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Evaluation of passive recovery, cold water immersion, and contrast baths for recovery, as measured by game performances markers, between two simulated games of rugby union.

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Abstract:

In team sports, during the competitive season, peak performance in each game is of utmost importance to coaching staff and players. To enhance recovery from training and games a number of recovery modalities have been adopted across professional sporting teams. To date there is little evidence in the sport science literature identifying the benefit of modalities in promoting recovery between sporting competition games. This research evaluated hydrotherapy as a recovery strategy following a simulated game of rugby union and a week of recovery and training, with dependent variables between two simulated games of rugby union evaluated. Twenty-four male players were randomly divided into three groups: one group (n=8) received cold water immersion therapy (2 X 5min at 10oC, whilst one group (n=8) received contrast bath therapy (5 cycles of 10oC/38oC) and the control group (n=8) underwent passive recovery (15mins, thermo neutral environment). The two forms of hydrotherapy were administered following a simulated rugby union game (8 circuits x 11 stations) and after three training sessions. Dependent variables where generated from five physical stations replicating movement characteristics of rugby union and one skilled based station, as well as sessional RPE values between two simulated games of rugby union. No significant differences were identified between groups across simulated games, across dependent variables. Effect size analysis via Cohen's d and ηp2 did identify medium trends between groups. Overall trends indicated that both treatment groups had performance results in the second simulated game above those of the control group of between 2% and 6% across the physical work stations replicating movement characteristics of rugby union. In conclusion, trends in this study may indicate that ice baths and contrasts baths may be more advantageous to athlete's recovery from team sport than passive rest between successive games of rugby union

We are pleased to resubmit our revised manuscript JSCR-08-1992 and have addressed the comments and suggestions raised by the reviewers.   Please find below a list of changes or rebuttal against each point.

INTRODUCTION

It has been postulated by sports scientists from the Australian Institute of Sport, professional coaches and strength and conditioning trainers, that recovery is an important factor in athletic performance, and that optimal recovery may prevent underperformance [1]. For athletic performance to be maintained throughout a season, an optimal balance between training load and recovery is essential [2]. Training generates overload, with the sport science community utilizing the overload principle to induce improvements in performance however, overtraining often results in athletic breakdown [3]. If the recovery rate could be improved, greater training volumes would be feasible without the negative impact of overtraining [3].

A review of the current literature on recovery from team sport has generally shown that recovery is evaluated through all-out tests and biochemical markers [4,5,6,7]. However, recent research [3, 4] has identified that well-trained athletes may have sufficient motivational drive to be able to perform at near-maximal levels in one-off tests regardless of the state of fatigue [3, 4]. More importantly, it is not always possible to translate laboratory observations to real life competitive situations [2].

The most important variable in evaluating sport is performance [3]. Therefore, when examining recovery modalities, researches should concentrate on actual sporting performance [3]. However, this in itself brings about a series of complications as team field sports are of an intermittent nature, with random, discrete bouts of activity varying both in intensity and duration throughout match-play [8]. The intensity and therefore load during match-play differs considerably between playing positions and between games [8].

There have been limited studies which have evaluated hydrotherapy and its effect on performance in team sports [4, 5]. In these studies, the researchers were able to evaluate the acute response of recovery. However, it is essential for research to examine the cycle of weekly activity in competition, particularly in reference to residual fatigue [9]. In addition, to date there is a scarcity of literature available on recovery from competitive rugby union [10], particularly regarding hydrotherapy.

Therefore, it is the purpose of this research to evaluate the benefits of two forms of hydrotherapy. The research evaluated performance between two simulated games of rugby union across a cyclic week of activity, which included three training sessions. The aim was to identify if hydrotherapy as a recovery modality was beneficial towards game performance across successive games. Based upon findings in previous research, it was hypothesised that cold water immersion would be more beneficial for recovery than either contrast baths or the non-intervention control, as measured in performance across two games of simulated rugby union and three weekly training sessions between games.

METHOD

Experimental Approach to the Problem

Despite the widespread use of cold water immersion (CWI) as a post-match recovery protocol in rugby union, there is relatively little evidence supporting its use. Performance indicators from two simulated games of rugby union were used to address the null hypothesis, that neither cold water immersion nor contrast baths would be beneficial for recovery. The current between groups study examined the effect between two recovery interventions and a control had on performance in six physical and one skill based stations.

The benefit of measuring changes in sporting performance is to allow coaches and athletes to make decisions on recovery modalities by identifying how different recovery modalities will directly affect sporting performance. This has been supported by Bishop and colleagues, who stated that in the sporting community, it is the performance in competition that is of the upmost importance to both coaches and athletes [3]. The aim of this study was to determine the effectiveness of cryotherapy as recovery from rugby union for rugby union coaches and highly trained players.

