

Opinion

Key factors to prioritize when preparing for the Olympic Games

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Short title: Preparation for the Olympic Games

Received 4 May 2024; accepted 11 May 2024

We need more research that will fulfill the needs of athletes and coaches. This is a common statement, highly relevant nowadays only a few weeks before the commencement of the Olympic Games Paris 2024. To fill this gap, we have identified 6 topics that we feel coaches and athletes would be interested in learning more in order to optimize their preparation for the Olympics. These topics are:

- ◆ Athletes' readiness for competition
- ◆ Preparation for competition and tapering
- ◆ Altitude/hypoxic training
- ◆ Coping with heat during the Olympic Games
- ◆ New technologies and new equipment
- ◆ Preparation for team sports

1. Athletes' readiness for competition

Readiness is the state of being fully prepared for competition. It is the state in which performance is optimal and to achieve this state training must progress methodically to maximize the fitness while mitigating the risks of injuries, illnesses, and overtraining.¹ Looking from another angle, readiness reflects the balance between the physical, technical, tactical, and psychological elements. There are multiple tools to assess the physical and psychological state of athletes, namely the global positioning systems and video analysis (for external load assessment), heart rate and heart rate variability analysis, rating of perceived exertion (for internal load assessment), as well as wellness and perceived recovery scales.² More advanced approaches include the analysis of the concentration of biomarkers in the blood and saliva.^{3,4} In the past, these tools have been used in isolation, but we are now in a position of a full integration of these measures.⁵ For example, coaches and support staff can now

combine the readings from the external load metrics, the internal load metrics, and the wellness data in order to better assess the readiness of their athletes. Although some applications can help toward this integration, coaches, athletes, and support staff should consider building their own approach tailored to their athlete(s) needs.

2. Preparation for competition and tapering

Since there are many excellent training facilities in Europe, jetlag will not be an issue; including for overseas teams which will arrive several weeks ahead of their events for a final preparation in holding camps. However, the pre-competition anxiety and stress are of high concern prior to a once-in-a-life-time event for some athletes. This may lead to altered sleep,⁶ poor recovery, illnesses, autonomic nervous system dysfunction,⁷ and consequently impaired performance. Several means are available to monitor stress and/or fatigue (e.g., questionnaires or heart rate variability⁸), and to mitigate inappropriate levels of stress/fatigue if and when needed.⁹ However, for being of practical use immediately prior to the Olympic Games, any of these investigations requires a multidisciplinary approach (submaximal performance tests; psychological tests; hematological, as well as hormonal, biochemical and immune markers).¹⁰

Since athletic performance can be modeled as the difference between positive (i.e., fitness) and negative (i.e., fatigue) adaptations to training stimuli,¹¹ the tapering period is paramount and should focus on reducing residual fatigue. Different strategies have been proposed (e.g., overload training prior to tapering; progressive nonlinear decrease in training loads, maintaining training intensity, reducing the training volume up to 60%–90%, reducing training frequency to less than 20%).¹² It is crucial to point out that performance usually improves by about 3% (range 0.5%–6.0%) during optimal tapering; a variation

far larger than the variability observed in Olympic sports performance at the elite level (e.g., 0.6%–1.4% in sprint and endurance sports¹³). Consequently, a 4-year preparation period can be compromised by a poor tapering or illnesses over the tapering period. One of the most important factors during the final preparation is the quality of sleep of athletes (that may be impaired in the Olympic village). Individualized prescription based on the athlete's perceived sleep needs and integration of napping are recommended.¹⁴

3. Altitude/hypoxic training

For a long time, altitude training (Live High-Train High (LHTH) and Living High-Training Low (LHTL)) was limited to endurance athletes. Altitude/hypoxic training is now regularly used by elite athletes and is recognized as an effective training method in a wide range of sports.¹⁵ This assumption is supported by athletes and technical staff since, in a survey prior to the 2012 Olympic Games, 75% of athletes and 50% of support staff believed altitude and hypoxic training to be a “*very important*” factor in their training regime.¹⁶ The proximity of many potential altitude training centers in Europe (i.e., in the Alps: Livigno, Saint Moritz, Tignes; in the Pyrenees: Font-Romeu, Sierra Nevada, Teide or Etna Volcanos) facilitates the scheduling of the altitude sojourn—usually 3–4 weeks—with a potential return to sea-level either only a few days prior to the Olympic competition or 15–25 days ahead.¹⁷ For example, at the Paris 2003 World championship, a Swiss 5000-m distance runner realized his best performance only 1 day after a LHTL training camp but the competition was 25–29 days after the camp. This emphasizes the difficulty to optimally individualize and combine the tapering and the post-altitude periods.¹⁸

