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INVITED COMMENTARY

# What Is "Zone 2 Training"?: Experts' Viewpoint on Definition, Training Methods, and Expected Adaptations

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***Background:*** The role of high-volume low-intensity training for enhancing endurance performance has gained growing interest in recent years. Specifically, so-called "zone 2 training" is currently receiving much attention, and many propose that this is the target intensity at which a large proportion of total endurance training should be performed. However, despite the popularity of this concept, there is no clear consensus among coaches, athletes, and scientists regarding the definition of zone 2 training. ***Purpose:*** This commentary summarizes the perspectives, experience, and knowledge of an expert panel of 14 applied sport scientists and professional coaches with the aim of providing insight and a basis for definitional consensus on zone 2 training. Moreover, potential training strategies at this intensity are proposed, and the expected physiological adaptations when exercising at this intensity and related research gaps are also discussed. ***Results:*** Experts reached consensus that zone 2 training should preferably be performed at intensities located immediately below the first lactate or ventilatory threshold through continuous, variable, or interval-type sessions. Furthermore, experts expected a broad range of central and peripheral adaptations from zone 2 training. These expected adaptations might not be unique to zone 2 and could also be induced with sessions performed at slightly higher and lower intensities. ***Conclusions:*** This commentary provides practical insight and unified criteria regarding the preferred intensity, duration, and session type for the optimization of zone 2 training based on the perspectives of acknowledged sport scientists and professional coaches.

***Keywords:*** exercise, intensity, prescription, cycling, endurance

Successful training programs in any sport involve correct manipulation of the training variables frequency, intensity, and volume to achieve peak performances at specific times in the competitive season while minimizing the risk of injury and maladaptation.[1] Previous research has highlighted that volume plays a key role in promoting endurance training-induced adaptations (including, but not limited to mitochondrial biogenesis), and evidence shows that world-class endurance athletes in general and cyclists in particular tend to perform large training volumes at low intensities, typically defined as below the first lactate or ventilatory threshold (<LT1/VT1).[2] It is worth noting, however, that this "low-intensity" training range can be quite broad in well-trained endurance athletes. Moreover, there is little available research to make clear distinctions regarding the adaptive impact of different intensity and duration prescriptive combinations within this intensity range.

Despite a growing interest around the importance of high-volume low-intensity training for inducing key peripheral and central adaptations, there is a lack of consensus regarding the optimal intensity for this purpose. Currently, so-called "zone 2 training" is being broadly discussed in social media and training circles when attempting to more narrowly define the preferred intensity at which low-intensity training should be performed. Recent studies have highlighted the importance of being able to clearly decipher between training zones and specifically zone 2 to aid in understanding the progression of secondary performance metrics in endurance sports such as rowing.[3] However, referring to intensity zones can be misleading, as their demarcation can be performed using different physiological or perceptual markers, such as rating of perceived exertion (RPE), blood lactate concentration, percentages of maximal heart rate (HR), or

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percentages of power maintained for some criterion duration. Previous evidence suggests that demarcation variables, such as lactate and ventilatory thresholds show large limits of agreement and should not be used interchangeably.[4,5] Therefore, they could result in variable training intensity zone divisions. Whereas some authors such as Skinner and McLellan[6] propose as few as 3 intensity zones, others propose 5, and some as many as 7 zones.[7,8]

Given all the above, if not consensually defined, "zone 2" might be interpreted as quite heterogeneous intensities requiring variable training methods and inducing different training responses. Accordingly, this commentary seeks to improve communication among scientists, athletes, and coaches by synthesizing a (current) consensus view from the perspectives, experience, and knowledge of an expert panel of applied sports scientists and coaches.

# Methods

A lead group of 2 authors (Sitko and Viribay) initiated discussions to develop a consensus document. Subsequently, 12 additional sports scientists and professional cycling coaches were invited to join the expert panel to formalize this document and establish recommendations regarding zone 2 training in cycling. The final panel comprised 14 male experts representing 8 different countries, bringing a wealth of knowledge from their experience in coaching professional cycling teams and riders, as well as their contributions to high-impact scientific publications on cycling training.

The lead authors conducted a thorough literature review using PubMed and MEDLINE to identify relevant peer-reviewed articles on training intensity distribution and zones in cycling. Based on the consulted literature, the lead authors drafted the initial version of the document, which posed 3 critical questions that were considered as the most relevant for the structure of the commentary: (1) How do you define zone 2 training? (2) What is your preferred method for implementing zone 2 training? and (3) What key physiological adaptations do you anticipate from zone 2 training? These questions were circulated to the full author group for preliminary feedback.

The reviewed draft included aggregated and unified responses to the aforementioned questions, compiled by the first and last authors. Email discussions facilitated accurate interpretation of the initial feedback and contributed to the manuscript's development. The responses were categorized into 3 themes: intensity, training, and adaptations. This revised document was returned to the authors for a third round of review, during which consensus was achieved.

