BMJ Open Sport & Exercise Medicine

Randomised controlled trial comparing two group-based exercise programmes (team sport vs circuit training) on men's health: study protocol

Henry T Blake [1,2] Brad J Stenner [1,2] Jonathan David Buckley [1,2] Alyson J Crozier [1,2]

To cite: Blake HT, Stenner BJ, Buckley JD, *et al*. Randomised controlled trial comparing two group-based exercise programmes (team sport vs circuit training) on men's health: study protocol. *BMJ Open Sport & Exercise Medicine* 2021;**7**:e001140. doi:10.1136/bmjsem-2021-001140

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/bmjsem-2021-001140).

Accepted 26 July 2021

[1]Allied Health and Human Performance, University of South Australia, Adelaide, South Australia, Australia
[2]Alliance for Research in Exercise, Nutrition and Activity, University of South Australia, Adelaide, South Australia, Australia

Correspondence to
Henry T Blake;
blaht001@mymail.unisa.edu.au

ABSTRACT

Introduction Physical activity promotes physical, psychological and social health. Despite this, almost half of middle-aged (35–54 years) Australian men are insufficiently active. Exercise adherence is increased with social interaction in a group setting. Team sport can leverage the power of groups and has shown to be more intrinsically motivating than discrete exercise modes. Evaluation of the effect of team sport compared with traditional group exercise on health, particularly psychological and social health, and physical activity levels of middle-aged men is limited. This study aims to compare the effects of team sport participation and group circuit training on physical activity levels and health in insufficiently active middle-aged men.

Methods and analysis In this parallel randomised controlled trial, n=128 men aged 35–54 years will complete a 12-week team sport or group circuit exercise programme. Participants must self-report to not be meeting Australian physical activity guidelines or participating in team sport before recruitment. Health-related quality of life, exercise motivation, psychological needs satisfaction, sleep and physical activity levels (accelerometry), blood lipids, glucose and metabolic syndrome risk score will be assessed at baseline, end of the programme and 12 weeks follow-up. Linear mixed effect models will be used.

Ethics and dissemination The study has received ethical approval from the University of South Australia's Human Research Ethics Committee (Ethics Protocol 203274). Study results will be disseminated via publication in disciplinary-specific journals, conference presentations, and as part of a Doctoral thesis.

Trial registration number ANCTRN12621000483853.

Key messages

What is already known

- Team sport participants experience high levels of intrinsic motivation.
- Small-sided team sports can improve the physical health of men.
- A correlation between sport participation and positive psychosocial health has been demonstrated.

What are the new findings

- Given this is a randomised controlled trial, it will provide causative evidence of the effect of sport participation on health and physical activity levels in middle-aged men.
- The follow-up will provide evidence of whether participants continue to engage in increased levels of physical activity after the intervention ends and what the health impacts are.

INTRODUCTION

Health is multidimensional, encompassing physical, mental and social well-being, and is more than just the absence of disease or illness.[1] The positive influence of physical activity (PA) on health is well established.[2] However, participation in PA declines with age,[3] and almost half (~46%) of middle-aged Australian men (aged 35–54 years) do not achieve the Australian government's recommended levels of PA.[4] Combined with low levels of PA, middle-aged men also present with elevated levels of worry and stress, low levels of well-being[5] and poor social support,[6] all of which can contribute to poor overall health. Increasing PA in the middle age can decrease cardiovascular disease-related mortality by 43%[7] and improve well-being into older age.[3] However, increasing PA in middle-aged men can be difficult due to barriers such as time constraints, competing factors (eg, family), lack of enjoyment, lack of motivation and low confidence levels.[8 9]

While exercise adherence is multifactorial and complex,[10 11] individuals are more likely to adhere when an exercise programme involves an element of social interaction or group work rather than just independent exercise.[12 13] Indeed, men have reported a desire for opportunities to exercise with those similar to them and enjoy a level of friendly competition.[14] Given the possible benefit of social interaction for improving exercise

adherence, sport has gained attention as an exercise mode for increasing PA.[15 16] In 2018, WHO released a 12-year global action plan to increase worldwide PA levels, highlighting sport as being underused.[16]

Adults participating in team-based sports have reported greater intrinsic motivation to exercise compared with inactive controls[17] or those participating in other forms of group exercise, including resistance training[18] and spin cycling.[19] Concerning men specifically, Nielsen *et al*[20] identified that middle-aged and older men participating in small-sided games reported that enjoyment and social interaction within the game motivated them to adhere to a greater extent than men participating in group-based exercise classes (ie, spin, CrossFit). Among older men with prostate cancer, participating together in recreational soccer was found to generate a sense of collectivity, team spirit and an obligation towards team members to continue to be involved, all of which positively influenced exercise adherence.[21] Taken together, the literature suggests that participation in team sport supports the development of interpersonal relationships, which positively influence motivation to continue to participate with a resultant increase in PA.

