Comparison of Sprint Interval and Endurance Training in Team Sport Athletes

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[1]*Department of Sport and Health Sciences, Athlone Institute of Technology, Athlone, Ireland;* [2]*Center for Preventive Medicine, School of Health and Human Performance, Dublin City University, Dublin, Ireland;* [3]*Insight, Dublin City University; and* [4]*Department of Health Sciences, Central Michigan University, Mount Pleasant, Michigan*

Abstract

Kelly, DT, Tobin, C, Egan, B, Carren, AM, O'Connor, PL, McCaffrey, N, and Moyna, NM. Comparison of sprint interval and endurance training in team sport athletes. *J Strength Cond Res* 32(11): 3051–3058, 2018—High-volume endurance training (ET) has traditionally been used to improve aerobic capacity but is extremely time-consuming in contrast to low-volume short-duration sprint interval training (SIT) that improves maximal oxygen uptake ($\dot{V}O_2$max) to a similar extent. Few studies have compared the effects of SIT vs. ET using running-based protocols, or in team sport athletes. Club level male Gaelic football players were randomly assigned to SIT (*n* = 7; 21.6 6 2.1 years) or ET (*n* = 8; 21.9 6 3.5 years) for 6 sessions over 2 weeks. $\dot{V}O_2$max, muscle mitochondrial enzyme activity, running economy (RE), and high-intensity endurance capacity (HEC) were measured before and after training. An increase in $\dot{V}O_2$max (*p* # 0.05) after 2 weeks of both SIT and ET was observed. Performance in HEC increased by 31.0 and 17.2% after SIT and ET, respectively (*p* # 0.05). Running economy assessed at 8, 9, 10, and 11 km·h^{21}, lactate threshold and v$\dot{V}O_2$max were unchanged after both SIT and ET. Maximal activity of 3-b-hydroxylacyl coenzyme A dehydrogenase (b-HAD) was increased in response to both SIT and ET (*p* # 0.05), whereas the maximal activity of citrate synthase remained unchanged after training (*p* = 0.07). A running-based protocol of SIT is a time-efficient training method for improving aerobic capacity and HEC, and maintaining indices of RE and lactate threshold in team sport athletes.

Key Words Gaelic football, maximal oxygen uptake, mitochondrial enzyme activity, running

Introduction

Field-based invasion team sports such as soccer, Australian football, and rugby involve irregular changes of pace and high-intensity efforts interspersed with periods of light to moderate aerobic activity. Although performance in these sports is dominated by technical and tactical proficiencies, players must also develop a number of fitness components including aerobic capacity, running speed, and power. The aerobic energy system contributes significantly to energy provision during low-to-moderate intensity level activities, whereas the phos- phagen system and anaerobic glycolysis are major contrib- utors to energy provision during high-intensity activities. A high maximal oxygen uptake ($\dot{V}O_2$max) is also associated with a higher playing intensity, increased number of repeated sprints, increased involvement with the ball, and greater distance covered during soccer (20).

Sport-specific training strategies that mimic the demands of the sport while eliciting improvements in $\dot{V}O_2$max and associated performance parameters are of great interest to coaches and players. High-volume endurance training (ET), characterized by repeated sessions of continuous moderate intensity exercise, induces numerous physiological and bio- chemical adaptations that facilitate improved exercise capac- ity (27). Although this type of training offers significant training adaptations, it requires a large time commitment and lacks specificity in relation to the movement patterns of match play. Low-volume short-duration sprint interval training (SIT) consists of alternating brief bouts (≤30 sec- onds) of high-intensity exercise interspersed with periods of active or passive recovery. This type of training allows play- ers to undertake a greater volume of high-intensity activities and can elicit similar or even superior physiological adapta- tions and improvements in exercise performance normally associated with traditional ET (26,37). Sprint interval train- ing is now considered as one of the most effective forms of exercise for improving physical performance in athletes (4).

