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THE EFFECT OF AN 8-WEEK ONLINE HIGH-INTENSITY INTERVAL TRAINING PROGRAM ON BODY COMPOSITION AND PERFORMANCE IN THAI PROFESSIONAL FOOTBALL PLAYERS DURING THE COVID-19 EPIDEMIC

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Abstract

Background/objectives. High-intensity interval training (HIIT) was used to be a strategy for improving physical performance. Especially, athletic training which were disturbed by the Covid-19 pandemic. Therefore, the objectives of this study were to determine the effects of an 8-week online HIIT program on the body composition, aerobic and anaerobic performances in professional football players.

Materials and methods. Thirty professional football players in Thai league division 2 were randomly assigned into the onsite group (n = 15) and the online group (n = 15). All participants performed the HIIT program at 85% maximal heart rate (HRmax), five times a week for 8 weeks. Body composition, aerobic and anaerobic performance at baseline, after 4 weeks and 8 weeks of training were calculated by repeated measures ANOVA and unpaired t-test.

Results. Weight, BMI and % fat were significantly decreased after 4 weeks of training in the onsite group and after 8 weeks of training in the online group ($p < 0.05$). FFM in the onsite and online groups was significantly increased after 4 weeks and 8 weeks of training, respectively ($p < 0.05$). Aerobic performance was significantly increased after 4 and 8 weeks of training ($p < 0.05$), whereas anaerobic performance was found increased after 8 weeks of training in both groups ($p < 0.05$). There were no significant differences between the groups.

Conclusions. Eight weeks of HIIT training can improve body composition, aerobic performance and anaerobic performance in both onsite and online conditions. It may be implied that an online HIIT training program should have beneficial effects similar to those provided in onsite condition.

Keywords: HIIT program, aerobic performance, anaerobic performance, soccer.

Introduction

The outbreak of the COVID-19 pandemic has presented significant challenges in managing various aspects of human life, including physical activities worldwide. Among the strategies employed to control the spread of COVID-19, social distancing measures have been widely implemented (Wang et al., 2020; Tsolakis et al., 2023). Unfortunately, these measures have disrupted the routines of athletes, affecting their training, skill development, and competitive opportunities (Fitzgerald et al., 2021). As a result, athletes have encountered difficulties in achieving their targeted exercise and training routines, often resorting to general physical well-being and health maintenance due to limited access to equipment and facilities. Consequently, key training factors such as intensity, duration, frequency, and mode have suffered notable reductions (Fitzgerald et al., 2021). For athletes engaged in high-intensity athletic activities, inadequate training can lead to detraining effects.

Football, being an intermittent sport involving a variety of high-intensity movements such as rapid changes in direction, sprinting, and jumping, has been particularly affected by the off-season period resulting from COVID-19 lockdowns (Radzimiński et al., 2021). Previous studies have also highlighted the negative impact of home isolation during the pandemic on athletes' aerobic capacity, muscle strength, muscle mass, body fat, and exercise performance (Tsolakis et al., 2023; Parpa & Michaelides, 2021). In this context, high-intensity interval training (HIIT), characterized by brief

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intervals of vigorous activity combined with periods of low activity or rest, has emerged as a valuable tool for enhancing health and performance across diverse populations. HIIT's aim is to accumulate activity at an intensity that the participant would be unable to tolerate for prolonged periods (i.e. 80-95% of peak oxygen consumption (VO_2peak) or >90% of maximum heart rate (HRmax), therefore the recovery time should be enough to allow the subsequent interval to be completed at the desired intensity (Cassidy et al., 2017). HIIT was used to be a tool for improving health and performances in many target groups (Gillen & Gibala, 2014) such as healthy untrained overweight/obese males (Khammassi et al., 2018), overweight/obese untrained individuals (Gripp et al., 2021), overweight and obese women,10 sedentary young females (Lu et al., 2022), futsal players (Marzieh et al., 2016). HIIT is a novel interval strategy that has recently piqued the interest of athletes which can increase physical fitness in athletes. The effect of HIIT on bioenergetic variables in professional football players has received little attention (Marzieh et al., 2016). Other study also found that 12 weeks of HIIT, BMI and fat mass percentage were dramatically reduced. In addition, HIIT can improves cardiopulmonary fitness in healthy untrained overweight/obese youth (Khammassi et al., 2018). According to Covid-19 pandemic, a home-based exercise training program was considered to be an instrument for conserving and improving health as well as performance in athletes. Especially, HIIT is an interesting training programs for this pandemic. There are many factors that affect to reach the goal of home-based exercise training program including individual's concentration and the environment such as limited space of the room for training. Therefore, the researcher tries to find out the online HIIT Program to assist athletes maintain and enhance their performances of professional football players during the COVID-19 pandemic. Thus, the objectives of this study were to determine the effects of an 8-week online high intensity interval training (HIIT) program on the body composition, aerobic and anaerobic performances in professional Thai football players during the Covid-19 pandemic.

