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Research article

Gender-Specific Effects of Short Sprint Interval Training on Aerobic and Anaerobic Capacities in Basketball Players: A Randomized Controlled Trial

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Abstract

This study compared the effects of a 6-week short sprint interval training (sSIT) on male and female basketball players' bio-motor abilities, aerobic fitness, and anaerobic power. Using a randomized controlled trial design, 40 basketball players of similar training backgrounds were randomly assigned to two training groups of females (n = 10) and males (n = 10) or two control groups of females and males (each of 10). The training groups performed 3 sets of 10 × 5-second *all-out* interval running, with a 1:3 work-to-recovery ratio, and a 3-minute rest between sets. The players were evaluated for bio-motor abilities, including muscular power assessed through the vertical jump, agility measured using a T-test and Illinois change of direction (COD) test, and maximal sprint speed measured by a 20-meter sprint test. Also, aerobic fitness was assessed by evaluating maximum oxygen consumption ($\dot{V}O_{2max}$) through the Yo-Yo intermittent recovery test level 1 (Yo-Yo IR 1) test before and after the 6-week training period. After the intervention, both training groups (females and males) demonstrated significant improvements in vertical jump (effect size [ES] = 1.29, 1.06, respectively), peak power output (ES = 1.27, 1.39), T-test (ES = -0.56, −0.58), Illinois COD test (ES = -0.88, -1.1), 20-m sprint (ES = -1.09, -0.55), Yo-Yo IR1 performance (ES = 2.18, 2.20), and $\dot{V}O_{2max}$ (ES = 2.28, 1.75). Gender did not exhibit any significant impact on the extent of changes observed over time. The results of this study suggest that adaptations in aerobic fitness and bio-motor abilities measured in this experiment in response to sSIT are similar across genders, and gender differences should not be a major concern when implementing sSIT in basketball players.

Key words: Short sprint, intermittent exercise, team sport, aerobic power, athletic performance.

Introduction

The basketball is an intermittent team sport consisting of a large number of short, high-intensity specific actions, including accelerations and decelerations, continuous changes of direction, physical contacts, jumps, and execution of sport-specific skills (Balčiūnas et al., 2006; Hernández et al., 2018; García et al., 2020; Figueira et al., 2022). Basketball athletes traverse approximately 4500–5000 meters throughout a match with significant contribution of both anaerobic and aerobic metabolic pathways (Hernández et al., 2018). High-intensity activities during the game rely on anaerobic energy metabolism, while low-intensity actions like jogging, walking, and standing are predominantly sustained by aerobic energy metabolism (Heishman et al., 2020; Song et al., 2023). Therefore, it becomes of practical importance for coaches to improve these attributes simultaneously.

Several training methods have been introduced to augment the abilities of basketball players (Ramirez-Campillo et al., 2014; Arazi et al., 2017). High-intensity interval training (HIIT) stands out as a highly effective method for improving both aerobic and anaerobic fitness (Laursen and Buchheit, 2019). This makes it a valuable and versatile tool for basketball players aiming to enhance their overall performance (Kunz et al., 2019). HIIT is commonly recommended in various formats, such as brief intervals, extended intervals, recurrent sprints, and small-sided games (Fereshtian et al., 2017; Rasouli mojez et al., 2021; Sayevand et al., 2022). This approach consistently addresses the metabolic oxygen, neuromuscular, and anaerobic systems throughout the season (Laursen and Buchheit, 2019). Recent reviews and experimental studies have indicated that HIIT sessions with shorter sprints and less time (i.e., 4-10 seconds) may lead to the same adaptive changes as traditional interval interventions (Lee et al., 2020; Boullosa et al., 2022) while causing lower peripheral fatigue (Buchheit and Laursen, 2013) and more enjoyable responses than other HIIT types (Tanisho and Hirakawa, 2009).

Although various training variables like duration and intensity of efforts and recovery between intervals, training frequency, training modality, and time of day (Song et al., 2023) must be considered to develop an optimal sSIT program, the impact of gender differences in designing sSIT programs has been overlooked. It is widely acknowledged that females possess a natural advantage in endurance situations, and have more aerobic metabolism with lower fatigue and the fastest recovery than male subjects (Laurent et al., 2010). Males generally possess a larger physique, resulting in the ability to generate higher absolute force and subsequently achieve greater speeds during maximal intensity performance (Laurent et al., 2010). The most plausible factors contributing to these disparities between genders are the variance in muscle mass, substrate utilization, and muscle morphology (Astorino et al., 2010). However, there is currently no evidence comparing the response of males and females, particularly in basketball athletes, to HIIT. Astorino et al. (2010) conducted a study examining potential gender differences in the adaptation to low-volume HIIT in active, young males and females. Their findings revealed that six sessions of HIIT throughout 2 to 3 weeks induced similar adaptations in both males and females.

However, due to the lack of previous studies analyzing the independent effect of participant sex on adaptations induced by long-term sSIT (i.e., 6 weeks) in basketball players, as well as the potential variations in adapta-

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tions based on factors such as sport type, training duration, exercise modes, intensity, and all-out or non-all-out effort of interval training (Boullosa et al., 2022), it would be unwise to extrapolate the results to basketball players. To the best of our knowledge, there is no research specifically integrating sSIT into basketball training practices wherein this type of training is essential for basketball players, and it is necessary to conduct a study that examines the longitudinal impact of using sSIT on performance adaptations and identifies potential gender differences in these athletes. Therefore, our objective was to compare the aerobic fitness and anaerobic performance adaptations to sSIT in male and female basketball players following the 6-week training period.

