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Effectiveness of a Community Football Programme on Improving Physiological Markers of Health in a Hard-To-Reach Male Population: The Role of Exercise Intensity.

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Abstract

The present study evaluated the effectiveness of participation in recreational football during a community health programme, on physiological markers of health within a hard to reach (HTR) population. Nine men (Age: 33±9 years, Mass: 75.4±13.7 kg, Height: 1.74±0.07m and Body Fat: 19±2%) were recruited to participate in the study in collaboration with an English Premier League Football Club. Participants completed the 12-week football-based programme which included two coached football sessions each week. Physiological tests for blood pressure, resting heart rate, cholesterol and an anthropometrical test for body composition were completed at 3 time points during the study (Weeks-1, 6 and 12) in an attempt to evaluate the impact of the intervention on health. During each training session, measurements of intensity (%HR_{max}, identified from the yoyo intermittent level 1 test), duration and rating of perceived exertion were made. The 12-week programme (mean HR_{max} throughout programme = 75±4% beats.min^{-1}; mean RPE throughout programme = 6±1) elicited few changes in physiological markers of health with the only significant change been a decrease in resting heart rate from weeks 6 – 12 (87±22 beats.min^{-1} at week-6, to 72±17 beats.min^{-1}; $p<0.05$). This data would suggest that the current community football-related health project was not effective in improving physiological markers of health, but was able to maintain their level of health. A lack of improvement may be due to the low intensity of sessions and a lack of coach education for the promotion of sessions that aim to improve health.

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Introduction

The uptake of traditional health services (General Practices) by men is a cause for concern amongst public health professionals in the UK[1]. Individuals from hard-to-reach (HTR) populations experience difficulty engaging in physical activity for a sustained period of time[2]. Hard-to-reach populations are those who are difficult to access due to a specific factor that characterises its members (homeless people, prostitutes, drug addicts), which results in marginalization and restricted access to appropriate health care due to social barriers created by ignorance, prejudice and discrimination[3]from the general population. Targeting health intervention is therefore an important factor in engaging HTR male populations who may be predisposed to cardiovascular health concerns[4].

Interventions that use popular sports such as football as the exercise stimulus have been developed as a way to engage with HTR populations. Football may have a great potential to act as a health promotion tool as a consequence of its ability to improve the motivational and social factors associated with its participation when compared to more traditional types of exercise interventions such as continuous moderate intensity running[5].In order to remove the barriers for male participation it has been suggested[6] that sports groups may serve as the most appropriate community setting for these populations, as traditional health care advice is typically dominated by female friendly practises which make male populations regard themselves as intruders[7]. Until recently few studies have investigated the health effects of football training, small sided game(SSG) play and match play[8].These investigations, typically conducted over 12 weeks with two-three 60 min sessions per week, have shown positive health benefits linked to football participation such as muscular hypertrophy and increases in strength[9], a decrease in blood pressure[10], decreases in total fat mass[11] as well as increases in$\dot{V}0_{2max}$[12].Therefore there may be a potential for football to remove the social barriers commonly perceived by the HTR population, and allow these interventions to provide the many health benefits observed within the literature.

Research into the health effects of recreational football[13] to date has typically employed well controlled experimental designs that predominately utilise carefully prescribed football-related activities. Furthermore, participants within these investigations are typically healthy and untrained who volunteer for the research. Such programmes are also typified by high levels of compliance to study requirements and regular attendance at sessions throughout the training programme. Golay *et al.* (2013) suggested[14] that 'real life' participation in such programmes or trials do not necessarily reflect study cohorts and can be influenced from factors outside the realm of the programme or trial. The framework employed within much of the previous literature may therefore not reflect the reality of provision within a typical community-based programme that uses skills coaches to deliver football sessions as a vehicle for health promotion. Such programmes, where the structure of training activities and the level of participant commitment may be more varied, may have the potential to reduce the effectiveness of football-based interventions. These concerns could be further amplified by participants from HTR populations who decline formal treatment, lack motivation and lead unconventional lifestyles.

The present study aimed to evaluate the effectiveness of regular participation in recreational football, as part of a Football in the Community (FitC) health programme, on markers of health within a hard-to-reach population.