Material and methods

Participants

A total of thirty professional football players from Rajpracha F.C. Football club, competing in the Thai League Division 2, were recruited for this study. The participants were randomly assigned to one of two groups: Group 1, the onsite group (control group, n = 15), and Group 2, the online group (experimental group, n = 15). The recruitment process adhered to ethical standards outlined in the Helsinki Declaration, and the study protocol received full approval from Walailak University (WUEC-22-317-01). Prior to the commencement of the experiment, all participants were provided with a detailed explanation of the procedures involved as well as the associated risks. Inclusion criteria for participation included the players' informed consent, absence of any illness records, and a minimum of six months of training experience. Exclusion criteria consisted of training-related injuries and a consecutive absence from two sessions or a non-consecutive absence from three sessions.

Experimental protocol

Upon completion of the consent form, participants underwent a series of assessments to determine their anthropometric measurements (height, weight, BMI), body composition (% fat, fat-free mass; FFM), aerobic performance (YO-YO test; VO_2max), and anaerobic performance (RAST test; maximal power, minimal power, average power, and fatigue index) at baseline. These parameters were assessed again at 4 weeks and 8 weeks following the training intervention. The participants then commenced an 8-week high-intensity interval training (HIIT) program, which was conducted either onsite or online, depending on the assigned group. The HIIT program was designed to be performed at 85% of maximum heart rate (HRmax) and consisted of five training sessions per week: Monday, Wednesday, and Friday sessions included six exercise modalities (Squat Jump, Mountain climbers, Step in-out, Push hand up, High Knee up, Burpee), while Tuesday and Thursday sessions involved different exercises (Jumping jack, Bicycle crunch, Slide L-R, Planking jack, Jump lunge, Burpee). Each session lasted for a total of five minutes, with four minutes of resting time between sessions.

During weeks 1-4 of the program, participants performed each exercise for 50 seconds, followed by a 30-second rest interval. From weeks 5-8, the exercise duration was increased to 60 seconds, with the same 30-second rest interval. The warm-up protocol included a combination of static and dynamic stretching exercises lasting for 10 minutes, while the cool-down protocol consisted of static stretching exercises performed for 8 minutes. Anthropometric measurements (height, weight, BMI) and body composition (% fat, FFM) were assessed using a Bioelectrical Impedance Analysis (Tanita SC330S Body Composition Scale). Aerobic performance (VO_2max) was evaluated using the Yo-Yo test, a well-established field test for measuring maximal oxygen consumption (Chaouachi et al., 2012). Anaerobic performance (maximal power, minimal power, average power, and fatigue index) was assessed using the RAST (Running-based Anaerobic Sprint Test) protocol, which involved a series of maximal sprint efforts (Draper & Whyte, 1997). To ensure the accuracy and reliability of the measurements, standardized protocols and procedures were followed consistently throughout the study, adhering to established guidelines for each assessment. The research team was responsible for conducting the assessments and recording the data in a systematic and unbiased manner. The collected data from the assessments at baseline, 4 weeks, and 8 weeks were used to evaluate the effects of the HIIT program on the selected variables, allowing for comparisons between the onsite and online groups. Statistical analysis was performed to determine the significance of any observed changes and to assess the overall impact of the HIIT intervention on the participants' anthropometry, body composition, aerobic performance, and anaerobic performance.

