Aerobic Conditioning in Football: Is Zone 2 Training Outdated?

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High-Intensity Interval Training (HIIT) | Zone 2 Training | Aerobic Conditioning | Football Training | Physiological Adaptations | Training Efficiency | Player Phenotypes

Headline

In contemporary football, the efficiency and effectiveness of training methods are subjects of critical importance and frequent debate. One such method under scrutiny is Zone 2 training—long-duration, low-intensity runs (i.e., below the 1st ventilatory threshold, VT1) traditionally valued for building aerobic capacity. There has been a belief since the days of Arthur Lydiard in the 60's for runners, and Tour de France riders and their coaches at about the same time, that spending substantial training time at your Zone 2 intensity is an effective means of improving cardiovascular endurance, the ability to oxidize fat as fuel, and enhance performance.

This opinion piece, inspired by discussions from my (MB) October 2023 appearance on the Football Fitness Federation podcast (Episode #262), along with ongoing conversations with peers and mentees, questions the relevance of Zone 2 training in the context of football.

We argue that High-Intensity Interval Training (HIIT) may serve as a more suitable and effective alternative in this specific context. This piece will explore not only the challenges of incorporating Zone 2 into the demanding schedules of professional players but also the significant concern that Zone 2 training takes valuable time off the ball, not addressing what matters most—playing football and improving team tactics. We will consider the motivational impacts of such training on today's football players, particularly given its questionable suitability for certain phenotypes. We will also evaluate whether the physiological benefits attributed to Zone 2 could be achieved more efficiently through HIIT.

Aim

By dissecting these aspects, we aim to demonstrate why Zone 2 training might not be the most strategic approach in the evolving landscape of football conditioning.

Argument 1: The Difficult Justification of Off-Field (Zone 2) Training in Football

The prevailing philosophy in football training stresses the necessity of seeing physical conditioning as an intrinsic part of the sport rather than treating it as an additional component. This approach is extensively detailed in Principle 10 of a recent paper, "11 Principles of Football Periodization," (Buchheit 2024), and was a focal point of discussion during my (MB) chat with Raymond Verheijen on the Training Science Podcast (Training Science Podcast 2024).

In football, every aspect of training should directly contribute to enhancing game performance, which primarily involves improving player interactions and tactical execution on the pitch. Therefore, when considering taking players off the field for conditioning, it must be justified by the inability to achieve those specific physical adaptations through football-specific activities. An example of such a necessity might be the development of maximal strength or specific physical attributes, which require tailored training like weight lifting, for example, elements that cannot be replicated through on-field activities. This principle underscores the importance of ensuring that any time spent away from football-specific training is both minimal and strategically employed to target adaptations that are unattainable through standard football drills.

Furthermore, much of a football player's time—approximately 70% during matches—involves low-intensity activity similar to Zone 2, questioning the necessity of additionally dedicated sessions.

Argument 2: The Phenotypic Mismatch of Zone 2 Training

Recent research into the physiological profiles of modern, fast and explosive footballers (Haugen 2013), such as the findings from Lievens at al. (Lievens 2021), underscores the incompatibility of Zone 2 training with the dominant player phenotypes in contemporary football. These studies reveal that players characterized by fast-twitch muscle fibers exhibit a diminished running economy when exercising at low speeds (Figure 1, Lievens 2021), greater neuromuscular fatigue development during high-intensity efforts -with the longer the effort the greater the fatigue- (Figure 2, Lievens 2020), slower neuromuscular recovery post-session (Figure 3, Lievens 2020), and poorer responses to high training loads in comparison with endurance-profile players (Figure 4, Bellinger 2020). Such heavy-volume training regimens often lead to signs of overtraining, and increased fatigue, which in turn can elevate the risk of injuries (Lievens 2021).

Zone 2 training, with its emphasis on sustained low intensity, does not cater to the needs of these explosive athletes, who typically benefit more from training modalities that match their high-intensity, short-duration performance characteristics seen in actual gameplay. The mismatch between the Zone 2 training method and modern players' phenotype directly questions the use of this practice.

