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Efficacy of a movement control injury prevention programme in adult men's community rugby union: a cluster randomised controlled trial

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ABSTRACT

Background Exercise programmes aimed at reducing injury have been shown to be efficacious for some non-collision sports, but evidence in adult men's collision sports such as rugby union is lacking.

Objective To evaluate the efficacy of a movement control injury prevention exercise programme for reducing match injuries in adult men's community rugby union players.

Methods 856 clubs were invited to participate in this prospective cluster randomised (single-blind) controlled trial where clubs were the unit of randomisation. 81 volunteered and were randomly assigned (intervention/control). A 42-week exercise programme was followed throughout the season. The control programme reflected 'normal practice' exercises, whereas the intervention focused on proprioception, balance, cutting, landing and resistance exercises. Outcome measures were match injury incidence and burden for: (1) all ≥8 days time-loss injuries and (2) targeted (lower limb, shoulder, head and neck, excluding fractures and lacerations) ≥8 days time-loss injuries.

Results Poisson regression identified no clear effects on overall injury outcomes. A likely beneficial difference in targeted injury incidence (rate ratio (RR), 90% CI=0.6, 0.4 to 1.0) was identified, with a 40% reduction in lower-limb incidence (RR, 90% CI=0.6, 0.4 to 1.0) and a 60% reduction in concussion incidence (RR, 90% CI=0.4, 0.2 to 0.7) in the intervention group. Comparison between arms for clubs with highest compliance (≥median compliance) demonstrated very likely beneficial 60% reductions in targeted injury incidence (RR, 90% CI=0.4, 0.2 to 0.8) and targeted injury burden (RR, 90% CI=0.4, 0.2 to 0.7).

Conclusions The movement control injury prevention programme resulted in likely beneficial reductions in lower-limb injuries and concussion. Higher intervention compliance was associated with reduced targeted injury incidence and burden.

INTRODUCTION

Sports injuries negatively influence team success[1 2] and may lead to withdrawal from sports participation.[3 4] Injuries are also associated with secondary degenerative disease including osteoarthritis,[5 6] which can impact on long-term quality of life.[7] There has not been a large-scale movement control-informed injury prevention randomised controlled trial in adult men's community rugby union, despite a need to minimise injury rates to maximise sports participation and maintain players' long-term health.

Exercise-based injury prevention interventions including FIFA 11+[8] focus on reducing lower-limb injuries by means of exercises targeting balance, coordination, strength and power. In soccer, FIFA 11+ has been reported to reduce injury incidence rates by between 32%[9] and 72%.[10] However, in addition to the injury mechanisms common in soccer, rugby union (rugby) has additional contact/collision events. In community rugby, 80% of match injuries are associated with contact events[11] compared with 44% in community soccer.[12] The high-impact collision nature of the rugby tackle[13] can result in blunt force trauma injuries. For example, fractures and lacerations account for 27% of all head injuries.[14] Similarly, acromioclavicular joint dislocation is the most common rugby shoulder injury,[15] where the injury mechanism is commonly a direct impact of the player's shoulder with the ground during a tackle.[16] Such injuries are likely to be difficult to prevent through movement control programmes.

Knee and ankle ligament injuries combined with hamstring injuries account for 33% of injuries overall and are the most common non-contact rugby injury diagnoses.[11] Importantly, injury prevention programmes have reduced knee (70% reduction) and ankle sprains (62% reduction)[17] as well as hamstring strains (70% reduction).[18] Although FIFA 11+ was designed to reduce lower-limb injuries in soccer, implementing the programme in basketball reduced lower-limb injury by 32%.[19] This indicates that the type of exercises included in FIFA 11+ may be appropriate across sports where lower-limb injuries predominate. Lower-limb injuries are common in rugby, but upper-limb and head and neck injuries account for 41% of all injuries[11] compared with 6% in soccer.[20] The profile of injuries in community rugby therefore warrants a new movement control exercise programme.

The aim of this study was to investigate the efficacy of a rugby-specific movement control programme to reduce injury risk in adult men's community rugby union players.