Statistical analysis

Data were expressed as mean ± S.D. by using SPSS version 26 was used to test the statistics. Repeated measure ANOVA was used to compare all parameters between times, Turkey's

post hoc test were applied in case of significant ($P < 0.05$). F ratio to locate the differences. Unpaired t test was used to identify condition differences between parameters. $P<0.05$ was considered significant.

Results

Baseline characteristic parameters

All participants had normal levels of BMI (onsite group; 22.74 ± 2.51 and online group; 23.31 ± 1.96 kg/m^2), % fat (onsite group; 8.62 ± 3.54 and online group; 10.18 ± 3.19 %) and FFM (onsite group; 64.62 ± 7.78 and online group; 67.11 ± 8.70 kg). There were no significant differences in anthropometric and body composition variables between onsite and online group at before training (Table 1).

Table 1. Baseline characteristics of participants

Variables	Onsite (n = 15)	Online (n = 15)
Age (Yr)	23.87±5.32	23.07±5.60
Height (m)	1.76±0.07	1.79±0.09
Weight (kg)	70.97±10.21	74.99±11.28
BMI (kg/m^2)	22.74±2.51	23.31±1.96
% Fat (%)	8.62±3.54	10.18±3.19
FFM (kg)	64.62±7.78	67.11±8.70

Data are expressed as mean ± SD., BMI – Body mass index; FFM – Fat free mass

Body Composition, Aerobic and Anaerobic performance

The onsite group had significantly lower weight and BMI after 4 weeks of training than before training ($p<0.05$). Moreover, the online group also had significantly lower weight and BMI after 8 weeks than after 4 weeks of training ($p<0.05$). The percentage of fat in onsite group had significantly lower after 8 weeks than before training ($p<0.05$), in addition, it was also found in online group after 8 weeks than after 4 weeks and before training ($p<0.05$). FFM had significantly higher after 4 weeks than before training in onsite group ($p<0.05$), it was also reported in online group after 8 weeks than after 4 weeks of training ($p<0.05$).

Aerobic performance in both groups had significantly higher after 4 and 8 weeks of training than before ($p<0.05$). Whereas, anaerobic performance in both groups had significantly higher after 8 weeks of training than before ($p<0.05$) which were seen in max and min power parameters. Furthermore, the online group had significantly higher in average power after 8 weeks than 4 weeks and before training ($p<0.05$). There were no any changes in fatigue index in both groups. However, there were no significant differences in body composition, aerobic performance and anaerobic performance variables between onsite and online group at any time of training (Table 2).

Discussion

The results of this study showed that body composition, aerobic and anaerobic performance were improved after HIIT training for 8 weeks in both onsite and online condition. Nevertheless, the online condition seems to be gradually increased in these parameters when compared to the onsite condition. Previous studies suggested that HIIT program was used to be an implement for improving health and performances in many individuals such as overweight/obese healthy untrained (Khammassi et al., 2018), overweight/obese untrained (Gripp et al., 2021), overweight and obese women (Nobari et al., 2022), sedentary young females (Lu et al., 2022), and futsal players (Marzieh et al., 2016). Especially, Covid-19 pandemic disturbed the maintaining and improving of the performances in athletes. Therefore, examination of the online HIIT training program affected on many aspects in athletics were considered.

This study reported that body composition for instance weight, BMI, % fat and FFM in both onsite and online condition were improved after training, which was found at 4 weeks after exercise in onsite group while it was found at 8 weeks after exercise in online group. In addition, aerobic and anaerobic performance were also improved after the training for 8 weeks in both groups. These findings were similar to the earlier studies, Balbasi and colleagues (2016) examined the effect of 3-week HIIT on body composition, maximum aerobic power and maximum anaerobic power in boys - futsal players. They reported that HIIT program with 3 sessions per week affected the reduction of weight,

Table 2. Body composition, Aerobic and Anaerobic performance in onsite and online group