Methods

Participants

Forty male (n = 20) and female (n = 20) national-level basketball players volunteered to participate in the study. Before the investigation, the subjects provided written informed consent. Subsequently, they were matched based on the playing position (i.e., guard, forward, and center) and randomly assigned to either the training or control groups, including the male training group (MTG, n = 10), male control group (MCG, n = 10), female training group (FTG, n = 10), and female control group (FCG, n = 10) (Table 1). All basketball players had participated in national events (i.e., college) and were familiar with HIIT interventions. However, they had not engaged in HIIT over the past three months before their inclusion in the study. The basketball players who were included in this study followed the specific criteria: (1) possessing a background of more than two years of basketball training and competitive experience, (2) engaging in continuous basketball training for at least six months before inclusion in the study, (3) having no experience with HIIT in the previous three months, and (4) not participating in any other competitive sport activity. A sport-medicine physician evaluated all participants to determine their injury history. Participants were excluded from the study if they had (1) a history of injuries on the lower body, (2) undergone any lower limb reconstructive surgery or had unresolved musculoskeletal disorders in the past two years, and (3) used ergogenic aids. All procedures were conducted by the Declaration of Helsinki and approved by the Institutional Ethics Review Committee for the Wuhan Sports University.

Study design

This study utilized a randomized controlled design. Before the baseline testing, a laboratory familiarization was conducted with all participants to ensure their familiarity with the testing and training procedure and study aims. Participants attended the lab on three separate occasions, with 24 hours of recovery between sessions, to assess anthropometric and performance measurements (Figure 1). Following anthropometric measurements, participants' aerobic capacity was evaluated at the first session using the Yo-Yo intermittent recovery test level 1 (Yo-Yo IR 1). The vertical jump and the 20-m sprint were measured on the second day, with a 30-minute rest between the tests. The third testing session evaluated COD (i.e., T-test and Illinois COD test), with a 30-minute recovery between the tests. All tests were conducted in the afternoon to control for diurnal performance effects. Participants were instructed to avoid rigorous physical activity, adhere to their regular diet 24 hours before the test, and abstain from caffeine and alcohol (Gharaat et al., 2020; Barzegar et al., 2021). Seventy-two hours after completing the pre-test measurements, participants began their six-week training period, and 72 hours after the final training session, the same testing sessions were conducted with the same conditions and testing order.

Testing procedures

All participants were directed to maintain their daily activities and food intake throughout the study. Before the day of testing, all participants were instructed to adhere to the following guidelines: a) obtain a minimum of 8 hours of restful sleep, b) consume an appropriate amount of carbohydrates as prescribed for each individual while ensuring

Table 1. Descriptive data of the male training group (MTG, n = 10), male control group (MCG, n = 10), female training group (FTG, n = 10), and female control group (FCG, n = 10).

	MTG	MCG	FTG	FCG
Age (y)	22.4± 2.2	22.7± 2.4	23.5± 1.8	23.1± 1.5
Height (cm)	185.4 ± 4.1	182.8 ± 4.5	177.4 ± 2.6	176.8 ± 2.5
Body mass (kg)	85.8 ± 8.3	87.2 ± 7.8	71.8 ± 2.2	72.2 ± 2.8
Training experience (y)	7.2 ± 2.6	7.6 ± 1.9	8.4 ± 3.1	7.9 ± 2.4

Study duration (weeks)							
Week 1	**Week 2**		**Week 3 to 8**			**Week 9**	
	Testing days		**Training days**	**Intervention**		**Testing days**	
	Female groups	**Male groups**		**Training groups**	**Control groups**	**Female groups**	**Male groups**
Familiarization and preparation for starting	Monday Anthropometric Yo-Yo IR1	Tuesday Anthropometric Yo-Yo IR1	**Monday** **Tuesday**	Female sSIT + BP Male sSIT + BP	BP BP	Monday Anthropometric Yo-Yo IR1	Tuesday Anthropometric Yo-Yo IR1
	Wednesday VJ 20-m sprint	Thursday VJ 20-m sprint	**Wednesday** **Thursday** **Friday**	Female sSIT + BP Male sSIT + BP Female sSIT + BP	BP BP BP	Wednesday VJ 20-m sprint	Thursday VJ 20-m sprint
	Friday COD	Saturday COD	**Saturday** **Sunday**	Male sSIT + BP Rest	BP Rest	Friday COD	Saturday COD

Figure 1. Study procedure. Yo-Yo IR 1: Yo-Yo intermittent recovery test level 1, VJ: vertical jump, COD: change of direction, BP: basketball practice.

adequate hydration, and c) wear identical footwear during both pre and post-tests. Before commencing the tests, all participants underwent a 15-minute general warm-up routine, which included a 5-minute jog, a 5-minute stretching, and 5 minutes of low-intensity sprinting. All measurements were taken on a basketball court surface with a temperature range of 27-29°C.