The impact of team sport on physiological outcomes and physical health has gained considerable attention,[22 23] including assessment of impacts of select small-sided team sports, such as recreational soccer,[23] handball,[24 25] touch-rugby[26–28] and basketball[29] on aerobic capacity, blood pressure, and blood lipids. However, evaluations of the impact of team sport participation on participants' psychological and social well-being, particularly in men in their middle years, has received less attention. Cross-sectional studies have shown that adult recreational sport participation is associated with positive psychological and social health, including mental well-being, life satisfaction, social functioning and improved quality of life,[30] and team sport participation has been associated with better psychosocial outcomes than participation in individual sport.[31] When comparing sport to non-sport exercise, independent of PA levels achieved, men who participated in sport reported superior physical, psychological and social health-related quality of life (HRQoL).[32] However, these findings are based on cross-sectional studies and causation cannot be assumed. This has led to recommendations that causal links between sport participation and psychosocial health be investigated.[30 31]

Cross-sectional studies have mostly compared team sport with individual sport or individual PA/exercise modalities (eg, running, gymnasium). However, as the existing literature suggests positive contributions of groups on exercise outcomes (ie, improved mental well-being[33]), it raises the question of whether team sport participation, fostering team spirit, enjoyment and social interaction influence health and well-being of men more positively than group-based exercise.

Emerging evidence promotes team sport participation for improving PA adherence (including motivational improvements) and health (as a construct of social, physical and psychological health). However, this has been limited in men in their middle years, with the majority of evidence derived from cross-sectional studies. Further, whether team sport has a differing effect on the health and/or PA levels compared with traditional group-based exercise remains unclear.

This study aims to employ a randomised controlled study design to compare the effect of a team sport intervention with a group exercise intervention on physical and psychological well-being variables in middle-aged men.

DESIGN

A parallel randomised controlled trial will be performed using n=128 insufficiently active middle-aged men (35–54 years) who will participate in one of two 12-week PA interventions[1]: small-sided team sport training, consisting of modified Australian Rules Football, or[2] group circuit exercise. A 'no-intervention control group' was not considered necessary because it has already been demonstrated that team sport participation improves physical health[22] and motivation[17] in comparison to inactive controls, and the Australian Government Department of Health recommends that the preferred comparator to assess the efficacy of new health procedure is current practice.[34] HRQoL, motivation to exercise, satisfaction of psychological needs, sleep and PA levels, blood lipids, glucose and metabolic syndrome risk score will be assessed before (baseline), at the end of the 12-week intervention (post-intervention), and after 12 weeks following the completion of the programme (follow-up). An overview of the study timeline is provided in figure 1. A Standard Protocol Items: Recommendations for Interventional Trial Checklist and Template for Intervention Description and Replication Checklist are provided as additional files (see online supplemental file 1 and online supplemental file 2, respectively).

INCLUSION AND EXCLUSION CRITERIA

Participants will be eligible for the study if they meet all of the following criteria: male aged 35–54 years, self-reported to have engaged in less than 150 min of moderate-to-intensity exercise or less than 75 min of vigorous-to-intensity exercise per week[35] over the 6 months leading up to recruitment, able to attend all testing and exercise sessions throughout the intervention and assessed as safe to engage in the exercise programme based on the Exercise and Sports Science Australia Adult Pre-exercise Screening System.[36] Participants will be excluded if they: have a medical condition or injury that restricts them from performing exercise, have experienced a change in medication that might influence outcome measures within 3 months of study commencement, are actively participating in a team sport, do not agree to be randomised to either treatment group, are unwilling or unable to provide written consent, or fail to satisfy the investigator regarding suitability to participate for any other reason.