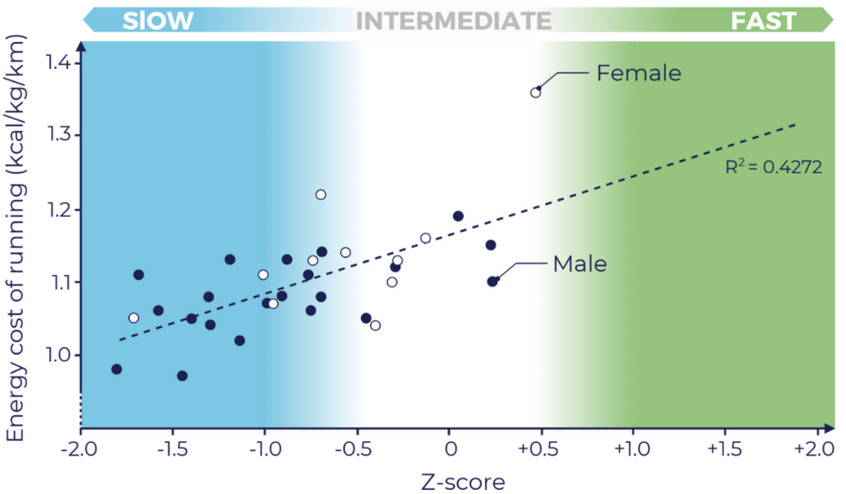

Fig. 1. **Relationship between between proton magnetic resonance spectroscopy estimation of muscle fiber typology (gastrocnemius carnosine z-score) the energy cost of running. Figure taken from Lievens 2021.**

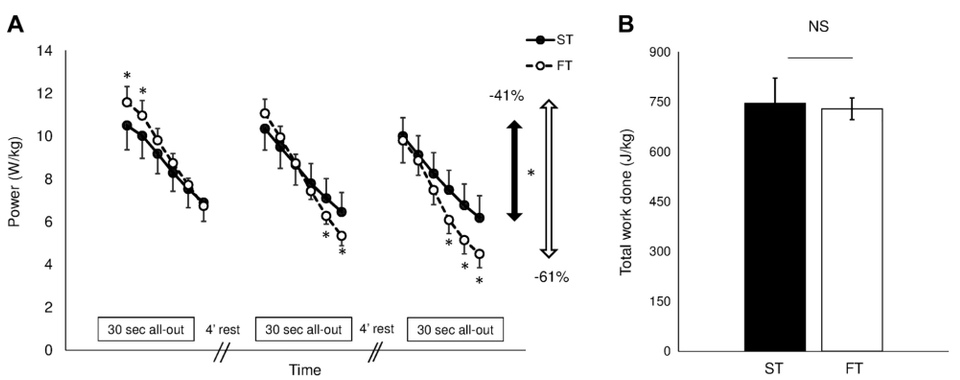

Fig. 2. **Fatigue profile of slow typology (ST) and fast typology (FT) groups during 3 repeated Wingate tests interspersed with 4 min of rest. A: power drop was significantly higher in FT (-61.0%) compared with ST (-40.9%). B: total work done over repeated Wingate tests was equal between groups. Means±SD are presented. *Significantly different between groups. NS, nonsignificant. Figure taken from Lievens 2020.**

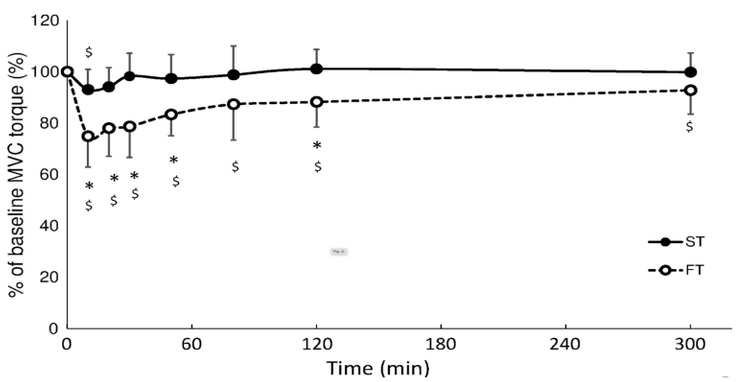

Fig. 3. **Recovery of maximal voluntary contraction (MVC) torque after 3 repeated Wingate tests. Values are mean±SD % of maximal baseline torque. *Significantly different between groups; significantly different from baseline. ST, slow typology; FT, fast typology. Figure taken from Lievens 2020.**

