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Individualizing High-Intensity Interval Training In Intermittent Sport Athletes With The 30-15 Intermittent Fitness Test

Martin Buchheit, PhD

Physiology Unit - Sport Science Department
ASPIRE, Academy for Sports Excellence

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Introduction

Despite the growing interest in game- or skill-based conditioning (16, 27, 32), running-based high-intensity interval training (HIIT) is still one of the most popular forms of exercise to improve cardiorespiratory fitness in athletes (1,2). To attain an optimal stimulus (and forthcoming adaptations), athletes are generally required to spend a couple of minutes in their 'red zone,' which generally means hitting >90 – 95% of either maximal oxygen uptake (VO2 max) or maximal heart rate (HR) (28).

To ensure that athletes reach this required intensity, several approaches exist to accordingly control and individualize running speeds. While the simplest method involve an athlete's own perception of effort (i.e., run as hard as possible, knowing x repetitions must be performed (18)), or a posteriori HR analysis (26), (wherein once the session is finished, responses from players help dictate any change in running distances for future sessions), using field running test performance is far more objective (3), accurate, practical (HR monitoring not required), and likely effective. For a long time, the speed associated with the VO2 max (vVO2 max) has been the preferred reference running speed to program HIIT (1, 2). However, since this speed is only determined by an athlete's VO2 max and energetic cost of running (20), its use to individualize supramaximal (i.e., > vVO2 max) intermittent runs including changes of direction (COD) as predominantly implemented in team (16, 21) or racket sports (23), is limited. For instance, athletes with similar vVO2 max can present with very different anaerobic, recovery, or COD profiles. Programming HIIT based on vVO2 max for these athletes can lead to different levels of aerobic and anaerobic incitement (9). This prevents the standardization of training load, and likely limits the possibility to target specific physiological adaptations.

To overcome the limitation inherent to vVO2 max for supramaximal, intermittent, and COD-based training prescription, the 30-15 Intermittent Fitness Test (30-15IFT) was developed (9, 11). The 30-15IFT was designed to elicit maximum heart rates (HR) and VO2, but additionally the anaerobic capacity, inter-effort recovery capacity, acceleration, deceleration, and COD abilities (8, 9). The final speed reached at the test, VIFT, is therefore a composite velocity, which takes into account all physiological variables elicited when performing HIIT including COD. In other words, the 30-15IFT is highly specific, not to a specific sport, but to the training sessions commonly performed in intermittent sports. While other protocols such as the Yo-Yo tests have quite similar physiological requirements, VIFT is the only speed that can be used for training prescription (i.e., the final performance measured at the Yo-Yo, or total distance covered, cannot be directly used for training prescription since its relationship with vVO2 max is speed-dependent (22)). In support to the logical validity of the test, VIFT was shown to be more accurate than (approached) vVO2 max (29) for individualizing HIIT with COD in team sport players (9). This was exemplified by lower between-player heterogeneity of the cardiorespiratory responses (9). Finally, the 30-15IFT is also attractive since it has been perceived to be less "painful" compared with continuous field tests (29, 30) by 70% of players assessed (5).

Protocol

The 30-15IFT consists of 30 s shuttle runs interspersed with 15 s passive recovery periods (9). Velocity is set at 8 km.h-1 for the first 30 s run, and speed is increased by 0.5 km/h every 30 s stage thereafter (well-trained players can start the test at 10 or even 12 km/h to save time). Players are required to run back and forth between two lines set 40 m apart (Fig. 1) at a pace governed by a prerecorded beep. This prerecorded beep allows the players to adjust their running speed when they enter a 3 m zone placed in the middle and at each end of the field. During the 15 s recovery period, players walk in a forward direction toward the closest line at either the middle or end of the running area, depending on where their previous run stopped. This line is where they will start the next run stage from. Players are instructed to complete as many stages as possible and the test ends when they can no longer maintain the required running speed or when they are unable to reach a 3-m zone in time with the audio signal for three consecutive times. The velocity attained during the last completed stage is noted as the player's VIFT.