Many previous studies that have compared high-intensity interval training with ET have been matched for total work or caloric expenditure (11,31). Sprint interval protocols are normally not matched for energy expenditure and therefore

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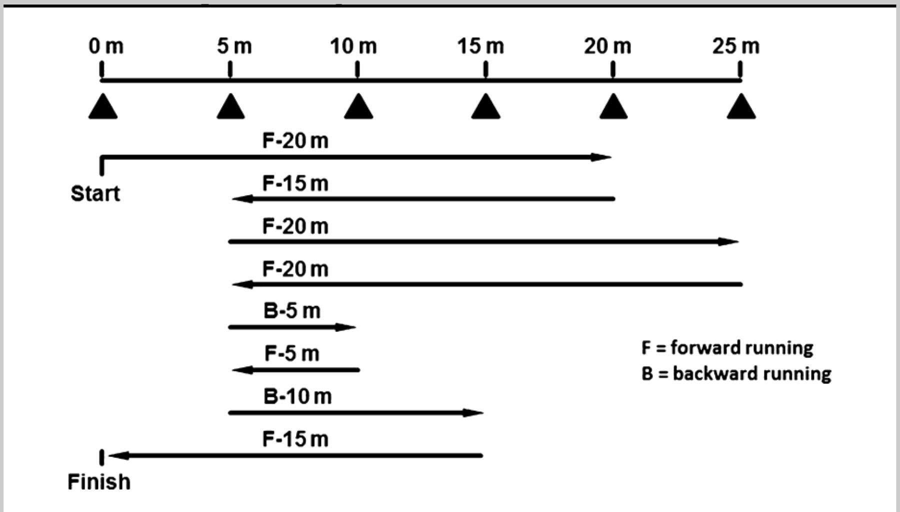

Figure 1. Schematic of the SIT running protocol. Each interval run was 110 m in total distance and involved forward and backward sprints over distances ranging from 5 to 20 m. A set consisted of 3 3 110 runs with a 20-second recovery period between each run. Each training session consisted of 3 sets of high-intensity running interspersed with a 5-minute recovery period between sets. SIT = sprint interval training.

involve a substantially lower time commitment and reduced total exercise volume than ET. For example, brief repeated sessions of SIT over as little as 2 weeks, induces changes in skeletal muscle energy metabolism that resembles endurance type training (8,30). Gibala et al. (14) found that 6 sessions of either SIT or ET induced similar improvements in muscle oxidative capacity, muscle buffering capacity, and exercise performance. The total volume of training was 90% lower in the SIT group than the ET group indicating that SIT is a time-efficient strategy to produce physiological adapta- tions similar to ET.

To date, most studies that have compared the physiological and performance changes in response to SIT and ET have involved cycle ergometer exercise performed by untrained or recreationally active participants (37), with a paucity of studies examining performance in trained ath- letes using running-based in- terventions (34,36). Given that the principle of specific- ity states that the training effect that occurs in response to an exercise overload is spe- cific to the way the load was applied, cycling-based protocols lack the specificity to develop the physical, physiological, and metabolic indices that are required for field-based invasion team sport. Furthermore, the time course and magnitude of the adaptive training response to exercise training is not only influenced by the intensity, volume, and frequency of the training stimulus but also the initial fitness level of the participant (32,36). Therefore, compared with ET, it is unclear whether SIT can induce similar physiological and biochemical adaptations when undertaken by trained athletes. Previous SIT studies have focused primarily on the changes to $\dot{V}O_2$max and mitochondrial enzyme activity, with no studies examining the effect of SIT on param- eters such as running economy (RE), velocity at $\dot{V}O_2$max ($v\dot{V}O_2$max) (1), lactate responses, and high-intensity endurance capacity (HEC), specifically in athletes involved in team sports. The novel aim of this study was to investigate the effect of 2 weeks of SIT, using a shuttle-based, bidirectional running protocol, compared with ET on physiological, biochemical, and performance