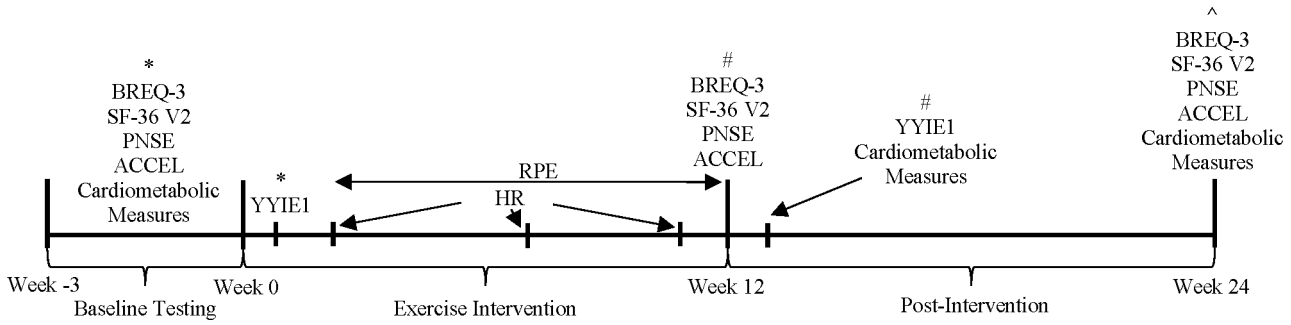

Figure 1 Overview of study design. *Baseline; #post-intervention; ^follow-up. Cardiometabolic measures, height, weight, waist circumference, blood pressure, finger stick blood sample. ACCEL, Physical activity and sleep assessed using Axivity AX3 accelerometers; BREQ-3, Behavioural Regulation Questionnaire V.3; HR, heart rate; PNSE, Psychological Needs Satisfaction in Exercise; RPE, Rating of Perceived Exertion; SF-36 V2, Short Form 36 Health Survey Version 2; YYIE1, Yo-Yo intermittent endurance level 1.

RECRUITMENT AND SCREENING

Participants will be recruited from the Greater Adelaide Metropolitan Area in South Australia using recruitment flyers, advertisements sent out to the mailing list of a local state league football club or posted on the University of South Australia social media pages, and paid social media advertisements.

Those interested in participating will be provided with an information sheet via a QR code or weblink provided with advertisements or by contacting the researchers directly. Interested participants will then complete an eligibility questionnaire hosted on Research Electronic Data Capture (REDCap)[37] software to determine their suitability to participate. If participants satisfy the eligibility criteria, they will be invited to attend a group familiarisation session.

FAMILIARISATION AND INFORMED CONSENT

The familiarisation session will include one of the researchers (HTB) providing an overview of the study and an opportunity for participants to ask questions. If they wish to participate, they will then complete an informed consent form (see online supplemental file 3). Those who consent will have their height and weight measured, and provided with an opportunity to practice the physical performance test.

RANDOMISATION, ALLOCATION AND BLINDING

Participants will be allocated to treatment via minimisation[38] using the participants HRQoL mental and physical composite scores (collected at baseline), self-reported PA level (collected in eligibility questionnaire), age (collected in eligibility questionnaire) and body mass index (collected at familiarisation visit). Minimisation has the advantage of achieving a balance of outcome measures between groups at baseline in studies with small sample sizes, which is particularly important where there may be strong prognostic factors and modest treatment effects.[38] HTB enrols participants, and a separate investigator (JDB) who is not directly involved in administering the intervention or data collection will generate the intervention allocations. HTB is not involved in the randomisation process and will be responsible for notifying participants of their group allocation. The nature of the study does not allow blinding of researchers/assessors or participants.

EXERCISE INTERVENTIONS

Participants will be randomised to undertake a 12-week exercise programme involving either team sport or group circuit training. The exercise session durations will be matched across the two groups (60 min per session) and will occur twice weekly. There will be at least 48 hours of recovery between each training session, and all training sessions will occur at the same time of day (ie, in the evenings). Sessions for each treatment will begin and end with a standardised 5–10 min warm-up/cool-down (light aerobic exercise and dynamic movements/stretches) and comprise of a 45 min conditioning phase. A qualified Exercise Scientist will administer all sessions. For participant safety, they will be requested to exercise at a light intensity (11/20 rating of perceived exertion (RPE)) at the start of the training programme before progressing to moderate intensity (14/20 RPE) by week 4. Further progression will be programme-specific, as detailed below. Participants will not be asked to change their PA levels throughout the 12-week programme. Still, they will be advised that they are free to participate in any additional PA they might wish to engage in, as long as the modality is not a team sport nor group-exercise class. Exercise sessions for both groups will be conducted outdoors on a grass oval. If inclement weather occurs, the circuit exercise session will move to a covered area beside the oval, but the team sport activities will remain on the oval.