Moreover, hypoxic training is also used now by team sports with the purpose to induce peripheral (microvascular, mitochondrial, and muscle) adaptations aimed

at delaying fatigue during high-intensity intermittent exercise. Different Living Low-Training High (LLTH) methods (e.g., repeated sprint training in hypoxia (RSH))¹⁹ have been developed and can be performed in normobaric hypoxic chambers (e.g., the French Rugby 7 performs RSH in its training center in Marcoussis). Combination of different types of hypoxic methods (e.g., Living High-Training Low and High (LHTLH))²⁰ in order to induce both hematological (e.g., total hemoglobin mass) and peripheral (e.g., buffering capacity) beneficial adaptations are also effective in team sports and can easily be implemented close to Paris 2024.

4. Coping with heat during the Olympic Games

The elevated environmental temperature could be a risk factor for athletes' health and performance during the Paris 2024 Olympics.²¹ The number one solution to beat the heat is acclimation/acclimatization.^{22,23} To maximize the benefits from acclimation/acclimatization, coaches should consider exposing their athletes to the heat at least 2 weeks before competition.²² The next best solution is proper hydration. This can be achieved by having athletes drinking enough fluids before, during, and after training and competition in the heat. In addition to these techniques, cooling before, during, and after the event can help in reducing the risk of elevated internal body temperature.^{22,23} Cold water immersion, either whole body or partial body, is the best option for cooling before an event that will challenge the thermoregulatory system substantially.²² Whenever cooling before the event is not possible due to practical reasons, the application of ice/cold towels over a large part of the body surface is the next most efficient method for reducing the internal body temperature.²² During competition, the selection of the most appropriate cooling technique will depend on the sport itself. For example, in long distance running/walking a combination of cold water and ice slushy drinks ingestion can help.²² In outdoor team sports,

such as football, cold water immersion during halftime and/or the application of cold towels during halftime and the cooling breaks in combination with chilled water consumption can reduce the level of internal body temperature.²⁴

5. New technologies and new equipment

Elite sport is overwhelmed by new technologies and new equipment/wearables. It is a tricky issue to negotiate. First, the introduction of potentially new ergogenic technologies, such as advanced footwear or Wavelight technology are clearly advantageous for performance and have to be mastered by the athletes and/or regulated by the International Olympic Committee to guarantee fairness and the integrity of sport.²⁵ Contradictory, there is a continuously increasing number of sensors/wearables that claim to measure mechanical (e.g., contact time, flight time, swing time, step time²⁶) and physiological parameters (e.g., energy expenditure²⁷). For most of these wearables, accuracy and reliability are unknown.²⁸ Some of them (e.g., continuous glucose monitoring systems²⁹) have been shown to be of little interest in sport, while other emerging technologies (e.g., near infrared spectroscopy, oximetry³⁰) despite being promising tools, they require further investigation and “real-life” field application. Overall, the introduction of any new technologies prior to the Olympic Games is irrelevant. Due to stress, athletes are not in a frame of mind to welcome and accept new technology that they have not tested, as that might just add another potential layer of anxiety. Our recommendation to coaches is to simplify routines and instructions, and to focus on the well-being of the athletes instead of any technical-technological advancements.

6. Preparation for team sports

Preparation for competition in team sports incorporates the development of physical, technical, tactical, and psychological components in a balanced manner, depending on the needs of the specific sport. In contrast to individual sports, in team sports, the performance of the team does not depend on the physical fitness of a single player. Therefore, the testing and monitoring of team sport athletes differs from that of an athlete in an individual sport. Training in team sports consists mainly of sport-specific drills (i.e., small-sided games in football) which can simultaneously improve both the physical and technical/tactical aspects of the game.³¹ The players' fitness assessment can be conducted either by using sport-specific drills (i.e., small-sided games in football³²) or submaximal running tests of short duration.^{33,34} Regarding the physical and mental readiness of each player, coaches should adopt a regular monitoring of the external and internal workload in combination with measures of wellness.⁵ Given that physical performance may not be the determinant factor of success in high level team sport,^{35,36} the combination of movement tracking systems and video analysis can assist further in contextualizing the physical performance metrics with the tactical demands of the game.^{37,38} Accordingly, sport scientists working with Olympic teams are advised to adopt a more holistic approach and evaluate physical performance taking into consideration the tactical demands too.

Authors' contributions

GPN and GPM drafted, reviewed, and edited the final manuscript. Both authors have read and approved the final version of the manuscript, and agree with the order of presentation of the authors.

Competing interests

Both authors declare that they have no competing interests.

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