TABLE 1. Blood lactate concentration before, during, and after each SIT and ET training session.*†

	SIT				ET	
	Preexercise	Set 1	Set 2	Postexercise	Preexercise	Postexercise
Session 1	1.20 6 0.36	8.83 6 3.13z	11.64 6 1.04z	12.19 6 1.32z§	1.03 6 0.26	5.64 6 3.36z
Session 2	1.03 6 0.21	9.30 6 2.43z	10.70 6 2.50z	11.41 6 0.50z§	1.09 6 0.20	4.54 6 3.30z
Session 3	1.23 6 0.41	7.63 6 3.71z	10.94 6 2.96z	11.88 6 1.69z§	0.97 6 0.15	4.66 6 3.51z
Session 4	1.29 6 0.39	7.58 6 3.32z	12.06 6 1.23z	12.45 6 1.59z§	0.90 6 0.17	2.97 6 2.27z
Session 5	1.29 6 0.38z	7.46 6 3.93z	10.90 6 3.30z	12.90 6 2.16z§	1.01 6 0.38	3.94 6 2.14z
Session 6	1.05 6 0.31	6.84 6 3.42z	13.19 6 2.08z	13.26 6 1.72z§	0.93 6 0.34	3.84 6 2.39z

*SIT = sprint interval training; ET = endurance training.
†Values are mean 6 *SD*, mmol$L²¹.
zMain effect for time (*p* # 0.05) vs. preexercise.
§Main effect for time 3 group interaction (*p* # 0.05) vs. post-ET.

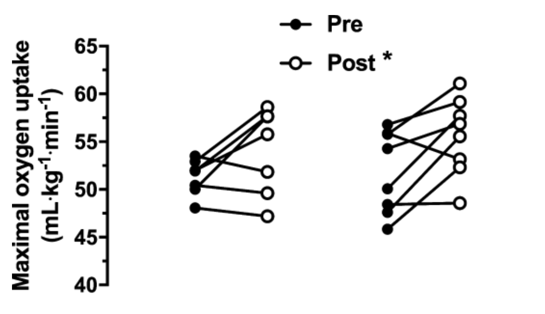

Figure 2. Changes in maximal oxygen uptake ($\dot{V}O_2$max) in response to 2 weeks of endurance training (ET) or sprint interval training (SIT). Data are mean 6 *SD*. Filled boxes ( ) represent pretraining values, and open boxes ( ) represent posttraining values. *Main effect for time (*p* ≤ 0.008) vs. preexercise.

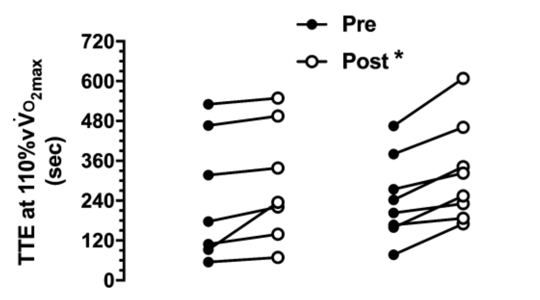

Figure 3. Changes in high-intensity endurance capacity assessed by time to exhaustion at 110% v$\dot{V}O_2$max in response to 2 weeks of endurance training (ET) or sprint interval training (SIT). Data are mean 6 *SD*. Filled circles ( ) represent pretraining values, and open circles (B) represent posttraining values. *Main effect for time (*p* # 0.05) vs. preexercise. TTE = time to exhaustion.

parameters in field-based intermittent team sport athletes, specifically, Gaelic football players. Gaelic football, much like other intermittent team sport involves weight bearing short-duration, high-intensity sprints interspersed with periods of light to moderate aerobic activity consisting primarily of walking and jogging (3).