Subjects

This study was performed on well trained male participants (n=24) from an under-20 rugby union team (mean ± standard deviation (SD), age 19.5 ± 0.8 y, body mass 82.38 kg ± 11.12 kg, height 179 SD± 6 cm). The study was conducted after 26 weeks of training which included 10 weeks of pre-season training (5.5 h/3 sessions-weekly), followed by 18 weeks of the scheduled 22 week competition (6.5 h/3 sessions-weekly).

Pre-season training included two weekly training sessions, Saturday beach sessions (first six weeks) and trial games (week's 7-9). Training sessions were structured to include a 15 minute warm-up followed by 40 minutes (first six weeks) and 20 minutes (week's seven to 10) of conditioning. Conditioning focused on speed and acceleration running drills, contact drills and small sided games. Work to rest ratio ranged from 1: 2-3 (first six weeks) to 1:1 and 2:1 (weeks seven to 10). After the conditioning phase, training of rugby skill sets became the focus. Intensity of the conditioning elements ranged between 75% HRmax to 95% HRmax. Skill set drills intensity ranged between 50% HRmax to 70% HRmax.

Beach sessions were structured around conditioning elements only. Each session commenced with a 15 minute warm up followed by 70 minutes of conditioning. The conditioning included speed and agility drills, wrestling drills, small sided games and team based relay shuttles. Intensity of the beach sessions ranged between 70% HRmax to 90% HRmax with a work to rest ratio of 1:3.

After six weeks, the beach training sessions where replaced with trial games of rugby union for three weeks. The last Saturday before the competition commenced was a scheduled rest day to mark the end of pre-season training. Trial games were played with standard laws of the game applying. However the first two trials were played with 20 minute periods. Players would rotate throughout the day, with most players competing in three 20 minute periods. The third trial was played under standard laws with 30 minute periods. Players would rotate throughout the day, with majority of players competing in two 30 minute periods.

During the competition phase, two training sessions were conducted during the week. Training sessions were structured to include a 10 minute warm-up followed by a conditioning period of between 10 minutes and 20 minutes. Conditioning sessions would vary between sprint work and small sided games. Intensity of conditioning elements would range between 85% HRmax and 100% HRmax, with a work to rest ratio ranging from 1-3:1. The remainder of the training sessions were structured around skills, rugby union units, team play and semi-opposed runs. Intensity would range from 50% HRmax to 85% HRmax. Volume of training throughout pre-season ranged from 6000 m to 7200 m and throughout the competition phase of the season ranged from 6000 m to 6500m.

Participants had no history of musculoskeletal injury in the previous four weeks prior to participating in the study. All the subjects were free of illness during the testing period. Each participant signed an informed consent form prior to taking part in the study, which was approved by The Australian Catholic University's Human Research Ethics Committee (N200708-24). We excluded from our participant pool, players who were involved in labour-intensive jobs, as well as those who had either been injured or suffered an illness prior to or during the study period.

Insert Figure 1 here

The study included two simulated games of rugby union six days apart during the competition and included three training sessions and was conducted over six consecutive days. The simulated games were conducted during the team's regularly scheduled game times 15:00 hours to 16:30 hours. The training sessions were conducted at the teams scheduled training time 18:30 hours to 20:00 hours.

Prior to the first simulated game, participants performed the team's standardised pre-game warm-up conducted prior to competition games. The warm-up commenced with a dynamic walking lunge for 25 metres followed by a walking sumo squat for 25 metres. Dynamic flexibility exercises were then performed consisting of butt kicks, high knees, lateral steps, fast feet and finally cross-overs. Participants then performed 10 swing throughs and 10 swings across on each leg. In addition, participants performed dynamic groin lunges and calf pumps. In total, the warm-up duration was 25 minutes.

The simulated game adopted for this study has previously been defined [11, 12]. Two simulated games were adopted due to the nature of individual games and the varying workloads associated with each game. As each game of rugby union is totally independent from any previous or future game of rugby union, and different positions have different roles and work outputs, the circuit allowed for control of each participant's work output.

Dependent variables used included scores from each working station in the simulated game. Times at each sprinting station were recorded (Swift Performance, Sydney Australia), and heart rate was accessed via telemetry with each participant wearing a polar heart rate monitor (Polar USA, Inc., Montvale, NJ). Mean heart rate and peak heart rate values for both simulated half's and mean heart rate for the entire simulated game were recorded.