METHODS

Trial design and randomisation

This prospective cluster randomised control trial was designed in accordance with the CONSORT framework for cluster randomised trials.[21] The playing population from which the study sample was recruited has been described previously as semi-professional (Rugby Football Union (RFU) levels 3–4; highest level of English community

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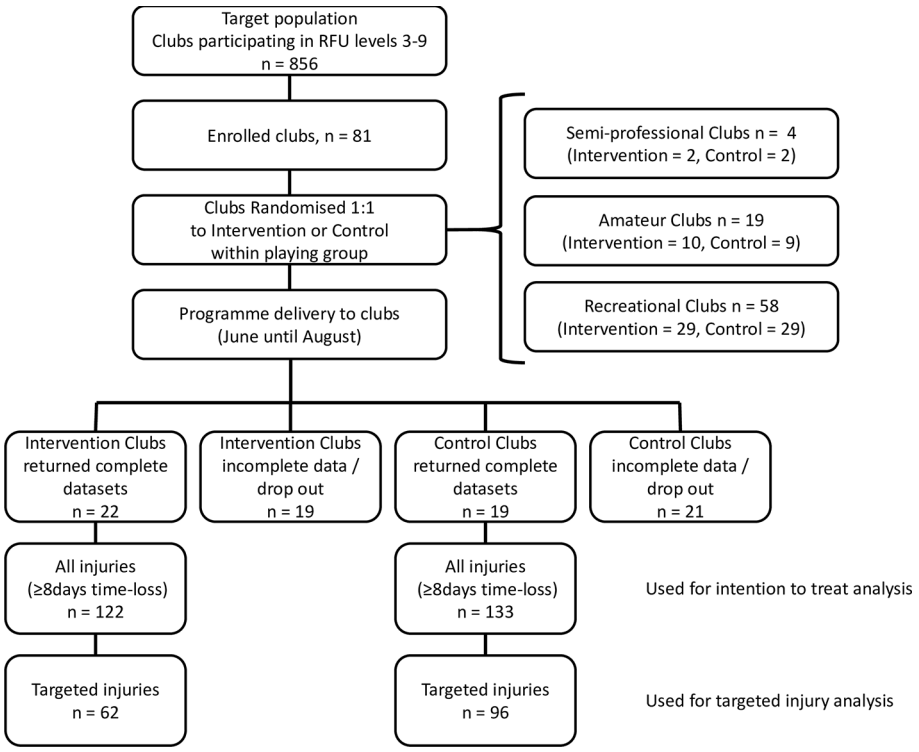

Figure 1 Flow chart of clubs through study period. RFU, Rugby Football Union.

rugby), amateur (RFU levels 5–6) and recreational (RFU levels 7–9).[11] Injury incidence varies across these playing categories,[11] and therefore, recruited clubs were stratified by playing level before being randomly allocated to the intervention or control group.

Ethical approval

The study was approved by the Research Ethics Approval Committee for Health, University of Bath, UK (Reference: EP14/15142).

Sample size

The required sample size was estimated[22] at club level, indicating 54 clubs (27 clubs per trial arm, intervention/control) for a minimally important (α=0.05) injury burden rate ratio (RR) of 0.70 or less based on expected injury burden of 899 days/1000 player match-hours[23] in the control group and anticipated exposure of 480 player match-hours per club (cluster). This allowed for an anticipated 50% drop-out rate and was adjusted for cluster coefficient (k=0.26).[23]

Study setting and recruitment

Between March and June 2015, before the 2015/2016 preseason, 856 adult men's community rugby clubs competing in RFU league levels 3–9 in England were invited to participate in this study (figure 1). Inclusion criteria were that clubs must have access to a registered healthcare practitioner for injury diagnoses (sports therapists, osteopaths, chiropractors, physiotherapists or physicians).

Programme design

Before the 2014/2015 preseason, a review of successful injury prevention exercises from different sports settings was conducted alongside a review of adult men's community rugby injury epidemiology. An evidence-informed injury prevention exercise programme reflecting the injury profile of community rugby players was developed following discussion with an expert 'Technical Group' of sports medicine researchers, physiotherapists and strength and conditioning specialists that specialised in human movement, injury prevention, epidemiology and rehabilitation and a rugby coach. The intervention programme included proprioceptive, mobility and strengthening exercises within a progressive structure targeting the lower limb, shoulder, head and neck. The control programme included dynamic stretching and non-targeted resistance exercises presented in a similar progressive format to the intervention. A pilot trial was conducted during the 2014–2015 season in 16 clubs. Delivery agents (typically coaches) from pilot study clubs were interviewed at the end of this season to determine factors that affected implementation, following which the exercise programmes were modified. Revised programmes were examined by a second expert 'Technical Group' including strength and conditioning coaches, sports physiotherapists and sports medicine researchers.