Methods

Experimental Approach to the Problem

Participants were randomly assigned to the ET or SIT group that involved 6 training sessions over a 2-week period, with assessment of physiological and biochemical parameters before and after training. Participants were instructed to refrain from any additional strenuous physical activity during the study. Participants were also instructed to continue their normal dietary practices throughout the study but refrain from alcohol and caffeine 24 hours before each laboratory visit for assessments.

Subjects

Fifteen male club level Gaelic football players (mean 6 *SD*; age 21.7 6 2.8 years [all subjects were 18 years or older];

body mass index 24.2 6 1.8 kg$m^2; $\dot{V}O_2$max 55.5 6 3.4

mlmin^{21}kg^{21}) participated in the study during the competitive phase of the season. Each player had a minimum of 3 years playing experience in Gaelic football. During the season participants trained, on average, 2 d$wk^{21} on the field, played a game on the majority of weekends, and sup- plemented this field-based activity with at least 1 resistance training session per week. Participants were fully informed of the experimental procedures, benefits, and possible discom- forts associated with the study before giving their written informed consent to participate. The study was approved by the Dublin City University Research Ethics Committee (DCUREC 148).

Procedures

Before starting the training phase, participants made 3 separate visits to the Human Performance Laboratory with each visit separated by 24–48 hours. The first visit assessed anthropometric characteristics, RE, blood lactate responses, and $\dot{V}O_2$max using a treadmill (Woodway ELG 55; Weil an Rhein, Germany) protocol. Briefly, height and body mass were measured to the nearest 0.1 cm and 0.1 kg, respectively, using a portable scale (Seca 707 Balance Scales; GmbH, Hamburg, Germany). Participants were instructed to wear a light top and shorts, and to remove their shoes before the measurement. The cardiopulmo- nary exercise test (CPET) involved participants warming-up at 8 km$h^{21} for 3 minutes at 1% gradient, after which the speed was increased by 1 km$h^{21} every 3 minutes. At the end of each 3-minute stage, participants straddled the moving treadmill and a 5 ml blood sample was taken from the earlobe to determine whole blood

lactate concentration. When blood lactate concentration reached 4 mM, the treadmill velocity was then kept con- stant and the gradient increased by 1% every 60 seconds until the participant reached volitional fatigue. Running economy was examined in mlkg^{21}min^{21}, mlkg^{21}km^{21}, and kcalkg^{21}km^{21} at submaximal speeds of 8, 9, 10, and 11 km$h^{21}. v$\dot{V}O_2$max was deter- mined by extrapolating from the submaximal velocity-$\dot{V}O_2$ relation during the CPET. Heart rate (HR) and RPE were recorded during the final 10 seconds of each minute of exercise.

During the second visit, a test of HEC was performed. The test consisted of a 5-minute warm-up at 50% v$\dot{V}O_2$max. Treadmill velocity was then increased to 110% v$\dot{V}O_2$max and participants ran to volitional exhaustion. Estimated v$\dot{V}O_2$ values were calculated once more by extrapolating from the submaximal velocity-$\dot{V}O_2$ relation from the participants

Table 2. Physiological parameters pretraining and in response to 2 weeks of training.*†

	SIT		ET	
	Pretraining	Posttraining	Pretraining	Posttraining
VEmax (L$min21)	101.18 6 17.42	113.52 6 14.92	99.57 6 17.38	105.50 6 20.64
RERmax	1.08 6 0.64	1.11 6 0.07	1.10 6 0.06	1.04 6 0.08
HRmax (b$min–1)z	185 6 12	189 6 9	200 6 13	189 6 11
vVO2max (km$h21)	14.68 6 1.68	16.31 6 2.82	14.66 6 1.73	15.00 6 1.62
Vel. at LT (km$h21)	11.3 6 0.3	11.8 6 1.7	10.6 6 1.1	10.7 6 1.2
Vel. at 2mM (km$h21)	10.0 6 1.9	9.9 6 1.2	8.5 6 0.6	10.4 6 1.9
Vel. at 4mM (km$h21)	12.8 6 1.2	12.9 6 1.4	11.6 6 0.6	12.7 6 1.3
%VO2 at LT	80.3 6 7.6	75.1 6 9.8	78.1 6 13.2	78.4 6 15.4
%VO2 at 2.0 mmol$L21	75.8 6 10.5	67.0 6 12.6	69.4 6 13.4	75.8 6 19.3
%VO2 at 4.0 mmol$L21	87.8 6 7.8	80.5 6 10.9	82.3 6 11.6	88.6 6 10.8
%HR at LT	89.6 6 4.4	89.9 6 4.3	89.1 6 9.2	83.7 6 7.3
%HR at 2.0 mmol$L21	84.9 6 8.5	83.0 6 7.7	82.2 6 11.3	81.7 6 8.2
%HR at 4.0 mmol$L21	94.0 6 2.9	93.9 6 2.2	90.3 6 8.6	91.4 6 4.1