## Zone 2 Definition

### Preferred Intensity-Distribution Mode and Zone 2 Location

Twelve experts reported that, for training prescription purposes, they used a 5-zone model for the aerobic intensity distribution, with additional 1, 2, or 3 zones for supramaximal intensities (ie, above maximum oxygen uptake [$VO_2$max]). Two experts did not use any additional zone for intensities higher than traditional $VO_2$max. These 5 zones were simply aligned within a typical 3-zone model obtained through graded exercise testing performed in a laboratory setting.[9] These 3 main zones were delimited by lactate and ventilatory turn points: LT1 or VT1 were used to separate zones 1 and 2. On the other hand, lactate or ventilatory turn points 2 (LT2 and VT2, also known as respiratory compensation point) demarcated zones 2 and 3.[4] When using the 5-zone model, experts located zone 2 just below LT1 or VT1. Figure 1 presents the alignment between both models.[10]

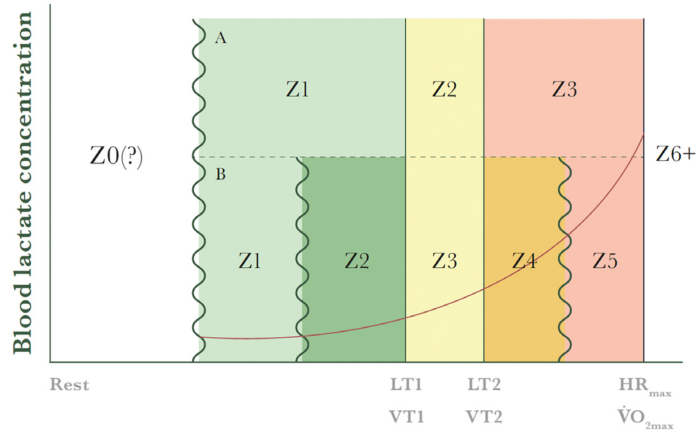


**Figure 1** — Alignment of the 3-zone model (A) assessed through laboratory testing with a typical 5-zone model (B) used in training practice. Additional zones can be found at supramaximal intensities (ie, above $VO_2$max). Reprinted with permission from Seiler.[10] $HR_{max}$ indicates maximum heart rate; LT, lactate threshold; VT, ventilatory threshold; $VO_2$max, maximum oxygen uptake.

### Preferred Intensity Markers

Expert consensus was reached that the preferred intensity for zone 2 training was located just below LT1/VT1. At this intensity, they expected a steady-state physiological response profile with no changes or only transient increases in blood lactate (~1–2 mmol/L), stable HR values: ~70% to 80 % of maximal HR, or ~80% to 90% of LT1 HR, low values of RPE (~10 [using 6–20] Borg RPE), and power outputs that represented ~75% to 80% of critical power. Table 1 represents the alignment of these markers across intensity zones.[10] Several experts highlighted the importance of monitoring HR, RPE, and preferably both when training sessions were prescribed according to an external load metric such as power output given the divergence between internal and external loads commonly observed during long training sessions, in which mental and physical fatigue, dehydration, glycogen depletion, and other internal and external factors could result in cardiac drift and decoupling between power output and RPE.

In conclusion, this expert panel defined zone 2 as a low-intensity endurance training zone that is typically characterized by intensities just below LT1/VT1 and is one of the foundational zones in endurance training frameworks, either the 5-zone or 7-zone model.

## Zone 2 Training

Experts identified 3 different methods that they believed were the best option for zone 2 training. The different zone 2 prescriptions can be classified as continuous, variable, and interval-based in nature. For the sake of simplicity, all training methods proposed here refer to cycling, although they could also be applicable to other endurance sports with some modifications.

### Continuous Methods

Experts highlighted that their preferred training method consisted of long (ideally > 2 h) rides performed at the intensity mentioned above. Given the length of these sessions, experts were in consensus regarding the importance of fatigue and its impact. Accordingly, the interplay between power output (or any external load metric) and both HR and RPE should be considered when adjusting the intensity of the late parts of each session. If cardiac drift or fatigue causes HR and RPE to rise disproportionately, the recommendation is to

**Table 1 Internal Responses (Perceived Exertion, Heart Rate, Breathing Responses, and Blood Lactate) Associated With Each Intensity Zone**

| Intensity | Borg RPE (6–20) | CR10 RPE (1–10) | Verbal anchor | $\%HR_{max}$ | Breathing | Blood lactate, mmol/L |
|---|---|---|---|---|---|---|
| I–1 | 8–11 | 1–2 | Very easy | ~55%–72%<br>Steady ~2–4 h | Effortless to talk, 20–35 breaths/min<br>“Steady” for 2–4 h | <1.5 |
| I–2 | 9–12 | 2–3 | Comfortable | ~67%–82%<br>Steady ~1–3 h | Can converse with some effort, 30–40 breaths/min,<br>“Steady” for 1–3 h | ~1.0–2.0 |
| I–3 | 13–14 | 4–5 | Comfortably uncomfortable | ~82%–87%<br>Drifts up slowly | Can speak in short sentences, 40–55 breaths/min<br>Gradual escalation over 60 min | ~1.5–3.5 |
| I–4 | 15–16 | 6–7 | Demanding but controlled, stressful | ~87%–92%<br>Drifts up steadily | 1-word responses, 50–70 breaths/min<br>Escalating hyperventilation | Highly variable<br>~4–9 |
| I–5 | 17–20 | 8–10 | Very demanding, painful | ~92–100%<br>Drifts up rapidly | Speechless and breathless!<br>60–85 breaths/min,<br>Escalating hyperventilation | Highly variable<br>~6–14 |

