and justified. The correspondents may advocate a different approach, but as I am sure they will know the one used in our manuscript is the one chosen by a number of other authors, including themselves on occasion. Whilst Drs Lovell and Weston might advocate a different approach, that taken in our paper is perfectly reasonable and allows comparison with previous research; deciding which portions of a match to 'normalise' against is quite reasonably open to debate. As such it is appropriate that it encourages academic dialogue.

Lovell and Weston also note that passive half-time intervals cannot be assumed in time-motion studies. This is a valid point generally but, as we did not assume this, it is not relevant with respect to our study. We observed and recorded what the players who participated in our study did prior to play and at half-time, as clearly described in our methods. They also make reference to a "strong assertion" we apparently made

regarding the efficacy of re-warm-up. The statement to which they refer (discussion first sentence, paragraph 5) is part of a substantial paragraph discussing our study's findings and its implications. Our study found that even with a pre-match warm up, there was no difference in high-speed running completed when the first 5 / 15 minutes of play was compared with the same period post-half time when there was no re-warm up. As outlined in the paper, there may be a number of possible reasons for our observations, but the delay between the end of warm-up or re-warm-up and the commencement of competitive play is probably key (discussion paragraph 5). The paper never advocated the elimination of warm-up or re-warm-up we merely examined what was happening in real competitive conditions and discussed some of the potential implications arising from these observations. It is not enough to demonstrate something can work in a laboratory or otherwise optimal conditions if a key aim is to subsequently apply a particular procedure in non-laboratory or less than optimal conditions. It is essential to know what happens in practice and in turn what are the implications of this. Given the delays that may occur between the end of a warm-up and the beginning of competitive match play in many situations and the necessity for other activities such as tactical discussions at half-time, it is simplistic to assume that any warm-up will be beneficial in performance terms (see paragraph 5). The correspondents are entitled to their interpretation but we do not believe that when the paragraph and associated paper is read in its entirety their interpretation is inevitable.

We are happy to have our attention drawn to 2 papers by the correspondents [3,7], but clearly their findings could not have been considered in the paper we published as they were not in the public domain at the time of its submission. Given the ever increasing volume of research and the guidelines set by journals it is inevitable that there will be some debate among authors, reviewers and indeed readers, regarding which academic papers should be referenced and which should not. We feel we gave due acknowledgement to the weight of available evidence given this was a research paper and not a review. If the correspondents feel there was insufficient acknowledgement to their work, it was not deliberate and clearly their correspondence will go some way to addressing any perceived oversight.

We believe that acknowledging weaknesses in one's work is an integral part of the scientific process and we have tried to acknowledge any shortcomings. In hindsight it may well be that an alternative analytical strategy (multi-level modelling) may have been a more optimal analysis methodology. There is clearly scope for further research investigating how both warm-ups and re-warm-ups at half-time impact on soccer performance. Our paper "Half-time and high-speed running in the second half of soccer" provides an observational description of what actually occurs during competitive soccer matches.

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