*SIT = sprint interval training; ET = endurance training; VEmax = ventilation at maximal effort; RERmax = respiratory exchange ratio at maximal effort; HRmax = heart rate at maximal effort; b$min–1 = beats per min; LT = lactate threshold.
†Values are mean 6 *SD*. A 2 and 4 mmol·L21 refers to blood lactate concentration.
zMain effect for group (*p* # 0.05).

CPET on visit 1. A muscle biopsy (pretraining) was taken from the vastus lateralis muscle during the third visit. After completing the training protocol, participants performed the same physiological assessments, starting with the muscle biopsy (48 hours after the last training session), anthropo- metric and physiological fitness assessment, and the perfor- mance test.

Lactate Analysis. Blood samples were drawn from the earlobe and measured for lactate. Before each sample, the earlobe was wiped with alcohol and allowed to dry thoroughly. The base of the earlobe was pierced with a lancet (Accu-Chek; Softclix, Roche, Germany), and the first drop of blood was wiped away. Pressure was applied to the earlobe with the thumb and forefinger to provide an adequate sample. A 5 ml sample of whole blood was automatically aspirated into a sin- gle use, enzyme-coated electrode test strip, and analyzed using a hand-held portable analyzer (Lactate Pro; Akray Factory Inc., Shiga, Japan). Plots of blood lactate against treadmill velocity and VO2 were provided to 2 independent reviewers who determined the lactate threshold (LT) as the first sustained increase in blood lactate above baseline (9). Blood lactate markers at 2.0 and 4.0 mmol$L21 were also identified from the treadmill velocity vs. blood lactate and VO2 plots.

Muscle Biopsies. A resting mus- cle biopsy sample was taken during the third assessment visit before commencing train- ing, and another biopsy was taken 48 hours after the last exercise training session. Each muscle biopsy was obtained from the m. vastus lateralis under local anesthesia. An area of the skin was anesthetized with 2% lidocaine and a small (0.5 cm) incision made. The biopsy needle was inserted into the muscle with suction applied (13). Muscle samples were snap frozen in liquid nitrogen and stored at 2808 C until analysis. Each biopsy was obtained from a separate inci- sion site, with incision sites spaced 2–3 cm apart.

Muscle Enzyme Activity. Frozen wet muscle (;15 mg) was dis- sected from each biopsy under liquid nitrogen for the spectrophotometric determination of maximal enzyme activities of mitochondrial citrate synthase (CS) and b-3-hydroxyacyl coenzyme A dehydrogenase (b-HAD) as described previously (33).