Anthropometric measurements

The measurement of height was completed using a stadiometer (Bodymeter, SECA, Germany, with the nearest 0.1 cm) and body weight using an electronic scale (Body Complete, Beurer, Germany, with the nearest 0.1 kg).

Vertical jump performance

The vertical jump (VJ) performance was assessed using a VJ tester (Wall-mounted VERTEC Power System, USA) positioned on the basketball court. Following a standardized warm-up period of 10 minutes, the players executed maximal VJs by utilizing a countermovement depth of 90° knee flexion. Each participant completed three maximal VJs, with a 30-second rest period between each attempt, and the highest displacement achieved was recorded for subsequent analysis. The test-retest reliability of the VJ was determined to be 0.95 (Stevanovic et al., 2019).

Peak power output

To evaluate the peak power output (PPO) of basketball players, the best score in VJ was utilized in the equation developed by Sayers et al. (1999). The equation is as follows: PPO (W) = (0.67) × (Jump Height, cm) + 45.3 × (body mass, kg) -2,055. The precision of this formula has been demonstrated to be unaffected by gender disparities and consistently yields high intra-class correlations (ICC = 0.99).

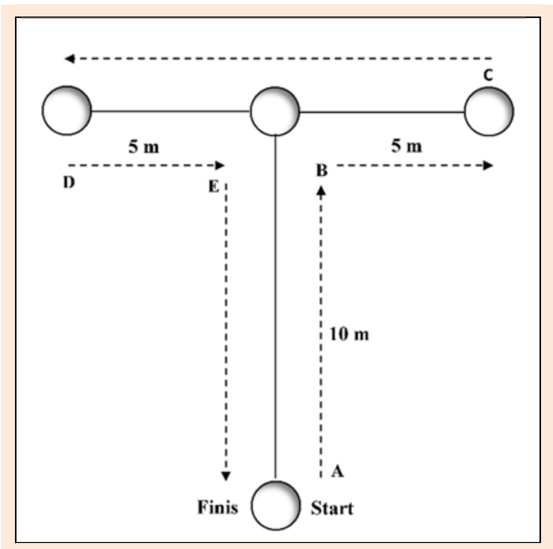

Figure 2. T-test procedure.

Change of direction ability (COD)

To assess the COD ability of basketball players, the T-test (Figure 2) and Illinois COD test (Figure 3) were used according to procedures described by Miller et al. (2006). After a 10-minute general warm-up and 2-3 practice trials in both tests, participants were instructed to perform three trials with maximal effort, with 3-minute rest intervals between the trials. The time to complete the trials was recorded using the timing gates (Brower Timing Systems, Draper, UT, USA) positioned at the start and finish lines. The best times for the T-test and Illinois COD test were used for further analysis. The test-retest reliability of the T-test and Illinois COD test was found to be 0.98 and 0.97, respectively.

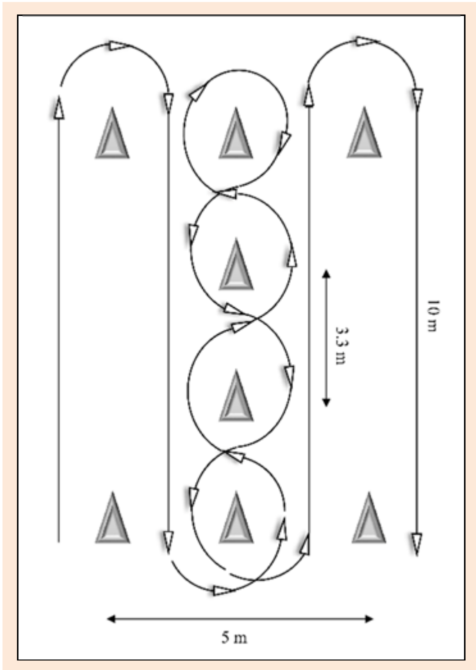

Figure 3. Illinois agility test procedure.

Sprint performance

The basketball players' maximal sprint speed was determined through a 20-meter sprint test conducted on an indoor track basketball court. Following a general warm-up, participants performed three maximal sprints with 2-minute rest periods between the attempts. Participants were instructed to perform a run between two electronic timing gates (Brower Timing Systems, Draper, UT, USA), which were fixed at 0 and 20-m at hip level, using a standing position with the preferred foot forward positioned 0.5 meter behind the starting line. The best record in sprint time was used for further analysis. The test-retest reliability of the 20-meter sprint test was found to be 0.92 (Rimmer and Sleveret, 2000).

Aerobic power

The Yo-Yo intermittent recovery test level 1 (Yo-Yo IR 1) was used to evaluate the aerobic power of the basketball players. The details of the Yo-Yo IR 1 have been previously explained by Bangsbo et al. (2008). In summary, the test involved shuttle runs of 20 meters, with a progressive increase in speed during the evaluation. The total distance accomplished by each participant was subsequently documented for subsequent analysis. Additionally, the estimation of $\dot{V}O_{2max}$ was conducted utilizing the equation as follows: $\dot{V}O_{2max}$ (ml·kg^{-1}·min^{-1}) = covered distance (m) × 0.0084 + 36.4 (Bangsbo et al., 2008).