The simulated game consisted of 11 stations set up as a circuit. Stations included straight line sprints, defensive sprints, attacking sprints, power output in a rugby specific action (hit and drive), tackling and passing skills, additionally; the circuit included three rest stations (see Table 1). Participants performed the task at each station, then immediately progressed to the next station. The participants completed four circuits, which equated to one half of a rugby union game, prior to having a 10-minute break followed by completion of the circuit another four times, equating to the second half of a rugby union game.

Insert Table 1 here

Trial runs for familiarisation were conducted through the circuit on four occasions in the preceding two weeks. Each station was manned by two trained researchers who assisted with data collection at each station. Researchers were tasked with operating the timing gates as well as recording the scores obtained by each participant throughout the simulated game of rugby union. At completion of the simulated game of rugby union, participants were randomly assigned through blind allocation to one of three recovery protocols, cold water immersion, contrast baths and passive recovery (control group).

Cold water immersion has previously been identified as the most common [13] method used for recovery in the Australian Rugby Championship. Participants were asked to climb into the cold water immersion and assume a seated, upright position. Water depth was individualized to the superior iliac spines [14], with a temperature range of between 10-12^{o}C [4, 7]. Participants underwent two by five minute immersions in the cold water immersion, separated by two and half minutes seated out of the baths at room temperature [4].

The contrast bath protocol involved alternating from cold water baths (temperature range 10-12^{o}C) to warm water baths (temperature range 38-40^{o}C) for 60 seconds in each. Participants performed a total of five cycles in each bath for a total of 10 minutes recovery and approx 75-90s out of the baths [4]. Cold water immersion and warm water baths were adjacent to one another. Participants stepped from the cold water immersion to the adjacent hot water bath every minute. The researcher monitored the time and instructed participants to change recovery conditions with the use of a standard stop watch (Seiko, Japan).

Baths used were 220-litre commercial storage tubs, with the temperatures continually monitored with floating temperature gauges with ice and hot water added when temperatures rose to 11.5^{o}C (cold water immersion) or fell to 38.5^{o}C (warm water baths). The control group initiated a passive recovery strategy involving remaining seated for 15 minutes in thermo neutral rooms.

A second simulated game commenced 144hrs after the first game simulation; the protocol previously stated and used in the first simulated game of rugby union was repeated for the second simulated game of rugby union.

Statistical Analysis

All statistical analyses were completed using SPSS (ver 17.0), which included between-group and within-group analyses. To examine the effects of recovery strategies on game performances dependent variables from the first and second simulated games were analysed. The dependent variables included mean heart rates for the simulated first half and second half as well as mean heart rate for entire simulated games. Additional dependent variables included total scores calculated in seconds for each individual station, with the use of timing gates. There were six stations in total which provided data for statistical analysis. The stations included station 1 (20 metre sprint), station 2 (20 meter swerving sprint and tackle), station 6 (sliding defence pattern), 8 (defensive drill including multiple tackles and shuttle run) and station 10 (30 meter sprint). Effect of fatigue on skill was assessed using passing scores from station 9.

In addition to scores from individual stations, analysis of overall work output was also analysed. Dependent variables included mean scores for total work output (secs) across the two simulated games (stations 1, 2, 6, 8. 10), as well as total work output from the first half and total work output from second half (mean scores). In addition, Sessional RPE values calculated into arbitrary units (AU) [15-17] were also analysed.

Statistical power was calculated at 0.60 for a sample size of N = 24, with an alpha level of 0.05 and an effect size of 0.8. Independent variables for weekly cyclic activity include contrast baths, cold water immersion and a control group undergoing passive recovery.

To eliminate initial differences at pre-test levels, based on participant scores, ANCOVA tests were conducted on the second simulated game scores as the dependent variable; the between-group factor were the treatments and the scores from the first simulated game were defined as the covariate. Additional analysis through effect sizes (Cohen's *d* and η_p^2) were also conducted to identify in detail outcomes based on treatment effects.

RESULTS

To verify work intensities between groups throughout the simulated games, mean heart rates and blood lactate levels were recorded. There was no significant difference in mean scores for heart rates, between groups in either of the simulated games (Game 1; sig dif p= 0.21, Game 2; sig dif p= 0.44). Heart rate mean scores as a percentage of peak heart rate for simulated game 1 were, cold water immersion 73%HRpeak, contrast baths 74%HRpeak, control 77%HRpeak. Heart rate mean scores as a percentage of peak heart rate for simulated game 2 were, cold water immersion 81%HRpeak, contrast baths 79%HRpeak, control 78%HRpeak. Blood lactate levels also indicated no significant difference between groups in either of the simulated games. With no significant differences between groups during the simulated games, the researchers were able to analyse results of tests with the view that any differences identified were a result of interventions applied.