Team sport intervention

Team sport interventions conducted outside of Australia have used sports popular within their respective geographical regions.[22] Australian Rules Football has the potential to attract sedentary Australian males as it has the strongest loyalty of all sports within Australia and is particularly popular in following and viewing among middle-aged men.[39]

The team sport intervention group will include sessions focused on developing Australian Rules Football skills and sessions in which participants will engage in gameplay. Weeks 1 and 2 will be structured to progressively introduce exercise and movement and develop participants' capabilities to jog, jump, land, stop and change direction safely. Injuries in similar sport-related interventions occurred during the initial training period, so gradual progression will be used.[18 40]

Across weeks 3–12, the first weekly session will be a 'training session' that progressively builds in physical demand and technical Australian Rules Football skills. This session will incorporate a range of skill-based drills to enable participants to practice the sport's fundamental skills (eg, kicking, handballing, marking). The second weekly session will involve playing a small-sided version of Australian Rules Football, known as AFL9s. AFL9s features modified rules more appropriate for insufficiently active individuals' physical capacity and skill level (eg, non-contact, small-sided and two 20 min halves). Where possible, 18 participants will form a training session and be divided each week randomly into two teams to play the AFL9s match. If session attendance is <18, teams will be divided evenly, and the playing field will be adjusted accordingly (eg, 9v 9=100×50 m, 8v 8=90×45 m, 7v 7=80×40 m). An additional file illustrates example sessions for the team sport intervention (see online supplemental file 4).

Group circuit training

Group circuit training was selected as the control condition for this investigation. Circuit training requires individuals to perform exercises, for a set number of repetitions or duration, in a circuit-based fashion with minimal rest between sets.[41] Circuit-based training has been previously shown to improve HRQoL,[42] aerobic fitness, body composition and cardiometabolic risk factors.[41]

Exercise sessions will comprise both aerobic and resistance-based exercises. The aerobic exercises will focus on whole-body movements that require minimal equipment. The resistance-based exercises will primarily focus on multi-joint movements following the American College of Sports Medicine Guidelines.[43] Each exercise station will last 30 s, with appropriate exercises (eg, squat, push-up) being performed at a 2 s repetition rate to ensure ~15 repetitions are completed per station. Based on the fitness level of the target demographic, 45 s rest intervals between sets will initially be provided before achieving a 30 s rest from week 7 onwards. This is consistent with work:rest ratios and work interval durations that have been shown to improve health and fitness.[41 42] From week 7 onwards exercise intensity will be further progressed through adding additional load and exercise modification (eg, supine glute bridge progressing to kettlebell deadlift). The circuit will be completed a total of 3 times with 3.5 min rest between each rotation. Exercises will be altered where necessary to accommodate any physical restrictions that participants may present with. An additional file illustrates example sessions for the circuit training intervention (see online supplemental file 5).

TESTING

Pretesting restrictions

Before testing sessions, participants will be asked to abstain from any strenuous PA for 24 hours, and alcohol and caffeine consumption for 24 hours and 12 hours, respectively. Participants will also fast overnight (10–12 hours) before blood collection.

Questionnaire delivery

All questionnaires will be delivered online through REDCap.[37] REDCap is a secure web-based electronic data capture tool hosted by the University of South Australia (REDCap Consortium).

Demographics

Demographic variables will be collected as a part of the baseline questionnaire and include ethnicity, previous sporting history (ie, type, duration, level played), the highest level of education, employment status, annual monetary income, marital status and number and age of dependants.

Primary outcome measure

The primary outcome (change from baseline to post-intervention) will be HRQoL assessed using the Australian version Short Form 36 Health Survey V.2. The 36-item survey assesses eight scales across two dimensions: (1) physical dimension made up of physical functioning, role physical, bodily pain and general health and (2) mental dimension made up of vitality, role emotional, social functioning and mental health.[44] This is a widely used measure validated in an Australian population[44 45] and has shown good internal consistency across all scales (Cronbach's α 0.80–0.95).[46]

Secondary outcome measures

Exercise motivation

The 24-item self-report Behavioural Regulation in Exercise Questionnaire V.3 (BREQ-3) will be used to investigate participants' motivation to exercise.[47] The BREQ-3 assesses six dimensions of motivation of the motivational continuum of self-determination theory. Participants respond to questions using a 5-point Likert scale (0=not true for me, 4=very true for me). The BREQ-3 is internally reliable (Cronbach's α 0.79–0.89),[48] demonstrates adequate test–retest reliability (>0.78),[47] and convergent[47 49 50] and criterion[48] validity.