Materials and Methods

Experimental Design

All participants were involved in a 12-week football-coached intervention programme. Two football sessions lasting 120 minutes in duration were completed each week as the exercise stimulus, with heart rate (HR) continually monitored to measure exercise intensity, following the measurement of HR_{max} (described below). To evaluate the health impact of the intervention health related physiological testing was completed at 3 time points during the study (Weeks-1, 6 and 12).This included body composition, blood pressure and cholesterol. Participants were familiarised with the training programme, testing procedures and gave their written informed consent to participate in the study and provide all additional measurements in accordance with the ethical clearance provided by the Universities ethics committee prior to the study completion.

Participants

Nine men (Age: 33±9 years, Mass: 75.4±13.7 kg, Height: 1.74±0.07m and Body Fat: 19±2%) were recruited to participate in the study from a men's homeless shelter and a drug addiction service, who were already in partnership with the FitC health programme at an English Premier League Football Club. Participants were recruited using a variety of mechanisms including face-to-face engagement, phone calls, referrals from service staff and word of mouth. The majority of the participants were smokers, had a history of drug-use (though were recovering and had not taken drugs for at least 6 months) and did not regularly participate in any form of structured physical exercise. Participants were deemed healthy and able to participate following responses given to standardised health questions. These included previous and current medical information around cardio-respiratory, bone and joint health.

In total, 20 participants signed up to the programme, however, 11 dropped out during the course of the study leaving the final sample to comprise of 9 individuals. Reasons for participant drop out included: depression and mental health issues (causing a lack of engagement), lack of motivation to attend sessions, and trouble with local authorities. The average percentage of attendance of participants to training sessions throughout the programme was 84±7%. Reasons for non-attendance during the programme included: illness, injury, family issues and situational issues, such as lack of money to travel to the training venue and obligatory appointments with social workers.

Training Intervention

Outdoor training was completed 2 times per week for 12 weeks on a 20m by 30m artificial pitch. Each training session was scheduled for 120 minutes. Football sessions were conducted by a qualified FitC coach and generally followed a similar format. Typically this involved a standardised 10-min warm-up comprised of gentle jogging, dynamic, football-related movements (e.g. side-steps, skipping, jumping and lunges), sprinting and dynamic and static stretching. Twenty to thirty min of technical practice(defined as: Individual or group practice covering technical elements under no pressure) was performed, followed by ~20-30 min of skills practice (defined as: Individual or group practice covering technical elements under opposed pressure), or possession games (defined as: Practice in which ball retention, rather than scoring a goal is the primary objective)[15]. The sessions were concluded with ~30-40 min of SSG (6v6, 5v5 or 4v4). Sessions differed from this format in weeks 1, 6 and 12 when physical fitness testing was completed during the first session of the week.

HR telemetry was continuously monitored throughout football sessions and was recorded every 5 seconds using HR monitors (Polar Team System, Polar, Kempele, Finland). The mean HR of each individual training activity (i.e. warm up, technical practice, skills/possession practice and SSG) was determined and used for analysis. The mean HR collected throughout the entire session provided an indication of the overall session intensity. Participant's' maximal HR (HR_{max}) was determined from the HR peak recorded during the Yo-Yo Intermittent Endurance Level 1(Yo-Yo IE1) test. This enabled the collected HR data to also be expressed as a percentage of the individuals HR_{max}. Rating of perceived exertion (RPE) was collected at the end of each session and determined using Borg's CR10-scale[16]. Training load (RPE_{load}) was determined by multiplying the training duration (minutes) by the session RPE, as previously described[17]. This RPE-based method of training load quantification has been shown to be a good indicator of internal training load in football[18].

Testing Procedures and Measurements

Testing was completed 3 times during the study (Weeks 1, 6 and 12), with participant's attending the laboratory for health screening. All testing procedures were explained and demonstrated to participants prior to the completion of the assessment. Participant's body composition was assessed via Dual-energy X-ray Absorptiometry (DXA) (Hologic QDR Series Discovery A, Bedfored, MA). Height and mass measurements were taken according to the anthropometric profile recommended by the International Society for the advancement of Kinantropometry (ISAK)[19] using a Stadiometer (Seca, Germany) and electronic weighing scales (Seca, Hamburg, Germany). Blood pressure and resting heart rate were measured using an automatic upper arm blood pressure monitor (Dynamap, Critikon, UK) following a 5 min period of seated rest. Two measurements were recorded and an average calculated from this data for the final recorded measurement. Blood samples were obtained from the antecubital vein in 2mL syringes without heparin. Plasma from centrifuged samples was collected and stored at -20°C until subsequent analysis. High density lipoprotein (HDL), low density lipoprotein (LDL), triglycerides and total cholesterol were determined flourometrically on an automatic analyser (RX Daytona, Randox Laboratory, Antrim, UK). All samples were measured in duplicate following completion of the 12-week programme using the same commercially available enzymatic spectrophotometric assays (RX Daytona Analyzer, Randox Laboratories, Antrim, UK). Co-efficient of variation for these assay kits were 1.47%, 1.80%, 3.29% and 3.73% for HDL, LDL, triglycerides and total cholesterol respectively.