As pre-test scores were different, a Univariate ANCOVA analysis was conducted, using baseline scores as covariates across dependent variables. No significant difference was identified for station 1, station 2, station 8, station 9 or station 10. Furthermore, no significant difference was identified between total work performed in the first half or second half or across the full game.

A significant difference was identified between the first simulated game and the second simulated game for station 6 ($p = 0.05$). Pairwise analysis identified a significant difference between the control group and cold water immersion ($p = 0.02$). However, the significant difference only occurred in the first half and no significant difference was identified between contrast baths and cold water immersion or between contrast baths and control group.

Insert Table 2 here

Insert Figure 2 here

Further analysis examining trends through effect sizes identified contrasting results across stations. Partial eta squared (η_p^2) indicated group association to show a wide range of scores from small to large. In addition, further contrasting results were identified with magnitude of change (Cohen's *d*) between simulated games 1 and 2. Cohen's *d* values ranged from large positive values to large negative values.

Insert Table 3 here

Sessional RPE scores were collated from both games and three training sessions conducted across the week. No significant differences were identified between Sessional RPE scores between simulated game 1 and simulated game 2.

Insert Table 4 here

Insert Figure 3 here

DISCUSSION

This study evaluated the effects of cold water immersion and contrast water immersion on recovery from simulated team sport. Furthermore, although traditionally, recovery from fatigue in sport has used one-off maximal tests of power and speed and/or passive tests including DOMS and biochemical markers, this study assessed changes in measured performance indicators from the two simulated games of rugby union. In addition, to date most studies into recovery from sport/exercise have examined the acute response. This study was designed to examine recovery modalities across a cycle of weekly training activity and competition games, currently absent from the literature.

Firstly, only one time point showed a significant difference between treatments and performance. No other dependent variables reported significant differences between treatments. Furthermore, both the magnitude of change (Cohen's *d*) and level of group association (ηp^2) reported effect size trends of small to moderate for performance scores for each station.

The significant difference was identified in the multiple defensive sprint pattern station 6. Evaluation of station 6 identified that the cold water immersion group suffered a 6% decrease in performance from simulated game 1 to simulated game 2 in the first halves. In comparison the control group suffered a 1.6% decrease in performance between the first halves of simulated game 1 and simulated game 2.

However, this result was not repeated during the second half performance. The cold water immersion group suffered a 4% decrease in performance compared to a 5.3% decrease in performance for the control group. As the differences in performances between cold water immersion and the control group were not consistent, it is advised that examination of performances across the entire game be the deciding factor. With this in mind the total work for station 6 showed differences between all groups of only 1.5%. With each group showing decreases in performance for station 6 from simulated game 1 to simulated game 2.

Both treatment groups for station 1 reported improvements in performance from simulated game 1 to simulated game 2 of approximately 5.5%, whereas the control group reported an improvement of 2.6% between simulated games. Station 2 reported a similar trend with performance improvements by all three groups with the control group reporting an improvement of 14%, cold water immersion reporting one of 16.4% and contrast baths reporting an improvement of 18% between simulated groups.

Station 8, a defensive pattern drill, reported decreases in performances similar to station 6. However, in station 8, the control group reported an overall decrease in performance of 8% across the entire game. Both treatment groups reported decreases in performance of only 3% across the entire game. The final station, station 10, reported improvements in performances across all groups of approximately 5 - 6%.

Of interesting note in this study, were the contrasting changes in performances between the two types of stations, single all-out maximal effort (stations 1, 2, 10) or multiple repeat effort (stations 6, 8). Each station that involved a single all-out maximal effort such as sprinting showed improvements in performance, between simulated games. In contrast, each station that involved repeated efforts or multiple tasks showed performance decrements, between simulated games.

The contrasting results between the two types of stations may reflect the effect motivational drive has on participants. In a single all out effort, the motivational factors may be sufficient to overcome levels of muscular fatigue. However, when multiple repeat efforts are called upon, impact of muscular fatigue may be the defining factor in performance, surpassing motivational aspects.

This trend of the level of group association with scores of total work conducted across two simulated games suggests that both cold water immersion and contrast baths offer more for recovery between games than conducting only a passive recovery of seated rest. The magnitude of change identified via Cohen's *d* identifies a similar trend. This trend includes improvements across each treatment group and control group at station 1, station 2 and station 10 and decreases in performance at station 6 and station 8.

Arbitrary Unit scores for Sessional RPE did not identify a significant difference between groups between simulated game 1 and simulated game 2. In addition, trend lines (Figure 3) identified similar patterns between groups. Partial eta squared did report a very large (η_p^2 = 017) group association with scores; however, this result needs to take into account the significant difference previously reported between training sessions. The large change in scores for contrast baths from 96hrs post to simulated game 2 may reflect the large η_p^2 reported.