Training protocols

The female participants engaged in formal training thrice a week on Mondays, Wednesdays, and Fridays, while the male participants trained on Tuesdays, Thursdays, and Saturdays. The basketball training sessions lasted approximately 70 to 80 minutes and were conducted in the afternoon, from 5:00 to 7:00 p.m. In addition to the formal basketball training, the players in the training groups (i.e., MTG and FTG) completed approximately 20 minutes of sSIT before their regular basketball session, and the athletes of the CON group underwent tactical and technical basketball training. Each training session commenced with a 15-minute warm-up (i.e., light running for 5 minutes, stretching for 5 minutes, and 3-5 submaximal sprint trials). After the warm-up, the participants in the training groups engaged in sSIT interventions with equal intervals and time commitment for each session, regardless of gender. The MTG and FTG performed three sets of 10 repetitions of "all-out" sSIT, each lasting 5 seconds. The rest interval between repetitions was 15 seconds (i.e., 5:15 [1:3 ratio]), while the rest period between sets was 3 minutes. The training sessions were supervised by specialized male and female Strength and Conditioning Coaches to ensure proper completion. To assess the load of the sSIT, the participants' rate of perceived exertion (RPE) was recorded using a 0-10 scale (Foster et al., 2001). The RPE was assessed after the entire sSIT sessions and before the initiation of basketball practice. After completing the sSIT sessions, the players were asked to rate their overall effort on a scale of 0 (rest) to 10 (maximal). Additionally, the training impulse (TRIMP) was calculated by the RPE × training time (i.e., minutes) (Foster et al., 2001).

Statistical analysis

All data are presented as mean ± SD. A repeated-measures analysis of variance (ANOVA) with a 4 × 2 (group × time) design was conducted to determine differences between groups, followed by a Bonferroni post-hoc test. Additionally, a t-test compared the training impulse, sRPE, and Δ% between the training groups. Furthermore, the percentage of change was calculated to identify the extent of any treatment impact [Δ% = (post - pre)/pre × 100]. Effect sizes (ES) were also calculated using Cohen's *d*. The magnitude of the effect sizes was categorized as trivial if less than 0.20, small if between 0.20 and 0.50, medium if between 0.50 and 0.80, large if between 0.80 and 1.30, or very large if greater than 1.30. The 95% confidence interval (CI) was also reported (Seitz et al., 2014). With an alpha level of 0.05 and a beta of 0.8, the sample size for each group was estimated to be 10 participants using the G*Power software (Faul et al., 2007).

Results

At the baseline and after the training period, the male groups exhibited greater height and body mass than their female counterparts, and their performance tests yielded superior results ($p < 0.05$). However, there were no differences between the groups of the same sex at pre-training values. Both male and female training groups exhibited significant improvements from pre- to post-training, with no notable gender-related interaction observed in the magnitude of changes.

There were significant main effects of time ($p = 0.001$) for the VJ and PPO (Figure 4). In addition, both

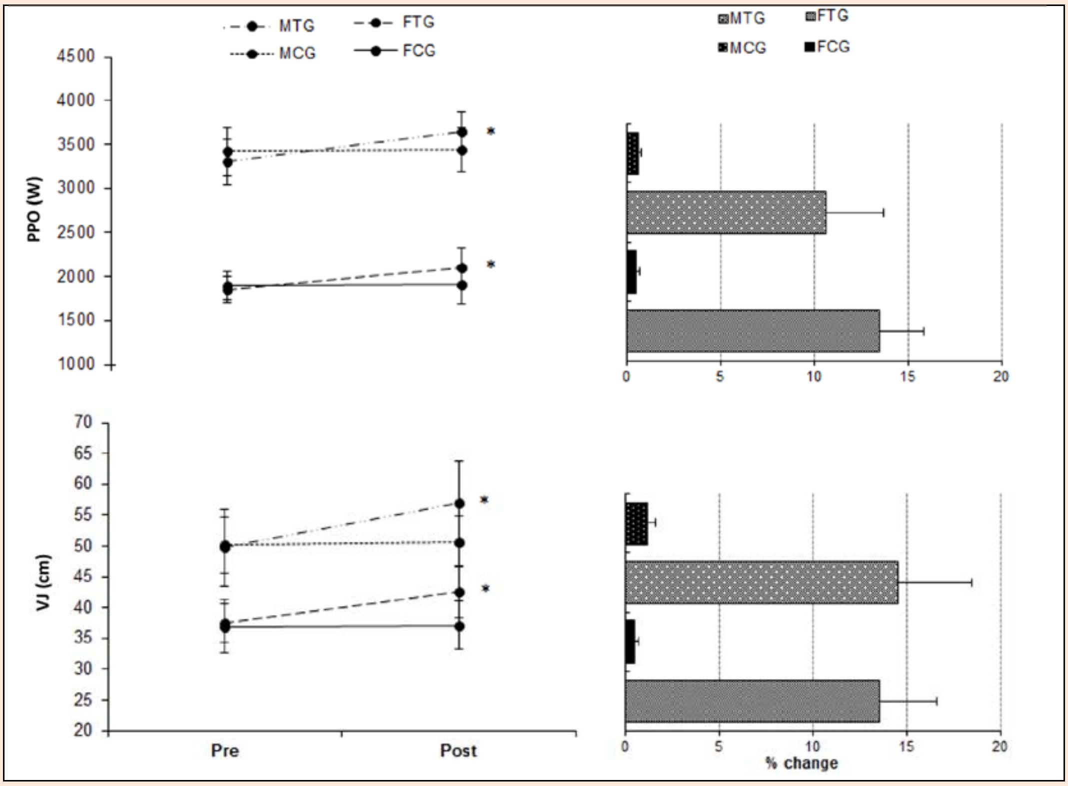

Figure 4. Changes in vertical jump (VJ) and peak power output (PPO) in response to 6 weeks sSIT (mean ± SD). FTG: female training group, FCG: female control group, MTG: male training group, MCG: male control group. * Denotes significant difference *vs.* control group and pre-training ($p \leq 0.05$).