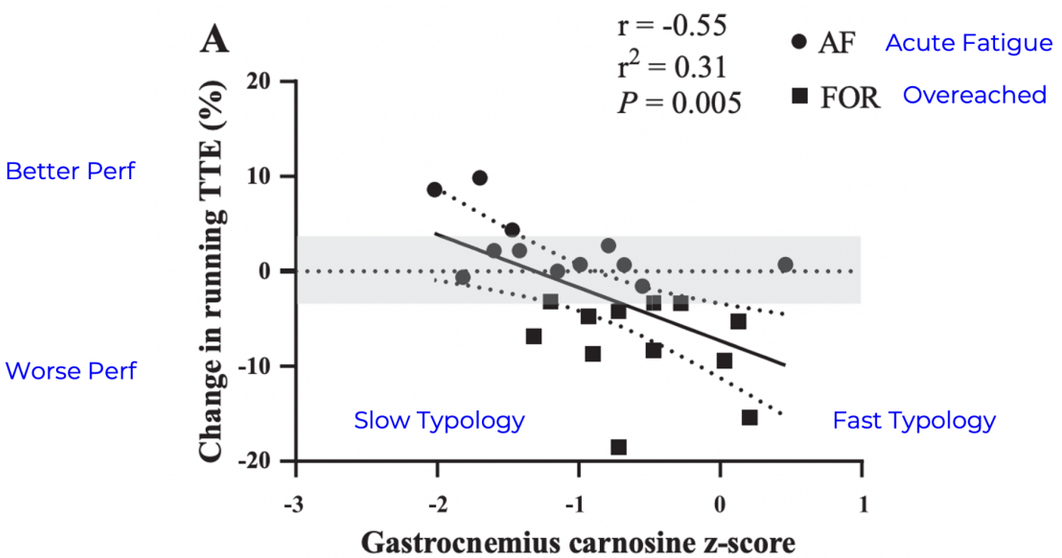

Fig. 4. **Association between proton magnetic resonance spectroscopy estimation of muscle fiber typology (gastrocnemius carnosine z-score) and the relative change in time to exhaustion from pre- to post-high-volume training (HVTr) Linear regression was used and all subjects were included in the analysis regardless of group (i.e., functionally overreached and acutely fatigued; n = 24 in total). Figure taken from Bellinger 2020.**

Argument 3: Equivalent Molecular Signaling and Greater Alignment of HIIT Over Zone 2 Training with Football Demands

The efficacy of Zone 2 training for achieving specific physiological adaptations in football players is increasingly debated. Research suggests that HIIT can offer similar if not superior physiological benefits within a framework that is better suited to the demands of professional football (Laursen & Buchheit 2018). The advantages of HIIT over Zone 2 can be detailed through three key points:

1. Molecular Signaling

While both HIIT and prolonged Zone 2 exercises activate key molecular pathways such as AMPK and calcium–calmodulin kinases (Figure 5, Laursen 2010), essential for developing an aerobic muscle phenotype, the evidence strongly supports the notion that HIIT can achieve these adaptations as effectively as Zone 2 training. Once it is acknowledged that similar physiological outcomes can be attained through HIIT, the argument for the continued use of Zone 2 training diminishes. There is no substantial evidence to suggest that Zone 2 provides more or different physiological adaptations than HIIT. Furthermore, while Zone 2 may promote increased parasympathetic activity (Laursen 2010, Plews et al. 2013), potentially serving as a recovery tool, players already have access to a variety of recovery strategies, such as cold water immersion (Al Haddad 2012) and other recovery modalities. This broader context of recovery options further reduces the necessity for Zone 2 training, highlighting HIIT as not only a sufficient alternative but also a more versatile and time-efficient method for achieving the desired aerobic adaptations in football training programs (Laursen & Buchheit 2018).

2. Volume of Work and Kinetic of Adaptations

Zone 2 training requires a high volume of activity to induce meaningful physiological changes (Laursen 2010), which can be logistically challenging and less appealing to players. In contrast, HIIT achieves these physiological benefits through more intense, shorter sessions, making it a more practical choice for teams with limited time that need to optimize their training schedules (Laursen & Buchheit 2018). Additionally, HIIT protocols involving sets of 6-8 minutes, conducted once or twice a week, are sufficient to create significant adaptations, improving performance measures such as a +1km/h increase at the 30-15 Intermittent Fitness Test (VIFT). Remarkably, only 4-8 sessions in total are required to achieve these benefits, with additional sessions not resulting in greater effects (Figure 6, Buchheit 2021). This efficiency makes HIIT particularly advantageous for football teams aiming to maximize physiological gains within a condensed training period.

3. Integration of Football-Specific Actions

Perhaps most critically, HIIT allows for the inclusion of football-specific movements and skills (Buchheit 2019), which enhances its relevance and applicability to actual training and game scenarios. This is a significant advantage over Zone 2 training, which typically involves steady, prolonged activities like jogging that do not allow the integration of football actions. This specific integration ensures that HIIT not only maintains but enhances player readiness for the tactical and physical demands of competitive play.