Psychological needs

Participants' psychological needs satisfaction will be assessed using the Psychological Need Satisfaction in Exercise scale (PNSE).[51] Meeting one's needs for autonomy, competence and relatedness influences one's motivation and positively impacts well-being.[52] Participants will

respond to 18 questions assessing the three subscales of autonomy, competence and relatedness satisfaction using a 6-point Likert scale (1=false, 6=true). Each subscale is scored by calculating a mean. The PNSE has good internal reliability (Cronbach's α 0.93–0.95) in exercising adults[53] and has convergent validity ranging from r=0.32 to 0.65 when compared with the Exercise Motivation Inventory 1 and 2.[51]

PA and sleep

PA will be assessed using a wrist-worn triaxial accelerometer (Axivity AX3, Axivity, Newcastle, UK). The Axivity AX3 device has shown to be valid in laboratory conditions[54] as well as in capturing the PA of older adults.[55] Participants will wear the wrist-worn device for seven consecutive days on their non-dominant wrist and be asked to complete a daily activity log capturing the time they went to bed and woke, whether they napped and whether they took the device off (including when and why). Raw data (as 60 s epochs) will be extracted using the open-source OMGUI Configuration and Analysis Tool (Axivity, Newcastle, UK). These data will then be imported into custom software (Cobra, developed at the University of South Australia, Adelaide, Australia) through MATLAB R2019a (MathWorks, Natick, Massachusetts, USA). This software will separate data into wear, non-wear and sleep time using the activity log, after which periods of sedentary time, low and moderate/vigorous PA will be determined using predefined thresholds.[56 57]

Anthropometric and resting measurements

The following measures will be collected according to the method outlined by Coombes and Williams.[58] Participant weight will be collected to the nearest 0.1 kg using an electronic scale (Tanita Ultimate Scale, Tanita, Tokyo, Japan) and height to the nearest 0.5 cm using a portable stadiometer (Seca, Hamburg, Germany). Waist circumference will be measured halfway between the inferior border of the 10th costal and the superior border of the iliac crest. Blood pressure will be measured manually in the left arm following at least a 5 min rest in a seated position. The average of two measurements separated by 30 s will be used. If the two measures differ by more than 10 mm Hg systolic or 6 mm Hg diastolic, a third reading will be taken after a 5 min rest, and the average of the two closest readings will be taken.

Blood profile and metabolic risk

Following an overnight fast (10–12 hours), a capillary blood sample will be collected from the fingertip and analysed using an automated analyser (Cholestech LDX System, Alere, Waltham, Massachusetts, USA). Measurements of blood glucose, total cholesterol, triglycerides, high-density lipoprotein cholesterol will be obtained and low-density lipoprotein cholesterol will be estimated within the Cholestech LDX System using the Friedewald equation. The Cholestech LDX System is accurate and has good reproducibility.[59] A Metabolic Syndrome Risk Score will be calculated for each participant according to the method of Gurka *et al*.[60]

Cardiorespiratory fitness

To assess cardiorespiratory fitness, the Yo-Yo Intermittent Endurance level 1 test will be performed during the first session of week 1 and post-programme. This test has been shown to detect changes in physical capacity in untrained men.[25] The test involves participants completing 2×20 m runs (ie, one shuttle) of incrementally increasing speed, interspersed with a 5 s recovery period (2×2.5 m). The test will be terminated once the participant fails to complete more than one shuttle in the allocated time or reaches volitional exhaustion. The test will be performed outdoors on a grass oval after a 10 min warm-up. Performance will be defined as the total distance covered during the test.[61]

Intervention adherence

Participant adherence to the exercise interventions will be assessed by monitoring session attendance. Reasons for non-participation will be collected from participants.

Session training loads

To assess the internal load of the exercise programmes, participants will be fitted with a Polar M400 heart rate monitor (Polar Electro Oy, Kempele, Finland) during their exercise sessions in weeks 3, 7 and 11. Average heart rate, peak heart rate and Edward's training impulse[62 63] will be quantified. Subjective session intensity will also be assessed using the RPE Category Ratio scale (CR-10 scale) across weeks 3–12.[64]

DATA MANAGEMENT AND CONFIDENTIALITY

Each participant will be allocated an ID number. All data will be coded with that number and stored on a password-protected Excel document (Microsoft, New York, USA), with access only granted to project investigators. Hard copy data will be stored in a locked filing cabinet in a secure room at the University of South Australia. Data obtained through REDCap will be backed up on the University of South Australia's secure REDCap data management system on a password-protected server.