the training groups indicated significant (p = 0.001) changes compared to their control groups after 6 weeks of the training period. The FTG demonstrated large increases in both the VJ (ES = 1.29, 95% CI = - 0.32 to 2.27, %Δ = 13.5, p = 0.0001) and the PPO (ES = 1.27, 95% CI = - 0.31 to 2.23, %Δ = 13.5, p = 0.0001), while the MTG demonstrated a large increase in the VJ (ES = 1.06, 95% CI = - 0.12 to 2.0, %Δ = 14.5, p = 0.0001) and a very large increase in the PPO (ES = 1.39, 95% CI = - 0.41 to 2.37, %Δ = 10.6, p = 0.0001).

There were significant main effects of time (p = 0.001) for the T-test and Illinois COD test (Figure 5). In addition, both the training groups indicated significant (p = 0.02) changes compared to their control groups after 6 weeks of the training period. Both the training groups indicated a medium increase in the T-test (FTG: ES = -0.56, 95% CI = - 1.46 to 0.33, %Δ = -3.7, p = 0.01; MTG: ES = -0.58, 95% CI = - 1.48 to 0.31, %Δ = -3.5, p = 0.01) and a large increase in the Illinois COD test (FTG: ES = -0.88, 95% CI = - 1.8 to 0.03, %Δ = -4.3, p = 0.02; MTG: ES = -1.1, 95% CI = - 2.05 to - 0.48, %Δ = -5.0, p = 0.001).

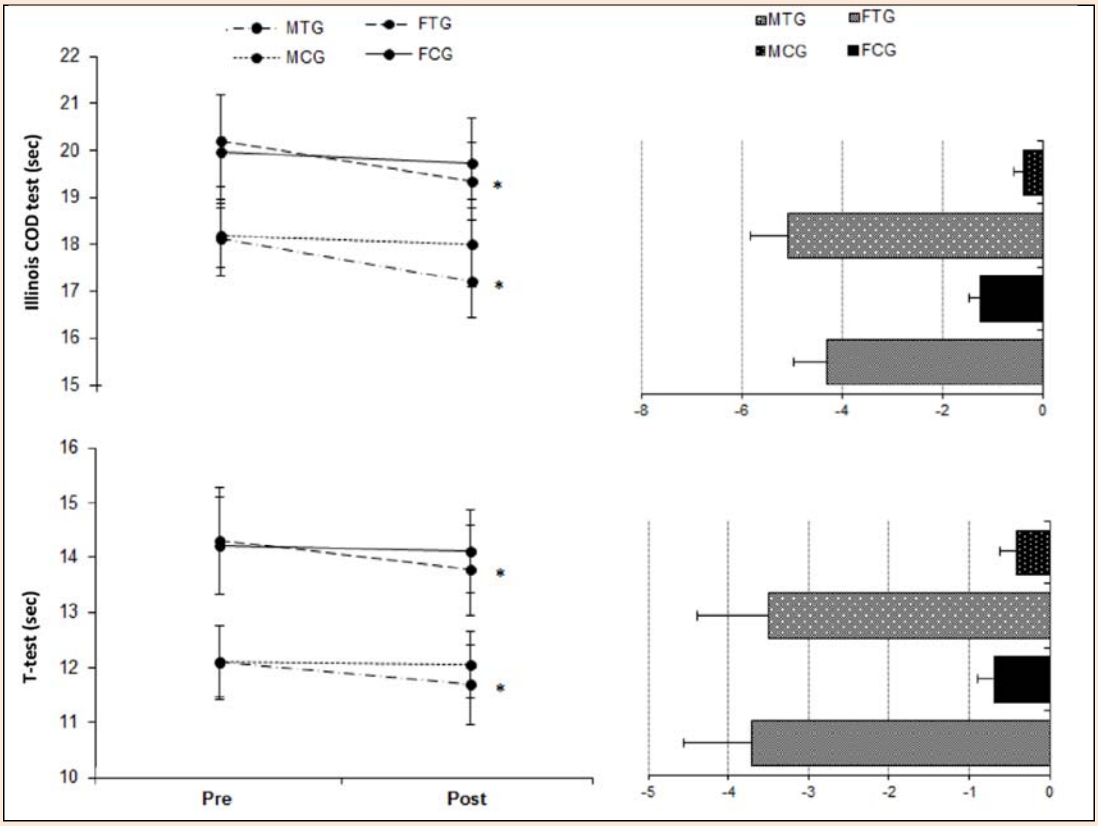

Figure 5. Changes in Illinois COD performance and T-test performance in response to 6 weeks sSIT (mean ± SD). FTG: female training group, FCG: female control group, MTG: male training group, MCG: male control group. * Denotes significant difference *vs.* control group and pre-training ($p \leq 0.05$).