A number of limitations are evident in this study. Firstly, no biochemical markers were used, which is in contrast to the majority of published studies into recovery. However, there is little evidence in the available literature showing a link between the most common markers, including lactate and CK, a faster clearance or lower levels of these biomarkers and improved athletic performance. Secondly, although a simulated game allows for control of work intensities and work output, it does not include impact and collision events associated with rugby union. The effect that these events have on fatigue, both physical and psychological, cannot be underestimated. However controlling, monitoring and measuring fatigue associated with them in itself is problematic, which cannot be replicated in a simulated game. The final limitation is the lack of equipment to perform and measure participants at station 4. Although the actions were replicated on a standard scrum machine, there was no way to measure each participant's actual performance

In conclusion, trends in this study may indicate that cold water immersion and contrasts baths may offer more to athletes recovering from team sport than passive rest between successive games of rugby union. Along with previous studies identifying similar findings [4, 5], a clearer picture is starting to unfold in regards to hydrotherapy and enhancing recovery from field team sport. Currently, there appears to be more evidence supporting the use of cold water immersion in recovery as opposed to passive recovery and contrast baths.

Future research should be structured to examine recovery across longer periods. If residual fatigue does have an impact on performance across a season, evaluating performance across a number of weeks would identify a more relevant effect on hydrotherapy in team sport recovery. In addition, if testing is to be relevant to identify changes in performance in team sport, the development of appropriate tests should be carried out. As has been shown here and stated in other studies, the use of repeated efforts may be more appropriate to identify fatigue. Furthermore, specificity has been identified to be important in training, thus it should also be reflected in testing.

Practical Application

As most sports involve a number of short periods of high-intensity, sport-specific actions and movement patterns interspersed with low intensity, active recovery tests should be developed to reflect this. Using the one-off maximal tests commonly in use to date may not give a true indication of the state of recovery of athletes. The development of more sport-specific tests should be undertaken to offer a specific test for each individual sport.

Finally, at this time it is important for coaches and athletes to understand the importance of identifying which recovery study is best associated with their sport.

Examining the available literature can lead to conflicting results, which may lead to confusion. Firstly, coaches need to assess whether the population in the study is similar to their own athletes. Comparing results from untrained subjects and generalising the finding to well-trained athletes is erroneous. Coaches and athletes need to identify subjects in a study as close to their own athletes' status as possible. Secondly, comparing different exercise/sports can also be problematic. In many field sports, a high level of eccentric contractions and collision impacts occur. Examining results from studies with lower levels of eccentric action may not identify a true result as the levels of exercise-induced muscle damage may be significantly different. It is expected that with the increase in research into recovery entering the sport science literature, a more definitive answer will follow.

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Figure Legend

Figure 1 - Research methodology and design

Figure 2 –Mean times in secs for station 6

Figure 3 – Sessional RPE trend lines across the weekly cycle of game and training activity

Table 1 - Station descriptors for simulated game of rugby union

Table 2 – Total mean scores in secs, for each station across both simulated games

Table 3 – Magnitude of effect across treatment groups (η_p^2 / Cohen's *d*)