STATISTICAL ANALYSIS

Justification of sample size

The sample size required for this study is based on identifying a difference in HRQoL between treatment groups with a medium effect size (ie, 0.5). This magnitude of effect size is considered meaningful for HRQoL.[65] Identifying this effect size at an alpha level of 0.05 with 80% power will require 128 participants (64 per treatment group) to complete the protocol. To account for a potential dropout of 10%, a total of 140 participants will be required. Given the sample size, the intervention is planned to run across two waves. The participant uptake during the recruitment phases will influence the specific size of the waves.

Data analysis

All data will be presented as mean±SD. Data analysis will be performed using Stata/IC V.15 (StataCorp). Independent samples t-tests will be used to compare participant characteristics between groups at baseline. A linear mixed-effect model will be used to assess the effects of the independent variable (team sport or circuit training) on the dependent measures. Outcome measures, treatment allocation and time will be entered as fixed effects, and participant ID entered as a random effect. If participants withdraw from the study, their available data will be included in an intention to treat analysis. A sensitivity analysis will also be performed using data only from participants who attended at least 70% of training sessions. Statistical significance will be set at an alpha level of 0.05. Preliminary data analysis will be conducted following the completion of the first study wave to confirm the proposed sample size.

PATIENT AND PUBLIC INVOLVEMENT

There was no patient or public involvement in the design of this study.

DISCUSSION

This protocol paper describes the methodology used to assess how a team sport programme influences the PA levels and health of insufficiently active men aged 35–54 years, compared with a group circuit condition. Despite cross-sectional evidence that shows that team sport participation improves a range of psychological and social health markers, cross-sectional data do not provide evidence of causation. This study will use a randomised controlled trial design to provide evidence of the causative effects of team sport participation on health (physical, psychological, social). Therefore, the findings of this study will, therefore, provide robust insight into the utility of team sport for improving the health of men through their middle years. The findings may inform the development of policy around the promotion of sport for health in this demographic.

ETHICS AND DISSEMINATION

This study has been approved by the University of South Australia's Human Research Ethics Committee (Ethics Protocol 203274). Research participants will be informed of any approved protocol amendments and the trial registry will be updated. Study results will be disseminated through publication in disciplinary-specific journals, conference presentations and will form a portion of a Doctoral thesis. Individuals who have contributed to the design and implementation of the protocol will be eligible to be included in publications.

ADVERSE EVENT

All investigators and primary staff involved in the delivery of the study are trained on the appropriate response to adverse events. HTB will report adverse events to the University of South Australia Human Research Ethics Committee. An adverse event is defined as any untoward medical occurrence that requires treatment and which does not necessarily have a causal relationship with this intervention.

INTERVENTION AND DATA MONITORING

To avoid bias in programme delivery, the principal investigator (HTB) will not deliver the 12-week programmes but will attend selected sessions to monitor appropriate delivery. Qualified Exercise Scientists, with a background in Australian Rules Football, will deliver the interventions. HTB will collect the outcome measure data and meet weekly with the research team to review study progress.

Twitter Brad J Stenner @B_JStenner and Jonathan David Buckley @jonbuckley9

Contributors HTB, JDB, AJC and BS designed the study. HTB is a PhD Candidate at the University of South Australia and JDB, AJC and BS are employed by the University of South Australia. JB secured the funding for the study. HTB prepared the manuscript which was reviewed by all authors.

Funding This study is funded by a grant provided by the Norwood Football Club, South Australia, Australia. No affiliates of the funding organisation had direct influence on the methods, data collection, or data analysis and reporting relating to this study. HTB is supported by an Australian Government Research Training Program Scholarship and a top-up scholarship from the grant provided by the Norwood Football Club.

Competing interests AJC, BS and JDB are employees of the University of South Australia which received a grant to support this study.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement The datasets generated and/or analysed during the current study are not publicly available due to participant privacy but are available from the corresponding author on reasonable request.

ORCID iDs
Henry T Blake http://orcid.org/0000-0001-9903-9287
Brad J Stenner http://orcid.org/0000-0003-1996-1613
Jonathan David Buckley http://orcid.org/0000-0003-0298-2186
Alyson J Crozier http://orcid.org/0000-0002-9652-6757

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