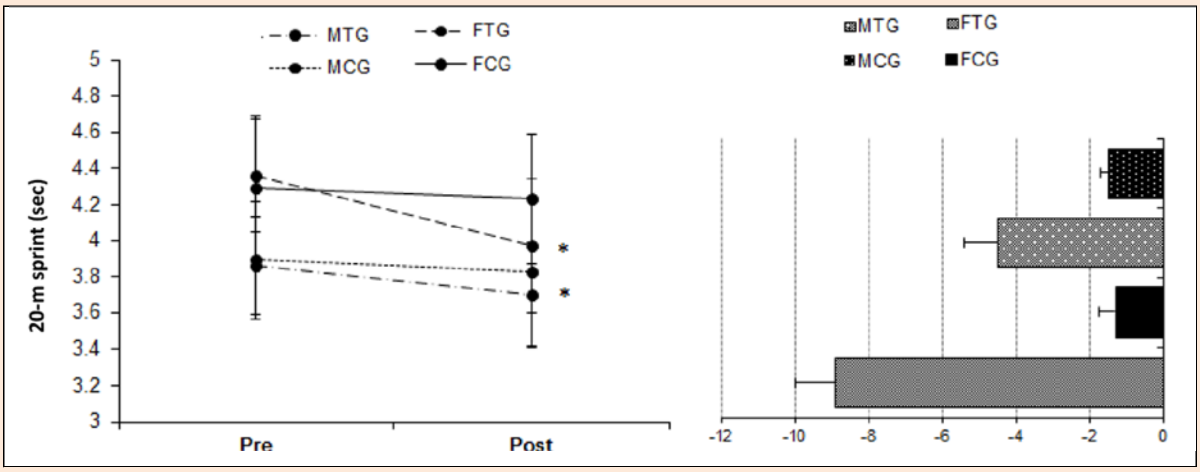

Figure 6. Changes in sprint performance and T-test performance in response to 6 weeks sSIT (mean ± SD). FTG: female training group, FCG: female control group, MTG: male training group, MCG: male control group. * Denotes significant difference *vs.* control group and pre-training ($p \leq 0.05$).

There was a significant main effect of time (p = 0.001) for the 20-m sprint test (Figure 6). In addition, both the training groups indicated significant (p = 0.001) changes compared to their control groups after 6 weeks of the training period. The FTG demonstrated a large increase (ES = -1.09, 95% CI = - 2.03 to -0.15, %Δ = -8.9, p = 0.001), while the MTG demonstrated a medium increase (ES = -0.55, 95% CI = - 1.44 to 0.35, %Δ = -4.5, p = 0.02) in the 20-m sprint.

There were significant main effects of time (p = 0.001) for the Yo-Yo IR1 and $\dot{V}O_{2max}$ (Figure 7). In addition, both the training groups indicated significant (p = 0.001) changes compared to their control groups after 6 weeks of the training period. Both the training groups indicated very large increases in the Yo-Yo IR1 (FTG: ES = 2.18, 95% CI = 1.08 to 3.29, %Δ = 26.7, p = 0.0001; MTG: ES = 2.20, 95% CI = 1.09 to 3.31, %Δ = 23.7, p = 0.0001) and in the $\dot{V}O_{2max}$ (FTG: ES = 2.28, 95% CI = 1.16 to 3.41, %Δ = 6.4, p = 0.001; MTG: ES = 1.75, 95% CI = 0.72 to 2.78, %Δ = 5.95, p = 0.001).

The results of RPE and TRIMP are presented in Figure 8. Both the training groups (i.e., FTG and MTG) indicated similar sessions in RPE and training load throughout the training sessions with no statistically significant differences (p > 0.05) observed between them.