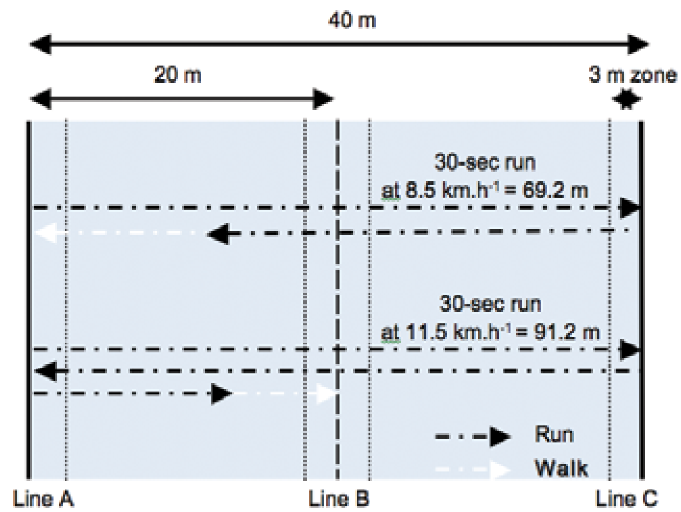

Fig. 1. Area prepared for the 30-15IFT and example of two intermittent runs. For the run at 8.5 km.h-1 (about 69.2 m in 30 s), subjects start at line A, run to line C crossing line B, and then return. After crossing line B again, they stop after 8.5 m and walk to line A during the 15s recovery to be ready for the next stage. For the run at 11.5 km.h-1 (about 91.2 m in 30 s), subjects start at line A, make one complete round trip and stop after 9.5 m when going towards line B, then walk to line B during the 15 s of recovery for the next start. Note that calculation of targeted distances take into account the time needed for direction changes (9).

Extension of the original protocol for Basketball and Ice Hockey

While the test is definitively non- sport-specific (but specific to HIIT sessions), we developed two protocols to better fit the demands of Basketball and Ice Hockey. For Basketball, we have restricted the shuttle length to 28 m, so that the test can be set on the Basketball court to save time (using the lines) (25). This protocol is also of interest for practitioners willing to implement the 30-15IFT in small gymnasiums who do not have a 40-m field. This shortening of the shuttle-runs does not modify the physiological responses or the VIFT reached (24). In the same line, we also developed the 30-15 Intermittent Ice Test (30-15IIT) for Ice Hockey (17). While we kept the original 40-m shuttles, we modified the velocity increments to make it compatible with the specificity of ice skating. This test has also been shown to be valid, reliable, and useful to monitor changes in ice skating-specific fitness (17).

Implementation of run-based HIIT on the field using the VIFT

Once the test is performed, the only thing that the conditioning coach needs to do is to set the individual running distances on the field for each player (Fig. 2). Running distance is simply calculated from a set running time and the chosen percentage of VIFT. For example, for a player with a VIFT = 19 km/h, and for a 15 s-15 s HIIT run at 95% of VIFT, the target distance will be: (19/3.6) x 0.95 x 15 = 75 m (19 is divided by 3.6 to convert for convenience the speed in km/h into m/s). This can be repeated for each single player, or at least for players grouped by VIFT (with 1-km/h groups). I have designed a spreadsheet (available upon request at mb@martin-buchheit.net) that does the calculation for 15 players at a time to save your time. On the field it is recommended to have the players starting from their own cone, and then finish all together on the same line (Fig. 2). With this particular setting, the faster players catch the slower ones by the end of each run, which increases players' motivation. It is also easier for the conditioning coach to check if all players reach the finish line on time.

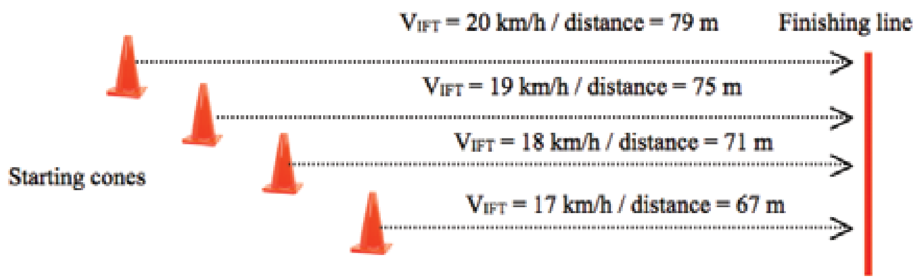

Fig. 2. Area prepared for a straight-line HIIT (15 s -15 s run at 95% of VIFT).

If runs have to be performed with COD, as it is often the case in team and racket sports, the time needed for a COD has to be taken into account when calculating the target running distance, to ensure a similar cardiorespiratory load in comparison with straight-line runs. Not surprisingly, covering the same distance with COD during the same time substantially increases the relative exercise intensity (19) (which is related to the number of CODs and the actual running speed) (14). Along these lines, the COD correction factor can vary between 3 and 30%. While stronger scientific evidence is still lacking, players' height and training volume might have to be taken into account for individual adjustments, with smaller and more trained athletes presenting with the better COD ability (14), thereby requiring a lower correction factor. At present, in the spreadsheet (available upon request), the correction factor is still not individualized and is based on an average player's profile. This is, however, enough to start with since the difference won't be greater than 1 – 2 m, and you can still modify the distance if needed a posteriori. Taking the above mentioned example, the player running at 95% VIFT over a 40 m shuttle will have to cover 72 m (instead of 75 m in straight-line). If the shuttle length is divided by 2 (20-m shuttle), the distance to cover drops to 65 m (Fig. 3).