Training Intervention. Participants commenced the training protocol 48 hours after the final pretraining assessment visit. Training involved 3 sessions of ET or SIT per week on alternate days (i.e., Monday, Wednesday, and Friday) for 2 weeks. Endurance training consisted of 50 minutes of continuous treadmill running at a velocity corresponding to 75% vVO2max. Before and after each ET session, a 5-ml blood sample was taken from the earlobe to determine whole blood lactate concentration. The SIT protocol involved 3 sets of high-intensity sprints interspersed with short recovery periods. Each interval run was 110 m in total distance and involved forward and backward sprints over distances ranging from 5 to 20 m with multiple changes of direction (COD) (Figure 1). A set consisted of 3 3 110 runs with a 20-second recovery period between each run, and a 5-minute recovery period between sets. Before exercise

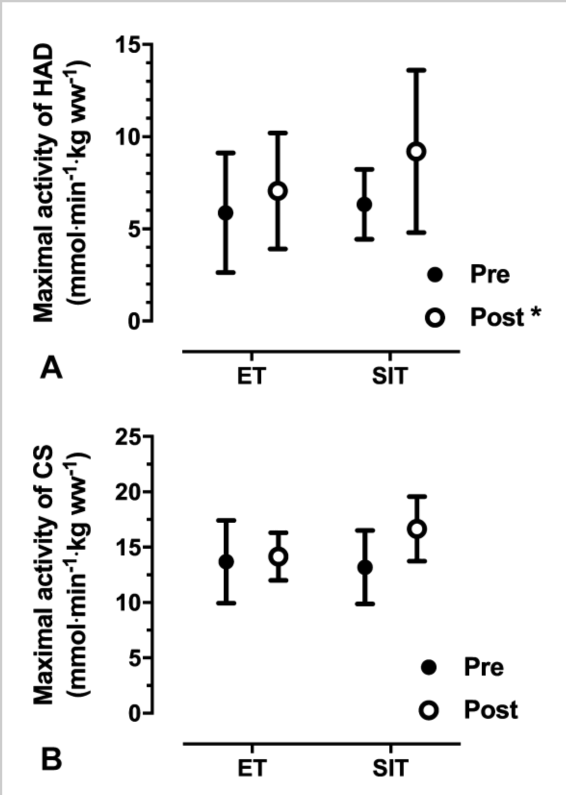

Figure 4. Changes in maximal enzymatic activity of (A) 3-b-hydroxylacyl coenzyme A dehydrogenase (HAD) and (B) citrate synthase (CS) in response to 2 weeks of endurance training (ET) or sprint interval training (SIT). Data are mean 6 *SD*. Filled boxes (■ represent pretraining values, and open boxes (□ represent posttraining values. *Main effect for time (*p* # 0.05) vs. preexercise.

blood lactate concentration. Participants were verbally encouraged throughout both exercise protocols. All training sessions for both groups were supervised by one of the study investigators.

Statistical Analyses

SPSS 21 (Statistical Package for Social Science, Chicago, IL, USA) was used to perform the statistical analysis. The data were checked for normality using the Shapiro-Wilk test. The data were analyzed using mixed design analysis of variance. With the exception of blood lactate, time (pretraining and posttraining) was treated as the within-group effect and training condition (SIT or ET) as the between-group effect for all other response variables. Time and training sessions were treated as the within-group effect and training condition as the between-group effect for blood lactate analysis. Post hoc analysis was conducted using a Bonferroni correction factor. Statistical significance was accepted at *p* # 0.05. All values are reported as mean 6 *SD*.

Results

Over the 2 weeks of training, compliance was 100% in both SIT and ET groups. Body mass was unchanged after the 2-week training intervention (SIT: pre, 74.80 6 7.30 kg, post, 75.05 6 6.87 kg; ET, pre, 75.14 6 6.82 kg, post, 75.30 6 6.64 kg). Blood lactate concentrations for each training session are summarized in Table 1. Circulating blood lactate levels increased significantly during each SIT and ET session, and the levels were significantly higher after each SIT than ET session.