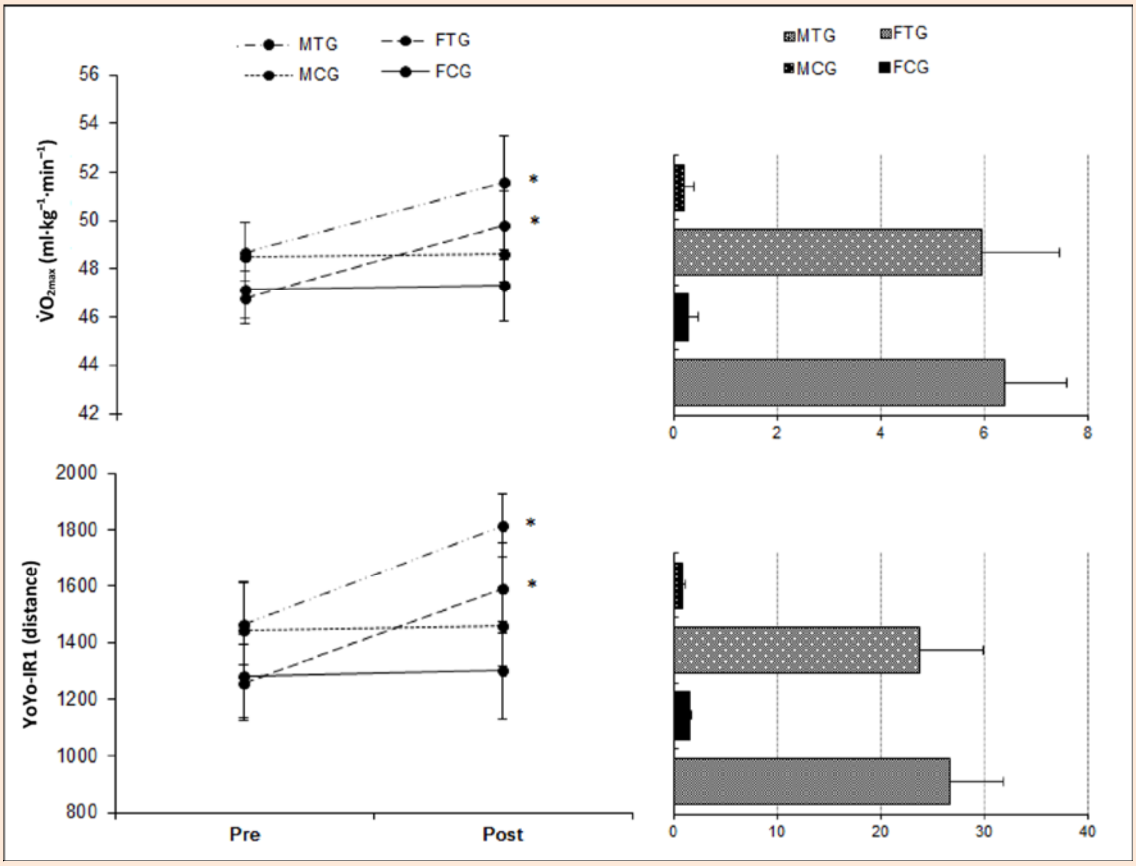

Figure 7. Changes in distance covered during YoYo-IR1 test and maximum oxygen uptake ($\dot{V}O_{2max}$) in response to 6 weeks sSIT (mean ± SD). FTG: female training group, FCG: female control group, MTG: male training group, MCG: male control group. * Denotes significant difference *vs.* control group and pre-training ($p \leq 0.05$).

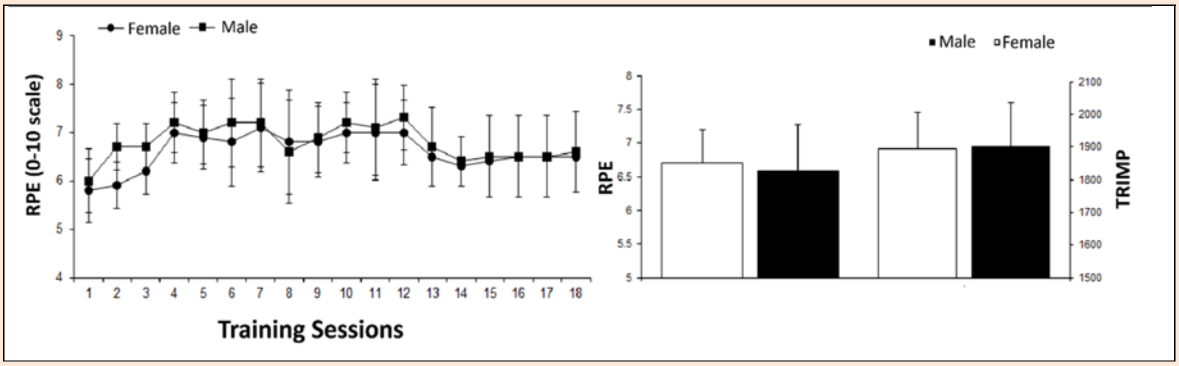

Figure 8. Sessions' rate of perceived exertion (RPE) and total training load [i.e., training impulse (TRIMP)] for both the training groups (i.e., FTG and MTG). Scatter chart indicates RPE values during each training session (1st to 18th sessions, respectively), and the bar chart indicates total training load over the training period.

Discussion

The present study compared the effects of a 6-week sSIT on bio-motor abilities, aerobic fitness, and anaerobic power of male and female basketball players. The most striking finding of this study was both male and female training groups exhibited significant improvements from pre- to post-training, with no notable gender-related interaction observed in the magnitude of changes.

Both genders significantly improved VJ and PPO in response to sSIT with large to very large ES. In line with our findings, previous studies demonstrated that different forms of HIIT induced statistically significant improvements in power performance in female and male athletes (Bayati et al., 2011; Arslan et al., 2022; Boullosa et al., 2022). To enhance jumping ability and power performance after sSIT, particular adaptations should be considered, including improvements in intermuscular coordination, mechanical properties of the muscle-tendon, and alpha motor-neurons firing rate (Buchheit and Laursen, 2013). On the other hand, the duration of foot contact in the sSIT is comparable to the utilization of the stretch-shortening cycle as jump training (Lee et al., 2020). As a result, this technique elicits adaptive modifications in the neuromuscular systems, leading to an enhancement in VJ and PPO performance (Laurent et al., 2010; Lee et al., 2020). To assess the impact of gender on power performance adaptations, it has been reported that the male population exhibits a higher level of trainability than female subjects (Bartolomei et al., 2021). However, our study showed that female and male athletes experience similar training benefits through sSIT, suggesting the adaptive responses to sSIT are comparable between the sexes when both groups are trained athletes. It is worth noting that this study is the first to investigate the effects of long-term sSIT on jumping ability and power adaptations in female and male athletes. Further research is necessary to elucidate the potential biochemical and neuromuscular pathways involved in this approach.