Statistics

Data are presented as means ± standard deviation (SD). All data were assessed for the assumption of normality using the Shapiro-Wilks test for normality of distribution. Mauchly's test of sphericity was performed on all data to assess for the assumption of sphericity. However, no corrections were required following these assessments. Within-group data for all variables for pre-, mid- and post-testing (Weeks-1, -6, and -12) were evaluated by one-way analysis of variance on repeated measures (ANOVA). The level of statistical significance was set at $P < 0.05$. When a significant effect was detected, data were subsequently analysed using Bonferonni corrected pair-wise comparison post-hoc test. All statistical analyses were carried out using SPSS Statistical Analysis Software (SPSS® Version 15.0.01 for Windows®, Chicago, Illinois, USA).

Results

Physiological response to training

Average heart rate during sessions across the 12 weeks was 138±7 beats.min^{-1}.This corresponded to around 75±4 %HR_{max}. Average time spent >90% HR_{max} for each session was 13 ± 7 min (Table 1), corresponding to 15% of training time. Mean RPE for the sessions was 6±1 (VAS 1-10). This data gave an RPE_{load} of 475±71 (Table 1). Average heart rate during the warm-up, technical practice, skills / possession practice and SSG were 67±6, 71±4, 76±5 and 82±7 $\%HR_{max}$ respectively (Figure 1.). Figure 2 provides an individual insight into the sessional HR response for a typical training session.

Blood Pressure and Resting Heart Rate

No differences (P=1.00) were observed for RHR between weeks-1 and -6. Resting heart rate did, however, change (P=0.008) from 87±22 $beats.min^{-1}$ at week-6, to 72±17 $beats.min^{-1}$ at week-12 (Table 2. and Figure 3.). No changes were observed in resting systolic (p=0.711) or diastolic (p=0.824) blood pressure following 12-weeks of training (Table 2.).

Body Composition and Blood Analysis

No changes occurred over 12-weeks of training for total mass (p=0.144), fat (p=0.173) and lean mass (p=0.484), bone mineral density (BMD) (p=0.199) and %body fat (p=0.098) (Table 2.). Similarly, no changes were observed over 12-weeks of training for blood lipid markers, including HDL (p=0.187), LDL (p=0.487), triglycerides (p=0.541) and total cholesterol (p=0.108) (Table 3.).

Discussion

The primary aim of the current investigation was to examine markers of health before and after a 12-week Football in the Community (FitC) health programme. The main finding was that 12-weeks of a recreational community based football training programme elicited little or no changes in physiological markers of health as reflected by HR, blood pressure, body composition and blood lipid profile.However, it could be suggested that the programme was successful in maintaining health, as the participants baseline data suggests that they were not especially unhealthy.The failure to find positive changes in health may be consequence of the myriad of problems associated with the delivery of such programmes within the community based setting (e.g. participant attendance). They may also be a result of the relatively low exercise intensity associated with the sessions included in the intervention. This intensity is probably a direct result of the organisation of the activities within the session. This may highlight the need for better coach education training for the delivery of community programmes.

The training programme included in the intervention had limited impact on a selected range of markers of health in our HTR population. No changes were observed in blood pressure, body composition (including; fat mass, lean mass, %body fat and BMD) and blood lipid profile. The findings in the current investigation are in contrast to previous research that indicated that recreational football training, with an approximate intensity of 80-85% generated during a 60-120 min session 2-3 times per week, was effective in reducing blood pressure. For example, previous investigations[20] have observed reductions in systolic and diastolic blood pressure of 8 and 5 mmHg respectively, following 12-weeks of training. Recent studies have also typically observed reductions in total mass, fat mass and % body fat as well as increases in leg muscle mass and BMD following a period of recreational football training[21]. This data is also in contrast to our findings. Resting HR was the only variable to decrease following 12-weeks of recreational football training (Table 2) in the current investigation. The decrease in resting HR as observed in previous studies[22] may reflect a reduction in sympathetic outflow and thereby reduced systemic vascular restrictions. Regardless of the lack of physiological change observed, it cannot be ascertained if the programme resulted in other adaptations in either behavioural and/or psychological characteristics. Such changes have previously been seen in other investigations[23], though were not measured here.