Physiological Parameters and High-Intensity Exercise Capacity

After 2 weeks of training, there was a significant time effect for V̇O_2max (p = 0.008, $F_{(1,12)}$ = 9.989) in response to 6 sessions of SIT and ET (Figure 2). There was also a significant time effect (p , 0.001, $F_{(1,12)}$ = 31.919) for performance in the test of HEC with increases (p , 0.001) of 31.0 and 17.2% in SIT and ET, respectively (Figure 3). There was a significant group 3 time interaction effect (p = 0.013, $F_{(1,12)}$ = 8.494), for HRmax with the maximal value decreas- ing significantly after ET. There was no significant change in vV̇O_2max, velocity, and %HR and %V̇O_2 at 2 mmol$L^{21}, 4 mmol$L^{21}, and LT (Table 2) or RE at 8, 9, 10, and 11 km$h^{21} (data not shown).

Mitochondrial Enzyme Activity

Maximal activity of b-HAD increased significantly (p = 0.008, $F_{(1,12)}$ = 9.981) in response to training in both SIT (pre, 6.33 6 1.90 vs. post, 9.20 6 4.41 mMmin^{21}kg ww^{21}) and ET (pre, 5.87 6 3.24 vs. post, 7.06 6 3.15 mMmin^{21}kg ww^{21}), (Figure 4A). There was no significant change (p = 0.069) in the maximal activity of CS in response to SIT (pre, 13.19 6 3.32 vs. post, 16.66 6 2.92 mMmin^{21}kg ww^{21}) or ET (pre, 13.69 6 3.74 vs. post, 14.16 6 2.16 mMmin^{21}kg ww^{21}) (Figure 4B).

Discussion

This study examined the effects of 2 weeks of running-based SIT or ET on physiological, biochemical, and performance indices in field-based intermittent team sport athletes. The primary finding was that 6 sessions of SIT or ET over a 2-week period is adequate to induce significant improvements in V̇O_2max in previously trained athletes. In addition, we observed comparable improvements in HEC and the maxi- mal activity of mitochondrial enzymes of the b-oxidation pathway, i.e., b-HAD after both SIT and ET.

Pretraining V̇O_2max values in SIT and ET were similar to values previously reported for club level Gaelic football play- ers (40). In addition to supplying the energy requirements for low-to-moderate intensity activities during field-based inter- mittent team sport, a high V̇O_2max also helps to ensure the provision of adenosine triphosphate for the replenishment of phosphagen stores after short-duration bouts of high- intensity activities, and decreases reliance on anaerobic glycolysis during periods of play that involve repeated high- intensity sprints, with relatively short recovery intervals (39). Despite SIT being 90% less in terms of total active exercise time, $\dot{V}O_2$max increased significantly compared with pre- training in response to both SIT (7.2%) and ET (5.4%). Pre- vious studies have also found similar increases in $\dot{V}O_2$max after 2 weeks of SIT (7,19), but this study demonstrates this effect specifically in previously trained team sport athletes using a novel, running-based protocol. Moreover, time to exhaustion in the test of HEC improved in both SITand ET. Endurance training has traditionally been used to develop aerobic fitness in team sport athletes. In general, an average improvement of between 5 and 25% can be anticipated for healthy young adults in response to ET ranging from 2 to 25 weeks in duration (21,24). This form of training is known to induce both central and peripheral adaptations that result in an increased $\dot{V}O_2$max (12,16). Therefore, the 5.5% increase in $\dot{V}O_2$max after ET is not surprising and may have been sufficient for the conse- quent increase in HEC. However, many other factors may influence endurance performance other than an in- dividual's $\dot{V}O_2$max (10). Other potential mediators of the change in HEC may include an increase in skeletal muscle blood flow (35), lactate transport capacity (2), ionic regu- lation, and sarcoplasmic reticulum function (18), but were beyond the scope of this study.