The results of the present study demonstrated that a 6-week sSIT induced statistically significant medium to large ES in the T-test and Illinois COD test scores for both the FTG and MTG. In accordance with our findings, Arslan et al. (2022) reported that HIIT is a suitable training method to enhance COD in basketball players. It has been reported that the enhancement of rapid force development and higher power generation in the lower extremities is crucial in enhancing muscular power, which in turn, enhanced muscular power facilitates change of direction ability and enhances COD speed (Miller et al., 2006). In tasks requiring the ability to COD, the leg extensor muscles experience swift transitions between eccentric and concentric muscle actions, accompanied by minimal ground contact time (Miller et al., 2006; Clemente et al., 2022). This phenomenon of eccentric to concentric muscle action and shorter ground contact time observed in sSIT compared to other forms of HIIT induced meaningful effects in the COD ability. The current study's results indicate comparable training adaptations in the COD between females and males following sSIT. These findings are noteworthy for strength and conditioning coaches designing sSIT programs for athletes. Additionally, it is worth noting that gender differences do not play a significant role in designing an optimal training program in sSIT. Both sexes can engage in similar training protocols and achieve similar training effects in the COD of basketball players.

The results of the present study demonstrated that a 6-week sSIT induced meaningful large ES for the FTG and medium ES for the MTG in the 20-m sprint. Consistent with our findings, prior research has indicated that interval training has a positive impact on the sprint of athletes within a training period of 4 to 6 weeks (Arazi et al., 2017; Lee et al., 2020). The potential mechanisms underlying this improvement in sprints may be attributed to the specificity of the training regimen, which involves short sprints and trials in sSIT sessions (Arslan et al., 2022). According to reports, interval training programs have been linked to increased sprint acceleration and velocity, as well as improved stride length, resulting in sprint gains (Rimmer and Sleveret, 2000; Clemente et al., 2022). Furthermore, the significant enhancements in muscle actions, specifically the transition from eccentric to concentric contractions of the leg extensor muscles, with minimal ground contact time and activation of fast-twitch muscle fibers induced by sSIT, are crucial in augmenting linear speed (Rimmer and Sleveret, 2000; Arslan et al., 2022; Clemente et al., 2022). It is noteworthy to mention that gender disparities do not substantially influence the adjustments of sprint performance, and both genders can attain comparable training advantages after sSIT in the 20-meter sprint examination of basketball athletes.

The results of the present study indicated that a 6-week sSIT induced meaningful, very large effects on improvements of Yo-Yo IR1 and $\dot{V}O_{2max}$ for both the training groups (i.e., FTG and MTG). The outcomes of this study have underscored the importance of aerobic fitness for basketball players, as there exists a positive correlation between aerobic capacity and power recovery during repeated bouts of intensive interval exercise (Laursen and Buchheit, 2019). The enhancements in aerobic capacity may be attributed to two critical aspects of aerobic fitness: the central component (i.e., improved oxygen delivery) and the peripheral component (i.e., increased utilization of oxygen by the active muscles during aerobic activities) (Sheykhlouvand and Forbes, 2017; Fereshtian et al., 2017; Sheykhlouvand et al., 2022). Our results indicate the sSIT employed in our study yielded comparable improvements in both central and peripheral components, resulting in similar increases in Yo-Yo IR1 and $\dot{V}O_{2max}$. Gender differences did not appear to be significant factors in cardiovascular adaptations following the 6-week sSIT regime.

Conclusion

This study evaluated the gender-specific differences in the adaptations of bio-motor abilities, aerobic fitness, and anaerobic power to short sprint interval training in basketball players. Our results indicated that both the male and female training cohorts demonstrated statistically significant improvements in aerobic power, linear speed, change of direction ability, agility, and jumping and muscular power from the pre- to the post-training assessments, and there was no discernible gender-related interaction noted in the magnitude of these changes. From a practical standpoint, the consideration of sex should not be a significant factor when implementing sSIT in adult basketball players, particularly when the objective is to enhance specific physical performance measures mentioned in this study. Consequently, male and female basketball players with similar training routines can be subjected to comparable sSIT programs, including similar volume, intensity, and frequency.

Acknowledgements

The authors have no conflict of interest to declare. The present study complies with the current laws of the country in which it was performed. The datasets generated and analyzed during the current study are not publicly available, but are available from the corresponding author who was the organizer of the study.

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Key points

- The current study suggests that adaptations to sSIT do not differ between sexes, and gender differences should not be a major concern when implementing sSIT in basketball players when both groups are trained athletes.
- Incorporating sSIT into the usual basketball training during the off-season induces adaptive responses that improve essential basketball-specific bio-motor abilities in both male and female athletes.
- sSIT sufficiently stimulate adaptive mechanisms improving the male and female athletes' aerobic fitness under the conditions of this study.
- The integration of sSIT into extended, basketball-specific training regimes empowers basketball players and coaches to optimize the efficacy and effectiveness of their training programs. This strategy yields favorable physiological enhancements and improvements in overall performance.

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