Mean weekly time spent above 90 $\%HR_{max}$ equated to 13$\pm$7 mins throughout the 12 training weeks. This may have been thought to be sufficient to induce a positive health increase as previous studies[24] demonstrate, although still lower than Randers *et al.* (2012) who found their street soccer programme resulted in 21$\pm$12mins above $90\%HR_{max}$. The lack of significance amongst the physiological variables could partially be attributed to the depletion of the statistical power due to the withdrawal of 11 participants from the original group of 20. This may have decreased the likelihood of any statistical difference from several of the variables measured, as positive improvements are clear but not to significance. This, and the lack of a control group, is a clear limitation of this investigation. Another possible explanation for the lack of health benefits observed following the programme may be linked to the overall exercise intensity achieved during the sessions. The overall average intensity of the football sessions conducted throughout the 12-week programme was 75 ± 4 $\%HR_{max}$. This is considerably lower than reported in recent research that has utilised a more controlled exercise prescription such as SSG[25]. The main disparity in the overall exercise intensity within our investigation seemed to have occurred as a consequence of the structure of the session, more specifically the inclusion of football drills and technical practices. Average heart rates during technical practice and skills / possession practice were 71 ± 4 and 76 ± 5$\%HR_{max}$ respectively (Figure 1.). This is lower than the 82% HR_{max} associated with the SSG's completed at the end of the session. The intensity of exercise is thought to act as a key primer for any physiological adaptations associated with chronic training programmes[26]. The previous research discussed[27] would suggest that an overall intensity between 80-85% HR_{max} would induce adaptation within a healthy population, similar to those described in the current investigation. Therefore, it appears that the inclusion of technically orientated football drills may have lowered the overall exercise intensity of the session and limited the time that each participant was required to work at near maximal levels of cardiovascular stress. This may suggest that programmes that do not create high physiological loads may not be effective in eliciting positive health gains. Thus, the absence of change in physiological markers of health observed in the current study could be explained by an insufficient training stimulus. An additional factor that may have explain the lack of effectiveness of the programme was the reduced average duration of the sessions (88 $\pm$ 18 min, see Table 1) when compared to scheduled completion time of 120 mins. This discrepancy was accredited to poor timekeeping of the HTR population, which severely restricted the ability of the coach to run the session for the appropriate duration.

Exercise conducted as part of community-based football health programmes may therefore, need to be more highly controlled from a physiological viewpoint in order to elicit the desired adaptations that may lead to improvements in health status. Beneficial adaptations to the exercise incorporated in such programmes could include a greater reliance on SSG's or a manipulation of any technically orientated football drill included within the session to increase the physiological load. For example, the size of area, number of players, and the exercise to rest ratio are all important determinants of the overall physiological stress associated with the training stimulus[28] that could be manipulated by the coach to improve the fitness outcomes of the session. Furthermore, SSGs have resulted in lower RPE values than jogging, interval training and strength training[29]. Providing more evidence for the use of SSGs. The current investigation found a higher RPE responses compared to the study by Elbe *et al.* (2010), although this may be due to the inclusions of training drills, and may have affected participant retention. There is also a need for further research to investigate the optimal dose response for beneficial health adaptations. It could be speculated that training twice per week for 60-120 mins would be suffice, although this may be dependent on the baseline health of the population undertaking the programme. There is a lack of understanding as to the effect of shorter football training or SSG sessions conducted and maintaining higher exercise intensities. This may be appropriate for populations that are not unhealthy, such as a more aggressive and intense programme can be prescribed, although more research is needed to investigate this hypothesis. Another potential aspect to consider is the development of appropriate standards of coach education for practitioners involved in this type of programme. Typically the coaches that lead community based programmes complete the same educational programmes as coaches who focus on the development of players from a technical and tactical perspective. This type of syllabus may not be suitable for the delivery of a knowledge base that equips individuals to deliver football sessions that are aimed at providing a suitable physiological intensity to improve markers of health.