An increase in muscle oxidative capacity is commonly reported in response to SIT and ET (5,14,28), and is likely to explain, in part, the improvements in HEC. Citrate synthase is an enzyme of the TCA cycle that is commonly used as marker of muscle oxidative potential, as it exists in constant proportion with other mitochondrial enzymes (17) and re- flects mitochondrial content (25). Interestingly, although there was a 26% increase in CS activity in response to SIT, no significant change (p = 0.07) was found during analysis, whereas b-HAD activity increased significantly in both groups after training. Peripheral adaptations such as an increase in skeletal muscle enzyme activity are indicated by these changes in b-HAD activity, as it plays an essential role in the mitochondrial beta oxidation of short chain fatty acids (38). Similarly, maximal activities of glycolytic enzymes such as hexokinase and phosphofructokinase (PFK), and other mitochondrial enzymes such as succinate dehydroge- nase and malate dehydrogenase increase in parallel with aerobic fitness after 7 weeks of SIT (29), whereas increases in activities of lactate dehydrogenase, PFK, and cytochrome c oxidase (COX) and the protein content of COX subunits II and IV occur after 2 weeks of SIT (14,34). Based on the observed changes in b-HAD activity, our novel running- based sprint protocol was sufficient to induce similar adap- tation to the classic cycle ergometer-based SIT protocols of recent years (8,15).

There was no change in workload, %HR, or %$\dot{V}O_2$ at 2 mmol$·L^{-1}$, 4 mmol$·L^{-1}$, and LT after training in either group. The ETgroup trained at an average treadmill velocity of 10.3 km$·h^{-1}$, which corresponded to an intensity ~5% above the LT. Our results are in contrast with previous stud- ies that found a period of ET induced a significant decrease in blood lactate concentrations during subsequent exercise bouts (24). Increased capillary density after ET increases the exchange area and decreases the distance between the site of lactate production and the capillary wall, leading to improvement in lactate exchange ability (22). In addition, the fact that the workload, relative HR, and $\dot{V}O_2$ at LT and fixed blood lactate concentrations did not change after 2 weeks of SIT, was surprising considering that SIT is also an effective strategy to alter lactate metabolism (7). Com- pared with straight line or continuous SIT, protocols using COD result in a larger increase in blood lactate accumulation because of the increased mechanical demands of repeated accelerations inherent with consecutive COD, further manipulating anaerobic glycolytic contribution (4). The stimulus experienced during both training programs may have been too short, and that a minimum duration of exer- cise may be required to induce a significant decrease in blood lactate concentration in trained athletes. Although SIT has been reported to elicit increases in both of the lactate trans- port proteins MCT1 and MCT4 content in the human mus- cle (6), little is known about the magnitude of the stimulus required to elicit such adaptations.

A major advantage of SIT over ET is the lower total time requirement. In this study, the total time requirement over the 2 weeks was almost 3 times greater in ET than SIT (300 vs. 102 minutes, respectively), whereas the actual exercise time was 12.5 times greater for ET (300 vs. 24 minutes). In both elite and subelite team sports, collective training during the early part of the season is spent undertaking ET to improve $\dot{V}O_2$max and associated performance parameters (23). Surprisingly, few studies have used a running protocol to compare the effects of SIT and ET on $\dot{V}O_2$max and performance parameters in trained athletes. Our findings suggest that as little as 6 sessions of SIT over a 2-week period is adequate to induce significant improvements in $\dot{V}O_2$max and HEC in club level Gaelic games players. Future studies should examine the most appropriate work to rest ratio to use during SIT to simultaneously improve or maintain aerobic capacity and indices of running speed and power. The cellular and molecular mechanisms underpinning the response to SIT and ET in previously trained team sport athletes also requires further investigation.

Practical Applications

This study found that 6 sessions of SIT performed over a 2- week period increased maximal oxygen uptake, HEC, and markers of muscle oxidative capacity in already trained, field-based team sport athletes. This represents a more time- efficient training method for improving these parameters than ET, and despite a much lower training volume, SIT can rapidly stimulate improvements in aerobic capacity that are comparable with previously used ET programs of similar duration. The short duration of the SIT sessions could potentially free-up considerable collective training time that could be used to develop technical and tactical aspects of play, as a major disadvantage of ET is the large time commitment involved (23).

Acknowledgments

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