Table 4 – Changes in sessional RPE mean scores (AU) across weekly cycle

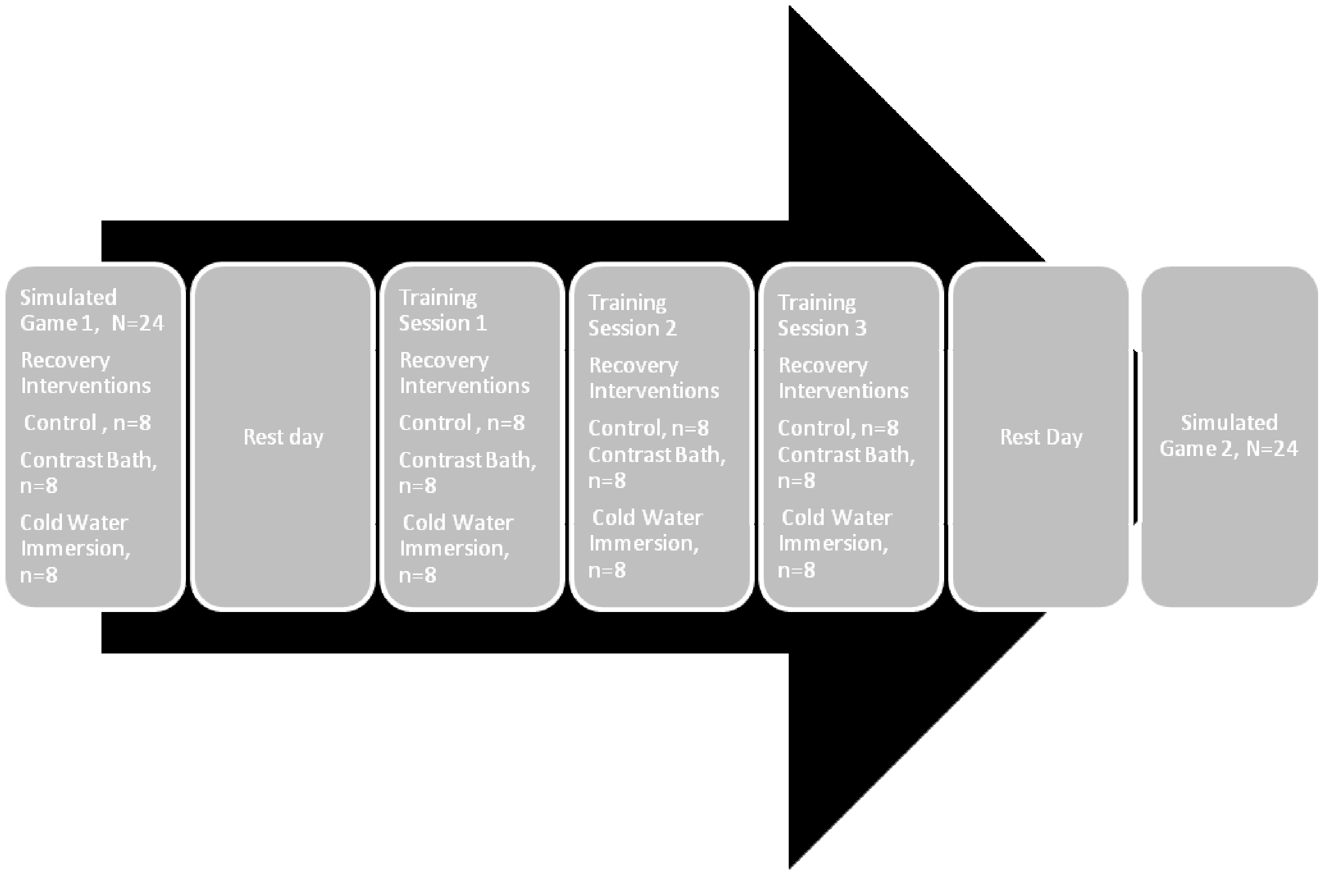

Figure 1 Research methodology and design

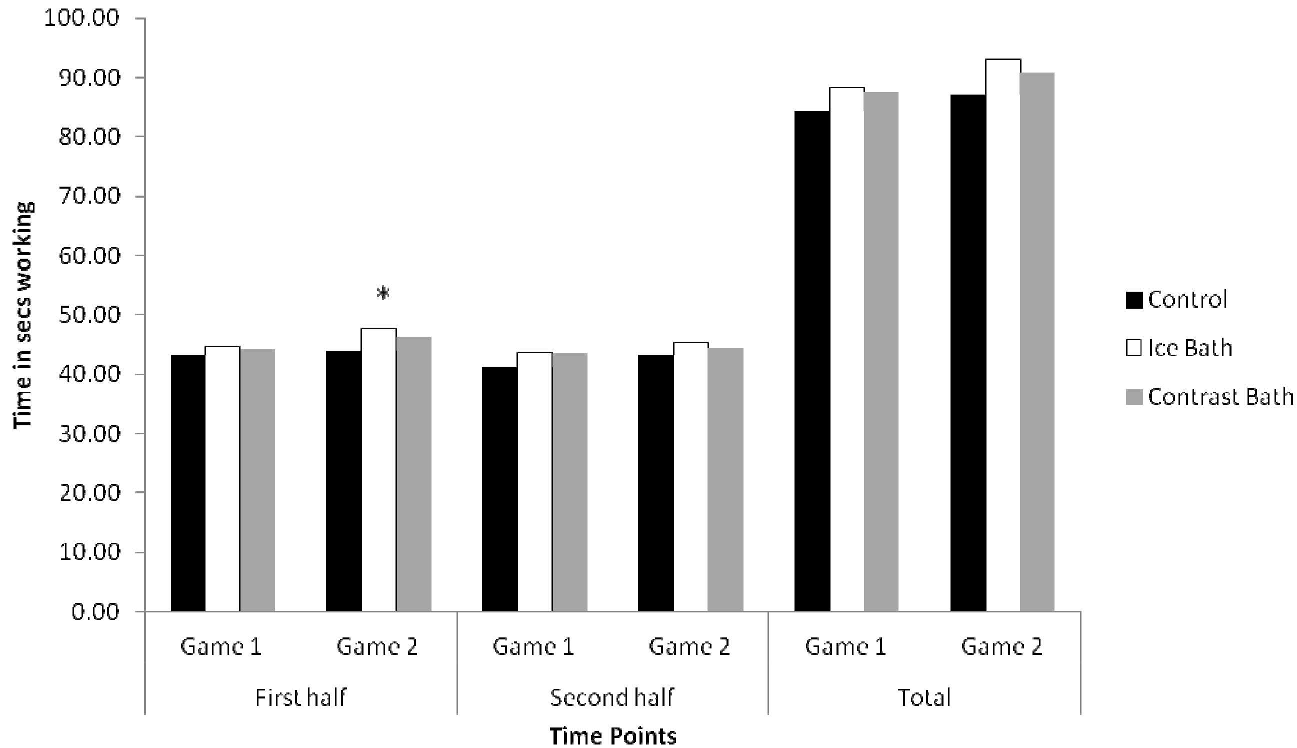

Figure 2 – Mean times in secs for station 6

* Denotes significant difference between groups (p = 0.02)