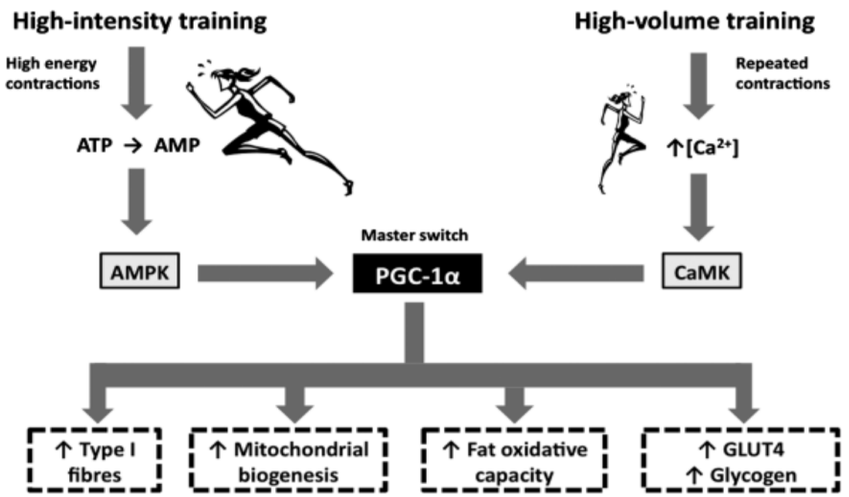

Fig. 5. **Simplified model of the adenosine monophosphate kinase (AMPK) and calcium–calmodulin kinase (CaMK) signaling pathways, as well as their similar downstream target, the peroxisome proliferator-activated receptor-g coactivator-1a (PGC-1a). This "master switch" is thought to be involved in promoting the development of the aerobic muscle phenotype. High-intensity training appears more likely to signal via the AMPK pathway, while high-volume training appears more likely to operate through the CaMK pathway. ATP, adenosine triphosphate; AMP, adenosine monophosphate; GLUT4, glucose transporter 4; [Ca^{2+}], intramuscular calcium concentration. Figure Taken from Laursen 2010.**

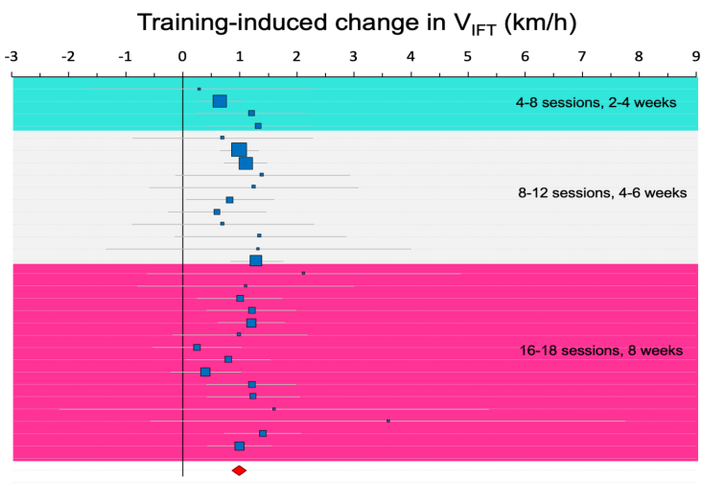

Fig. 6. **Training-induced changes (90% confidence intervals) in performance for the 30-15 Intermittent Fitness Test (VIFT) as a function of study duration and number of sessions. The size of the squares is related to each study sample size. Figure taken from Buchheit 2021.**

Conclusion

The debate surrounding the appropriateness of Zone 2 training for football players is vital in an era where training efficiency and specificity are paramount. This opinion piece has critically assessed the role of Zone 2 training and argued for the superior benefits of HIIT within professional football. By examining the compatibility of training methods with player phenotypes, the physiological adaptations provided by HIIT, and the ability of HIIT to incorporate football-specific actions, it becomes evident that HIIT is not just an alternative but a preferable option in the context of modern football training. The evidence suggests that HIIT offers similar or enhanced physiological benefits compared to Zone 2, in a more time-efficient manner and in alignment with the dynamic nature of football. Therefore, football trainers and coaches are encouraged to reconsider the prominence of Zone 2 in their training regimens, in favor of more time-efficient, integrated, and game-specific conditioning approaches.

Summary of Main Points

- **Integration of Conditioning**: Only essential physical adaptations that cannot be achieved on the pitch, such as maximal strength, justify taking players off the field.
- **Phenotype Incompatibility**: Modern footballers, particularly those with fast-twitch muscle fibers, do not respond optimally to Zone 2 training. This method can lead

to overtraining, reduced performance, and increased injury risk, making it less suitable for explosive athletes.
- **Molecular Signaling**: Both HIIT and Zone 2 activate key molecular pathways necessary for aerobic development. Once it is acknowledged that similar physiological outcomes can be attained through HIIT, the argument for the continued use of Zone 2 training diminishes.
- **Volume and Intensity**: HIIT provides necessary physiological adaptations with less time compared to the high-volume demands of Zone 2, aligning better with the tight schedules of professional athletes.
- **Integration of Football-Specific Actions**: HIIT allows for the inclusion of football actions, enhancing tactical and physical readiness for games, unlike Zone 2, which involves non-specific, steady activities.
- **Recovery and Parasympathetic Activity**: While Zone 2 may be beneficial for increasing parasympathetic activity and aiding recovery, football players already have access to a range of effective recovery strategies, reducing the need for Zone 2 as a primary recovery training method.

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