This study illustrates that the intensity of the session is paramount in providing beneficial health gains for participants, which may require the use of appropriate measures for the monitoring of the intensity to ensure that the coaches are providing a sufficient load to generate the physiologic and metabolic adaptations. However, the coaches may also need to be mindful of the psychological issues that may impact the participation and potential behavioural change. It is important that the training does not simply become fitness based drills to increase intensity, but retain the inclusion of football based drills and SSGs carefully designed to generate sufficient intensity, as these have shown to provide increases in motivation that can increase physical activity compliance.

In conclusion, community-based football projects endorsed by elite teams may be successful at engaging those from HTR populations and important to combat increasing levels of physical inactivity in the general population and associated levels of obesity and cardiovascular diseases. However, the current study suggests that exercise administered during these programmes may not be efficient in promoting positive health changes, although it was successful in maintaining health over the 12-week intervention. As the HTR population were not necessarily unhealthy, more time could be prescribed for SSGs that may not only increase intensity, but also lower RPE, yet maintain participation. It is important for long-term success that the education of participants and healthy lifestyle messages endorsed by such programmes are supported by measurable positive health adaptations. As such, careful consideration needs to be taken when planning training programmes. The completion of a suitable amount of exercise at a high intensity would seem to be an important component of such a planning process. This may necessitate the improved training and education programmes of personal that are required to deliver the programmes.

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[1] Pringle et al, 2011
[2] WHO 2003 – social determinants of health
[3]Faugier and Sargeant 1997 - Sampling hard to reach populations
[4]Witty and White, 2010
[5]Randers et al, 2010; Krustrup et al, 2010 – Soccer training to increase health
[6]Wilkins and Baker, 2003. Policy for men's health, presented at the Men's health forum
[7]Gough, 2013 psychological reasoning behind men's attitudes to health care
[8]Krustrup et al, 2007; 2009; Bangsbo et al, 2009; Anderson et al, 2010; Randers et al, 2010 – SSGs to imporve health benefits
[9]Krustrup et al, 2009
[10]Anderson et al, 2010
[11]Randers et al. 2010
[12]Krustrup et al. 2010
[13]Krustrup et al, 2007; 2009; Bangsbo et al, 2009; Anderson et al, 2010; Randers et al, 2010 – SSGs to imporve health benefits
[14]Golay et al.2013
[15]Yates & Williams, 2008 – technical definitions of practice
[16]modified by Foster et al, 1995
[17]IBid
[18]Imellizzeriet al, 2004 - Use of RPE-based training load in soccer
[19]Marfell-Jones, Olds, Stewart & Carter, 2006 – guidelines set by ISAK
[20]Krustrup et al.2009 – reductions in BP
[21]Bangsbo et al, 2010; Krustrup et al, 2009; 2010a; Randers et al,2010 – positive changes have been see in body composition
[22]Krustrup et al, 2009; Andersen et al, 2010; Randers et al, 2010 – physiology associated with a decrease in HR
[23]Pringle et al, 2013 – behavioural change previously observed when football clubs involved in such programmes
[24] Nybo et al, 2010; Krustrup et al, 2010; 2013; Connolly et al, 2014 - would suggest that 13 mins per week training over 90%HRmax could induce positive health benefits.
[25]Bangsbo et al, 2010; Krustrup et al, 2009; 2010a; Randers et al, 2010 – these studies observed a greater intensity during their SSGs
[26]Nybo et al, 2010b
[27] Bangsbo et al, 2010; Krustrup et al, 2009; 2010a; Randers et al, 2010
[28]Köklüet al, 2011 – determinants of physiological stress during training
[29] Elbe et al, 2010 – REP reduced in football training compared to other methods

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Tables and Figures

Table 1. Mean ± SD data (n=9) for session duration, RPE, RPE Load, and HR training data for 12 weeks of football training. Mean HR data is the mean of both sessions during the week.

Week	**Mean Session Duration** (min)	**RPE** (VAS1-10)	**RPE load**	**Overall Mean Heart Rate** (beats.min^{-1})	**%HR$_{max}$**	**Time >90% HR$_{max}$** (min)
Week 1	73±30	7±0	511	136±24	75±3	10±6
Week 2	74±35	6±1	444	135±16	74±3	2±2
Week 3	104±7	5±1	521	145±20	79±3	21±18
Week 4	93±0	6±0	558	132±18	72±3	10±15
Week 5	89±1	6±2	534	136±23	74±3	15±15
Week 6	80±37	5±1	400	133±24	73±3	8±11
Week 7	92±4	6±2	552	148±22	81±3	21±18
Week 8	99±2	4±0	396	141±21	77±3	17±15
Week 9	92±11	5±1	460	132±19	72±3	14±12
Week 10	100±0	4±0	400	140±25	76±3	14±15
Week 11	92±3	6±1	552	143±19	78±3	12±15
Week 12	53±0	7±0	371	132±24	72±3	7±7
Overall Mean ± SD	**88±18**	**6±1**	**475±71**	**138±7**	**75±3**	**13±7**

Table 2. Mean ± SD Group body composition, blood pressure and resting heart rate for Weeks 1, 6 and 12.