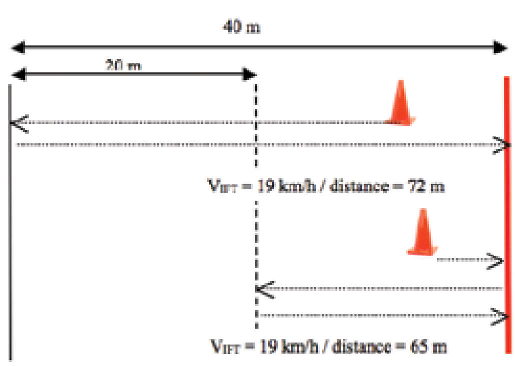

Fig. 3. Area prepared for a HIIT with COD (15 s-15 s ran at 95% of VIFT).

Percentages of VIFT to use for scheduling interval training sessions

Since VIFT is 2 – 5 km/h faster than vVO2 max or the velocities reached at the end of the other popular continuous field tests (6, 13), it is necessary to adjust the percentages of VIFT used when scheduling training sessions. While HIIT is generally performed above vVO2 max (i.e., 110 – 120% for a 15 s – 15 s with passive recovery) (2), VIFT constitutes the upper limit for these exercises (i.e., 100% – except for all-out repeated-sprint sequences). Therefore, depending on the various combinations between the intensity and the duration of the runs and following recovery periods, exercise modality (e.g., running with or without COD, ground surface) and series duration, intervals can be set at intensities ranging from 85- to 100% of VIFT (Table 1). While most of the sessions detailed are likely to have an impact on cardiorespiratory function (a possible exception being the one described on the last line), a more detailed description of the acute responses of each type of HIIT (4, 12, 15, 33) can guide the coach in selecting the most appropriate form of HIIT in relation to the weekly training schedule (e.g., varying the level of anaerobic system solicitation, peripheral demands, neuromuscular strain, etc.). For more information, several articles (most in French but still explicit for non-French readers) are available at http://www.martin-buchheit.net and provide a detailed description of appropriate intensities to use for HIIT with COD based on the VIFT (6, 7, 10, 31).

Running time	Running intensity (%V_{IFT})	Recovery duration	Recovery intensity (% V_{IFT})	Running modality	Max series duration	Number of series	Recovery time Between series
3′	85-88%	-	-	Straight line	-	5 to 6	3′
45″	90%	15″	passive	Straight line	7′-8′	2 to 3	3′
30″	90%	15″	passive	Straight line	7′-8′	2 to 3	3′
30″	90%	30″	40%	Straight line	>12	2	3′
30″	93%	30″	passive	Shuttle 40m	10′-12′	2 to 3	3′
15″	100%	15″	passive	Straight line	10′	2 to 3	3′
15″	95%	15″	25%	Shuttle 40m	15′	2	3′
20″	95%	20″	passive	Straight line	7′-8′	2	6-7′ active
20″	90%	20″	45%	Shuttle 30m	7′-8′	2	6-7′ active
20″	95%	15″	passive	Shuttle 30m	7′-8′	2	6-7′ active
15″	100%	15″	passive	Shuttle 40m	7′-8′	2	6-7′ active
15″	95%	15″	25%	Straight line	7′	2	6-7′ active
15″	95%	10″	passive	Shuttle 40m	7′	2	6-7′ active
10″	90%	10″	passive	Shuttle 20m	6′	2	6-7′ active
10″	100 – 105%	20″	passive	Straight line	6′	2	6-7′ active
3″	sprint	17″	passive	20m sprint or 2 x 10m Shuttle	6′	2	6-7′ active

Table 1. Examples of high-intensity intermittent shuttle runs using VIFT as a reference speed to individualize running distance

In conclusion, choosing the appropriate exercise intensity when programming HIIT in the field is important to solicit specific physiological systems, and in turn, target specific adaptations. The speed reached at the end of 30-15IFT (VIFT) is a composite velocity, which takes into account all physiological variables elicited when performing HIIT including COD (e.g., anaerobic capacity, inter-effort recovery capacity, acceleration, deceleration, and COD abilities). The VIFT is therefore an accurate reference speed for getting players with different physiological profiles to a similar level of metabolic demands, thereby standardizing training content.

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