Variables	Onsite (n = 15)			Online (n = 15)		
	Before	4 wk	8 wk	Before	4 wk	8 wk
Weight (kg)	70.97±10.21	70.64 ±9.87*	70.93±10.01	74.99±11.28	74.46±10.47	75.09±10.70**
BMI (kg/m^2)	22.74±2.51	22.64±2.45*	22.73±2.45	23.31±1.96	23.16±1.70	23.36±1.82**
% Fat (%)	8.62±3.54	7.68±2.75	7.76±2.93*	10.18±3.19	9.03±2.67*	8.56±2.34*,**
FFM (kg)	64.62±7.78	65.05±7.96*	65.23±7.85	67.11±8.70	67.52±8.33	68.52±8.91**
YOYO (ml/kg/min)	49.59±2.86	52.94±3.04*	56.29±3.17*,**	49.10±3.50	53.17±3.08*	57.01±2.83*,**
Max Power (watt)	913.83±182.01	928.79±180.93	950.36±173.71*,**	943.74±234.44	949.15±226.06	977.31±227.40*
Min Power (watt)	631.43±144.89	638.51±123.15	658.89±122.63*	614.82±164.54	635.21±160.30	665.39±164.85*,**
Average Power (watt)	762.81±145.21	765.72±139.14	775.42±132.35	778.34±202.26	783.95±199.38	809.40±197.71*,**
Fatigue Index (%)	9.72±5.29	10.03±4.35	10.10±3.64	11.15±4.24	10.69±3.72	10.71±3.55

Data are expressed as mean ± SD.; BMI – Body mass index; FFM – Fat free mass; * Significantly different compared to before training ($p<0.05$); ** Significantly different compared to 4 weeks of training ($p<0.05$)

BMI and % fat in experiment group after training (Marzieh et al., 2016). Khammassi and co-workers (2018) investigated the effects of 12 weeks of HIIT program without caloric restriction on aerobic capacity, body composition and lipid profile in twenty healthy young overweight/obese men. They found that the HIIT program comprised of 3 exercises sessions per week (30 sec of work at 100% maximal aerobic velocity) improved aerobic capacity (VO_2max), body composition (BMI, waist circumference, % fat) and lipid profile (Khammassi et al., 2018). Gripp and co-worker (2020) suggested that HIIT improved indicators of cardiometabolic health such as VO_2max, BMI, body fat, visceral fat after 8 weeks of training in healthy overweight/obese untrained individuals. The benefit effects of the HIIT program were also institute to be longer lasting and maintained after the holdup of high-intensity interval running for 4 weeks (Gripp et al., 2021). Moreover, Lu and co-worker (2022) also studied the effects of 8-week high-intensity interval training and moderate-intensity continuous training on body composition, VO_2max and bone metabolism in sedentary young females. They also found that the HIIT program could improve weight, BMI, % fat and VO_2max after the training in HIIT group (Lu et al., 2022). The beneficial consequences of HIIT training program on health and cardiorespiratory fitness were considered in many situations such as athletic and metabolic health. It was well-known that HIIT can affect the cardiometabolic health (Cassidy et al., 2017), specially, the changes in skeletal muscle via increased muscle work capacity, oxidative capacity and glucose transport. Furthermore, there were evidences supported that HIIT could induce positive effects on body composition, particularly, fat loss through possible mechanism for instance 1) increased mitochondrial density and capacity following HIIT caused increasing of fat oxidation rate (Talanian et al., 1985), 2) great raises in catecholamines, which have been shown to motivate lipolysis (Zouhal et al., 2008) exclusively, in the abdominal tissue where there are significantly more β-adrenergic receptors, compared with subcutaneous fat (Rebuffé-Scrive et al., 1989), 3) appetite suppression (Sim et al., 2014).

Besides, it could be said that the most important outcome following HIIT training is cardiorespiratory fitness, which examined by VO_2max. VO_2max is the gold standard parameter of fitness and a strong indicator of how well the cardiac, pulmonary, vascular and peripheral systems are working together. Previous studies have been shown that HIIT improves the capacity of both aspects of the oxygen supply and demand chain, nonetheless it is the cardiovascular adaptations in response to HIIT that are more likely to leading to VO_2max enhancement (Baekkerud et al., 2016).