	Week 1	**Week 6**	**Week 12**
Body Composition			
Mass (kg)	75.4 ± 13.7	74.7 ± 13.7	74.0 ± 14.7
BMI	24.85	24.62	24.39
BMD ($g{\cdot}cm^2$)	1.240 ± 0.135	1.247 ± 0.124	1.194 ± 0.093
Fat Mass (kg)*	13.9 ± 6.4	14.7 ± 7.3	13.8 ± 6.3
Lean Mass (kg)*	54.0 ± 8.9	53.6 ± 8.3	55.0 ± 9.7
Total Fat (%)*	19.2 ± 5.8	20.2 ± 6.4	18.9 ± 5.6
Blood Pressure			
Systolic BP (mmHg)	134 ± 14	134 ± 12	131 ± 11
Diastolic BP (mmHg)	76 ± 13	78 ± 9	79 ± 9
RHR ($beats.min^{-1}$)	88 ± 20	87 ± 22	72 ± 17# **

BMD – Bone mineral density, BMI - Body Mass Index, BP – Blood Pressure, RHR – Resting Heart Rate

* Indicates subtotal value (i.e. excluding head)

Significant difference from Week 1

**Indicates significant difference from Week 6

Table 3. Mean ± SD blood lipid values for Weeks 1, 6 and 12.

	Week 1	Week 6	Week 12
Cholesterol (mmol/L)	5.28 ± 0.83	5.28 ± 0.49	5.31 ± 0.79
Triglycerides (mmol/L)	1.85 ± 0.42	2.04 ± 0.43	1.83 ± 0.40
HDL (mmol/L)	1.10 ± 0.15	1.13 ± 0.22	1.12 ± 0.20
LDL (mmol/L)	3.53 ± 0.95	3.50 ± 0.81	3.46 ± 0.92
HDL/LDL Ratio	0.85 ± 0.41	0.95 ± 0.57	0.79 ± 0.36

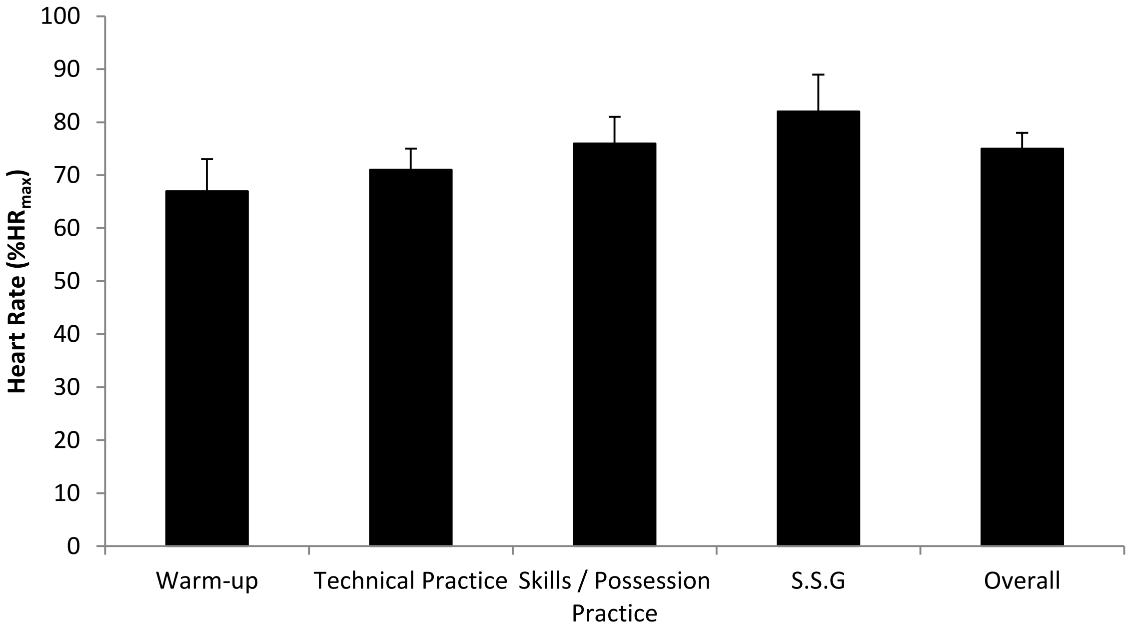

Figure 1. Mean ± SD Heart rate values (%HR_{max}) for activity breakdown during football sessions