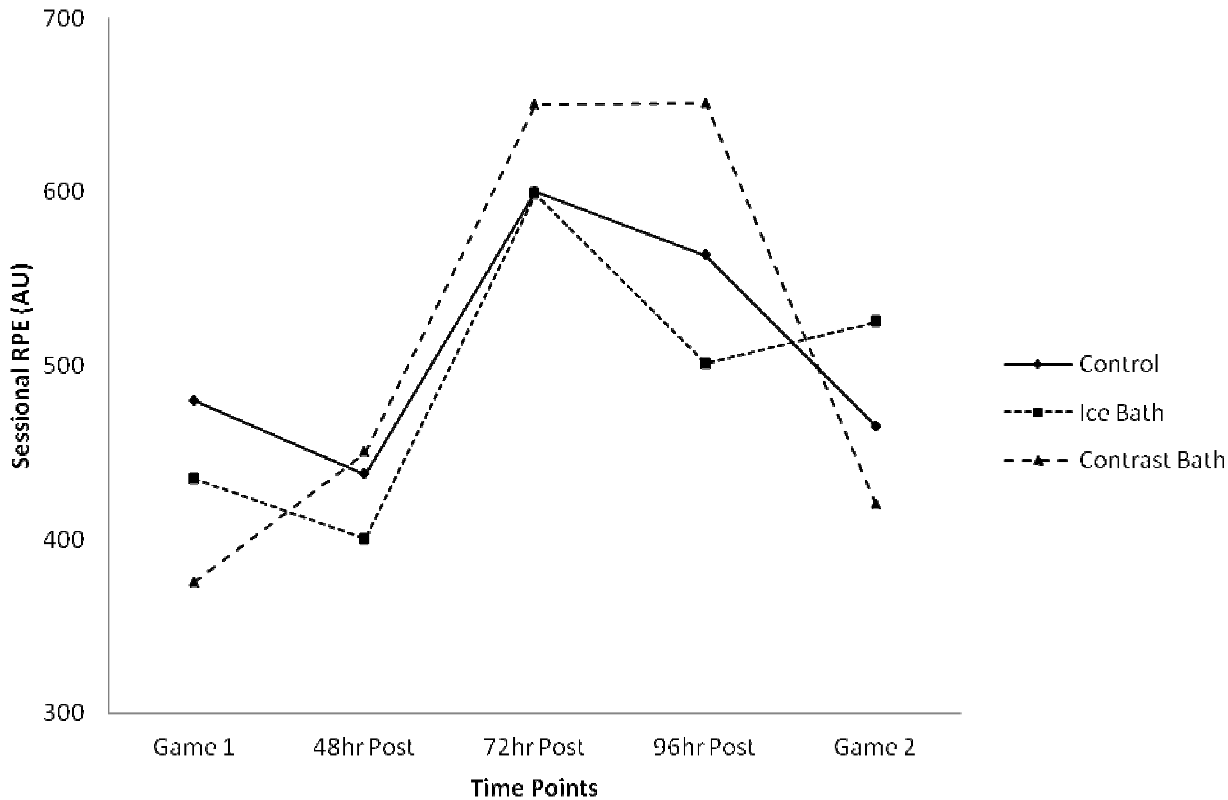

Figure 3 – Sessional RPE trend lines across the weekly cycle of game and training activity. No significant difference between groups when AU underwent ANCOVA analysis to compare results between game 2, with game 1 serving as the covariate.