On the other hand, recent study in 2022 reported that 8 weeks of HIIT program combined with Spirulina Supplementation could not affect to weight, BMI and % fat in sedentary overweight/obese women while FFM was lower after the training (Nobari et al., 2022). However, there were many factors that affected the efficacy of HIIT program such as a complicated training protocol and psychological factors (mood, motivation, perception of effort, etc.) (Khammassi et al., 2018; Gibala, 2007).

Limitation

The limitation of this study was to the participants did not undergo the caloric restriction during training, which directly to affected body composition parameters. It may be leading to there were no significant differences outcomes between onsite and online groups.

Conclusions

In conclusion, 8 weeks of HIIT training can improve body composition, aerobic performance and anaerobic performance in both the onsite and online groups. Likewise, there were no significant different between onsite and online condition, it may be implied that online HIIT training program have similar beneficial effects to onsite condition. Nevertheless, the online condition seems to be slower improvement of all outcomes than the onsite. It may be due to the factors that affect to reach the goal of home-based exercise training program including individual's concentration and the environment such as limited space of the room for training.

Conflicts of interest

The authors declare that there is no conflict of interest.

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ВПЛИВ 8-ТИЖНЕВОЇ ІНТЕРАКТИВНОЇ ПРОГРАМИ ВИСОКОІНТЕНСИВНИХ ІНТЕРВАЛЬНИХ ТРЕНУВАНЬ НА СКЛАД ТІЛА ТА РЕЗУЛЬТАТИВНІСТЬ ТАЙСЬКИХ ПРОФЕСІЙНИХ ФУТБОЛІСТІВ ПІД ЧАС ЕПІДЕМІЇ COVID-19

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 6 с., 2 табл., 22 джерела.

Історія питання та мета дослідження. Високоінтенсивні інтервальні тренування (ВІІТ) використовували як стратегію для покращення фізичних показників. Зокрема, спортивні тренування, яким завадила пандемія Covid-19. Таким чином, метою цього дослідження було визначити вплив 8-тижневої інтерактивної програми ВІІТ на склад тіла, аеробні та анаеробні показники професійних футболістів.

Матеріали та методи. Тридцять професійних футболістів зі складу 2-го дивізіону тайської ліги методом випадкової вибірки розподілили на фізичну групу (n = 15) та інтерактивну групу (n = 15). Усі учасники виконували програму ВІІТ на рівні 85% максимальної частоти серцевих скорочень (МЧСС) п'ять разів на тиждень протягом 8 тижнів. Склад тіла, аеробні та анаеробні показники на вихідному рівні, після 4 тижнів і 8 тижнів тренувань розраховували за допомогою дисперсійного аналізу повторних вимірювань і двовибіркового t-критерію Стьюдента для незалежних вибірок.

Результати. Показники ваги, ІМТ та % жиру в організмі статистично значуще знизилися після 4 тижнів тренувань у фізичній групі та після 8 тижнів тренувань в інтерактивній групі ($p < 0,05$). Показник маси тіла без жиру у фізичній та інтерактивній групах статистично значуще збільшився після 4 та 8 тижнів тренувань відповідно ($p<0,05$). Аеробна продуктивність статистично значуще зросла після 4 та 8 тижнів тренувань ($p < 0,05$), тоді як анаеробна продуктивність зросла після 8 тижнів тренувань в обох групах ($p<0,05$). Статистично значущих відмінностей між групами не було.

Висновки. Вісім тижнів занять ВІІТ можуть покращити склад тіла, аеробну та анаеробну продуктивність як у фізичних, так і в інтерактивних умовах. Можна припустити, що позитивний вплив інтерактивної програми занять ВІІТ має бути аналогічним до впливу занять у фізичних умовах.

Ключові слова: програма ВІІТ, аеробна продуктивність, анаеробна продуктивність, футбол.

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