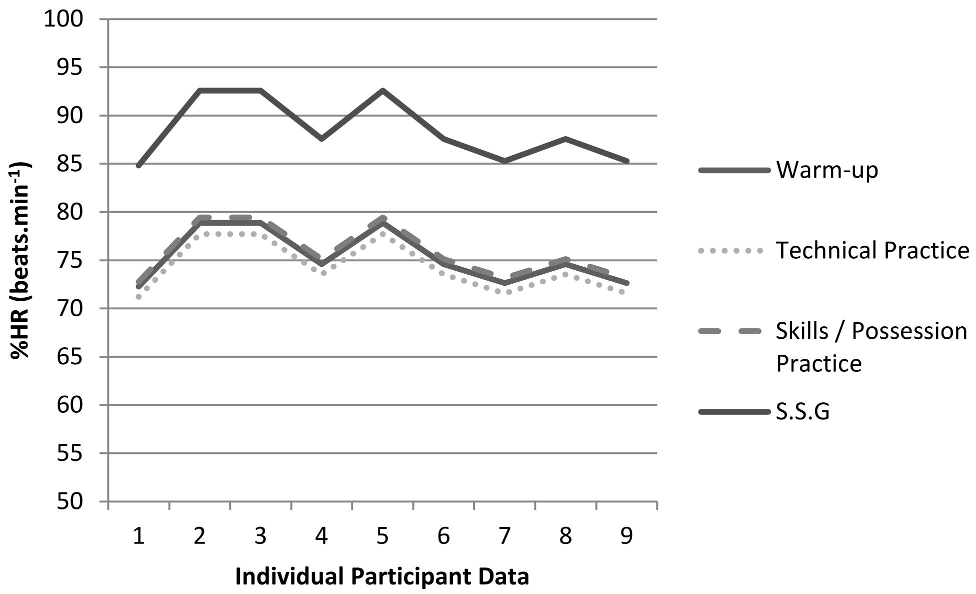

Figure 2. Individual HR data for a single session within the programme, highlighting the variability between participants and HR increase during the SSG.

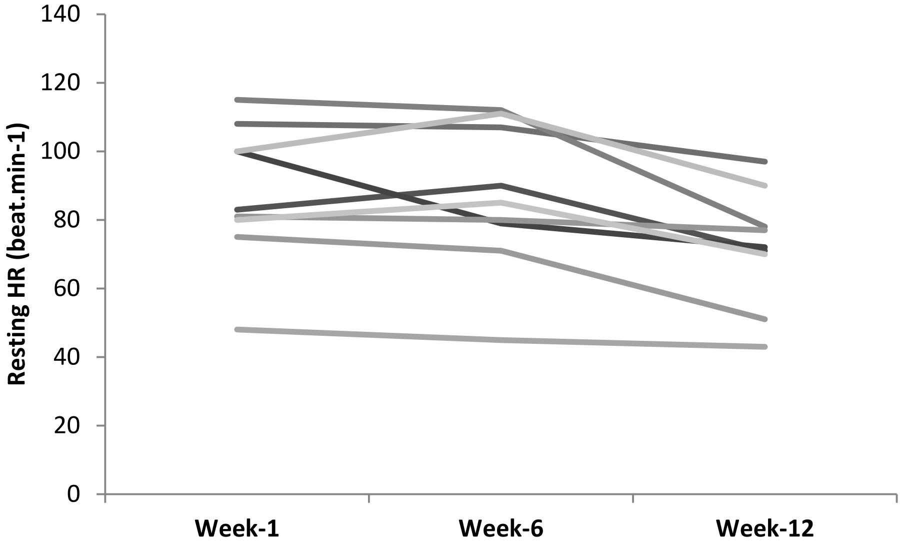

Figure 3. Individual RHR pre, during and post the 12-week training programme.