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Re-thinking athlete training loads: little rocks and big rocks can be understood with a multivariable approach

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Dear editor,

I would like to praise the authors (Renfree et al., 2021) for raising a very important issue regarding training load quantification; that is, all training loads are not created equally. Renfree et al. (2021) illustrate that a given training load, derived as a single unit as the product of exercise intensity and volume (i.e., duration), can manifest from vastly different combinations of intensity and volume. Furthermore, the quantification of a given training load value is typically biased towards longer duration training sessions and may underestimate the stress imposed by shorter, very high-intensity sprint training sessions. While it may not have been within the scope of the author's brief commentary to suggest solutions to this issue (Renfree et al., 2021), it is imperative that recommendations are proposed in order to provide coaches and practitioners with a better understanding of how the nature of a given training load may impose a vastly differentiate physiological, psychological and/or tissue stress.

The two major considerations that were discussed by the authors was the failure of some training load metrics to account for the non-linearity in the exercise intensity-response above the lactate turn point and the lack of context to differentiate between two training sessions that may accumulate an equivalent training load yet impose a vastly different training stress. In order to better account for these considerations, the individualised training impulse (i.e., iTRIMP) metric has been described by Manzi et al. (2009). The iTRIMP metric is derived as the product of the duration of a specific training session multiplied by the average ΔHR, whereby the ΔHR is weighted by a multiplying factor (y). The weighting factor assists in avoiding a disproportionate importance provided to long-duration, lower intensity training sessions at low ΔHR levels compared with intense but short-duration activity. While this may reduce the bias given to longer duration training sessions associated with other training load metrics, it is still conceivable that vastly different training sessions (i.e., long low-intensity or shorter high-intensity) may register similar training loads despite imposing a very different training stress. Furthermore, training load metrics derived from heart rate may fail to account for the stress imposed by short, very high-intensity sprint work intervals, despite being associated with a very large psychological and/or tissue stress (Impellizzeri et al., 2019). As such, no single training load metric can be relied upon that can differentiate the stress imposed by a given training session. A multivariable approach is required in order to provide more context for a single measure of training load, as well as the fatigue and adaptative outcomes in response to variation in training load.

I would advocate that physiological (i.e., heart rate derived), psychological (i.e., rating of perceived exertion) and external (i.e., running speed) measures of training intensity should be employed to determine intensity method-specific training load quantifications. The integration of all 3 measures of training load could be used to quantify training load ratios derived from different intensity measures to identify fatigue and/or quantify changes in fitness (Sanders et al., 2018). Furthermore, the way in which athletes distribute their training across the training-intensity spectrum (i.e., training-intensity distribution; TID) could be determined employing a time-in-zone approach. Appreciating the TID would assist in differentiating between training sessions that may accumulate an equivalent training load with vastly different combinations of intensity and volume (Bellinger et al., 2019). For example, a training session consisting of 20 minutes at 85–95% maximum heart rate may accumulate 15-20 minutes in training zone 3 (i.e., above the lactate turn point), while a training session consisting of 40 minutes at 65–70% maximum heart rate may accumulate 35-40 minutes in training zone 2 (i.e., between the lactate threshold and lactate turn point). Despite a vastly different TID, both sessions may render a similar heart rate derived TRIMP (Renfree et al., 2021). Lastly, as highlighted by Paquette et al. (2020) the addition of biomechanical metrics may improve estimates of training stress in runners during short, very high-intensity sprint interval sessions whereby the total training load may be very small, despite the high effort and tissue stress. For example, a track running session consisting of 2 × 400 m at maximal effort, with full recovery between repetitions would likely register a very small training load derived from the majority of metrics (Renfree et al., 2021), which does not reflect the training stress associated with this session. However, the inclusion of a biomechanical metric that considers the cumulative lower limb load may better reflect the tissue stress associated with maximal sprinting (Verheul et al., 2020). Nonetheless, as noted by the authors (Paquette et al., 2020; Verheul et al., 2020), future research is required to validate biomechanical metrics that could be used to quantify the stress associated with very high-intensity track sprint sessions.

Quantifying the training load of athletes is imperative to better understand the extremely complex performance adaptation process and it is extremely unlikely that any single training load metric can contextualise this training stress-response continuum. Indeed, no single marker has been identified that can measure the fitness and fatigue responses to exercise or accurately predict performance (Borresen & Lambert, 2009). Thus, a multivariable approach to monitoring training load is the way forward, whereby the physiological, perceptual and tissue stress responses to a given external load are appreciated, as well as how these responses are distributed across the training intensity spectrum.

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