Abbreviations: $HR_{max}$, maximum heart rate; RPE, rating of perceived exertion. Note: Reprinted with permission from Seiler.[10]

prioritize maintaining HR and RPE within zone 2 ranges, even if this requires a reduction in external load (ie, power output/pace/speed). This approach ensures that the physiological adaptations targeted by low-intensity training are preserved without excessive strain.[11,12] In order to limit cardiac drift and accumulate more time within zone 2 ranges based on internal load, the segmentation of total work into smaller sessions may also be considered.[13]

#### *Variable Continuous Methods*

The panel agreed on the suggestion made by several experts, who highlighted that to reduce training monotony, variable intensity sessions could also be used when accumulating higher volumes in zone 2. As an example, long zone 2 (within a 5-zone model) workouts could be interspersed with short periods in zone 1 (preferred ratio of 5 to 1). The reported duration of these sessions was similar to a continuous steady-state prescription.

#### *Intervals*

Coaches and scientists concurred on the fact that zone 2 training could be integrated during active recovery periods between harder intervals performed in zones 4 and 5. Experts expressed that they preferred work/rest ratios of 1:1 in these cases, with the additional opportunity to incorporate long zone 2 rides, either in the first phase of the session (to accumulate fatigue prior to the intervals), or at the end, in which case the objective was to accumulate time in zone 2 once fatigue impeded further high-intensity work. The total duration of these sessions was reported as generally 2 hours or less and generally shorter than the continuous and variable continuous prescriptions.

### Expected Zone 2 Adaptations

Although research is needed to confirm this hypothesis, experts agreed on a varied range of central and particularly peripheral adaptations expected from zone 2 training. Among the most frequently listed changes, they highlighted increased muscle capillarization, increased mitochondrial enzymes in type I muscle fibers, and improvements in metabolic efficiency, with modest increases in critical power and $VO_2$max.[14–17] One particular adaptation that was frequently mentioned was the compression of LT1/VT1 toward LT2/VT2. In general, zone 2 training was expected to increase power output both before and after fatigue at HR, blood lactate concentration, and RPE values commonly associated with LT1/VT1. Another adaptation frequently mentioned by experts was cognitive resilience due to the mental fatigue that cyclists must endure in long (and somewhat monotonous) zone 2 rides. Finally, experts highlighted that the physiological responses to increasing intensities are better explained as a continuum instead of adaptations that are turned on and off by crossing specific intensity zone demarcations established from “fresh” testing. Accordingly, they did not expect large differences in the adaptations produced by the upper end of zone 1 and the lower end of zone 3 when compared with what they expected from zone 2. In practice, experts suggested that the potential adaptations induced by zone 2 training could be assessed through several methods: lactate measurements (likely resulting in lower lactate levels at the same power output), indirect assessments of durability (with smaller declines in power output after a given effort), or comparing the internal load elicited by a given external load (eg, with a lower HR or RPE in response to a given submaximal power output).

## Practical Applications

Given the growing popularity of zone 2 training, as well as the debate regarding its actual definition, and the optimal intensity, duration, and session type for its optimization this manuscript provides a novel contribution by unifying insights from 14 experts in the field. These experts’ opinions bridge the gap between theoretical research and real-world practice, offering actionable guidance for coaches, scientists, and athletes aiming to enhance low-intensity training sessions. Although scientific evidence is still lacking, this consensus statement suggests that continuous sessions performed immediately below the LT1/VT1, and for durations exceeding 2 hours might be the preferred method for inducing a wide range of central and peripheral adaptations associated with zone 2 training. By integrating experts’ perspectives and contextualizing them within the current landscape of both scientific literature and practical trends, this work provides a comprehensive framework for implementing effective zone 2 training strategies.

## Conclusions

This commentary has facilitated sharing the ideas, experience, and knowledge around zone 2 training from the perspective of an expert panel of 14 applied sport scientists and professional coaches, with a particular focus on the cycling field. Experts reached consensus that zone 2 training should preferably be performed at intensities located immediately below the first lactate or ventilatory threshold. Continuous, variable, and interval-type sessions were all commonly used when attempting to implement training at this intensity, although continuous and long rides were the most popular sessions among the consulted experts. Finally, although research is warranted in this regard, experts expected a broad range of central and peripheral adaptations from zone 2 training. These expected adaptations are likely not unique to zone 2 and could also be induced with sessions performed at slightly higher and lower intensities.

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