Table 1 Station descriptors for simulated game of rugby union

Station identification Number	Station Task
Station 1	20 metre straight sprint
Station 2	20 metre swerving sprint with tackle
Station 3	Rest and hydration station
Station 4	Hit and drive X 2
Station 5	Rest and hydration station
Station 6	Defensive up, slide and back run, 3 times
Station 7	Rest and hydration station
Station 8	Multiple task defensive station
Station 9	Skill station, passing
Station 10	30 metre straight sprint
Station 11	Walking recovery return to station 1

Note: participants move from station to station, performing the stated task, every 30 seconds.

Table 2 – Total mean scores in secs, for each station across both simulated games

	Game 1				Game 2			
	First Half		Second Half		First Half		Second Half	
Station/Treatment	Ẋ	SD	Ẋ	SD	Ẋ	SD	Ẋ	SD
Stat 1 Control	13.64	0.99	13.53	1.26	13.15	1.14	13.33	1.27
Stat 1 Ice	14.84	0.65	15.03	0.94	14.30	0.64	14.04	0.62
Stat 1 Contrast	14.54	0.79	14.27	1.00	13.62	0.78	13.59	0.82
Stat 2 Control	25.33	2.26	24.77	2.12	22.24	1.32	21.69	1.65
Stat 2 Ice	27.03	1.34	26.99	1.67	23.50	1.34	22.97	1.67
Stat 2 Contrast	26.61	1.76	26.23	1.82	22.67	1.76	22.10	1.82
Stat 6 Control	43.17	3.78	41.01	3.73	43.86*	2.98	43.18	3.89
Stat 6 Ice	44.73	2.37	43.64	3.03	47.69*	3.00	45.40	2.65
Stat 6 Contrast	44.13	2.62	43.38	2.20	46.30	3.38	44.39	3.48
Stat 8 Control	39.69	3.95	38.88	3.37	42.92	3.86	42.54	4.29
Stat 8 Ice	43.02	2.38	44.68	3.38	45.71	2.74	44.60	2.88
Stat 8 Contrast	42.12	2.09	43.72	4.53	44.73	2.64	43.87	2.69
Stat 10 Control	18.96	1.32	18.85	1.59	17.95	1.47	18.16	1.34
Stat 10 Ice	20.45	0.85	20.80	0.73	19.64	0.74	19.67	0.72
Stat 10 Contrast	19.96	0.86	20.09	0.97	18.68	0.93	18.89	1.15

Mean totals for work periods in seconds, between groups, across stations. ***** ANCOVA analysis identified a significant difference ($p = 0.02$) with game 1 scores as the covariate.

Table 3 – Magnitude of effect across treatment groups (η_p^2 / Cohen's *d*)

Stations	η_p^2			Control			Ice Baths			Contrast Bath		
Time Points	1st	2nd	Tot	1st	2nd	Tot	1st	2nd	Tot	1st	2nd	Tot
Station 1	0.11	0.07	0.08	-0.49	-0.16	-0.32	-0.83	-1.05	-1.12	-1.16	-0.68	-0.92
Station 2	0.02	0.02	0.03	-1.37	-1.45	-1.51	-2.63	-2.41	-2.62	-2.24	-2.27	-1.56
Station 6	0.25	0.02	0.09	0.18	0.58	0.38	1.25	0.58	0.91	0.83	0.46	0.70
Station 8	0.02	0.02	0.01	0.82	1.09	0.98	1.13	-0.02	0.53	1.25	0.03	0.44
Station 9	0.04	0.01	0.01	-0.90	-0.86	-1.24	-2.11	-0.60	-1.44	-0.78	-0.57	-1.08
Station 10	0.12	0.03	0.08	-0.77	-0.43	-0.59	-0.95	-1.55	-1.24	-1.49	-1.24	-1.44

Note: η_p^2 signifies small at < 0.02, medium at < 0.08 and large at > 0.12 scores and levels of group association.

Cohen's *d* reflects magnitude as trivial at *d* = 0.02, medium at = 0.05, large at = 0.08 and greater than large at = 0.08.

Table 4 – Changes in sessional RPE mean scores (AU) across weekly cycle

Treatment		Game 1	48hr Post	72hr Post	96hr Post	Game 2
Control	Mean	480.00	437.50	600.00	563.50	465.00
	N	8	8	8	8	8
	S.D	192.43	140.79	106.90	140.31	76.90
Ice Bath	Mean	435.00	400.00	599.00	501.00	525.00
	N	8	8	8	8	8
	S.D	156.30	185.16	92.63	75.65	127.28
Contrast Bath	Mean	375.00	450.00	650.00	651.00	420.00
	N	8	8	8	8	8
	S.D	100.14	141.42	75.59	118.11	90.71
Total	Mean	430.00	429.17	616.33	571.83	470.00
	N	24	24	24	24	24
	S.D	153.91	151.74	91.76	126.21	105.67