Exercise programmes

The final exercise programmes included seven 6-week progressive phases spanning the 2015/2016 rugby preseason and inseason period to be used at training sessions (twice weekly) and prematch (once weekly). Programmes recommended 5–10 min of small-sided games after which the main content lasted 15 min. The control programme followed a raise, activate, mobilise and potentiate format[24] incorporating whole-body dynamic stretching and resistance exercises, such as partner grappling, front planks, press-ups and sprint drills, before finishing with high-intensity running exercises. The intervention warm-up incorporated balance/proprioceptive exercises, resistance and perturbation exercises and sport-related landing, cutting and plyometric exercises. Proprioception and balance exercises progressed through alterations including the use of upper-limb movement, performing the exercises with eyes closed and thus

removing the visual component to balance and by perturbations in frontal and sagittal planes. Dynamic stability exercises targeting upper and lower limbs progressed in load by altering the number of sets and reps, intensity and by variations in the directions of movement. Resistance exercises progressed in duration or intensity as well as by altering the type of muscle contraction to include isometric, concentric and eccentric muscle activity. Landing, cutting and plyometric exercises varied phase to phase but reflected sport-specific skills such as jumping to catch a high ball and progressed in difficulty. Variations included progressing from a single cutting manoeuvre to a cut, spin and accelerate movement pattern. Plyometric exercises progressed through each of the phases beginning with lower-load double-legged tasks to high-load single-legged tasks. Throughout the intervention warm-up, there was a consistent theme of quality of movement control and body alignment for delivery agents to feedback to the players (see online supplementary file for an example of one intervention phase). The intervention finished with the same high-intensity shuttle running exercises as the control programme.

Blinding of clubs

Club members were blind to which programme they received. Clubs were informed that they were involved in a study evaluating the efficacy of different combinations of exercises for injury risk reduction and that clubs throughout the country were using different exercise combinations. This was deemed a pragmatic approach to limit contamination due to clubs who, due to being randomly assigned, could be situated in close geographical proximity to other participating clubs.

Programme delivery

Each club was visited by a 'programme trainer' from the research group to train each club's nominated 'delivery agent' (commonly the strength and conditioning coach) in how to deliver the programme to their players. Seventy-four per cent of clubs (n=60) received training before the start of preseason and 26% (n=21) received training before the start of the competitive season. Two clubs received training less than 5 weeks before the start of the season.

Data collection

Data were collected during the 2015–2016 English rugby union season from July 2015 to May 2016. Clubs nominated a programme coordinator to report first team match exposure, exercise programme compliance and match injuries on a weekly basis using standardised forms. Data collection forms were available in paper and electronic formats.

Injury definitions

All first-team match injuries that resulted in absence from match play for ≥8 days were defined as a 'time-loss' injury, including both acute and overuse injuries. Injuries were recorded using the Orchard Sports Injury Classification System (V.8)[25] detailing injury type and location. The date a player was fit to play was recorded as the return to play date. Overall injury incidence refers to injuries with a ≥8 days time-loss. Severe injuries were defined as injuries with >28 days time-loss.[26] Injury burden was defined as the total number of days lost from training or match play. Targeted injuries were defined as injuries to the lower limb (buttock, hip, upper leg, knee, lower leg, ankle and foot), head and neck, or shoulder (glenohumoral joint), with diagnoses limited to muscle strains, ligamentous sprains, joint and neurological injury that resulted in ≥8 days time-loss. Diagnoses including haematoma, laceration/contusion, fracture and undiagnosed pain at any body site were excluded from the targeted injury analysis.

Outcomes

Injury burden was the primary outcome between trial arms for all injuries. Secondary outcomes included overall injury incidence, targeted injury incidence and targeted injury burden.

Statistical methods

Data analysis, computed using SPSS (V.22 for Windows, IBM) was performed on an intention-to-treat (last observation carried forward) basis with the control clubs as the reference group.

Injury burden (number of days absence per 1000 player match-hours) and 90% CIs were estimated vis-à-vis for primary and secondary outcome measures of this study. Injury incidence was estimated as the number of injuries per 1000 player match-hours. The General Estimating Equation was used to conduct Poisson regression analysis and explore the effects of the intervention on injury outcomes. Club (cluster) and playing level (semiprofessional; amateur; recreational) were included as random effects, and analysis was offset for club match exposure. Overdispersion was controlled for using a Pearson χ^2 scaling parameter.[27] Club programme compliance was defined by two measures: overall club compliance (proportion of all possible sessions where the programme was delivered) and the number of club programme sessions/week. Overall compliance, adjusted for varying lengths of clubs' participation in the study and the proportion of compliant sessions, was measured as the number of compliant sessions/total potential compliant sessions. Results are presented as RR with 90% CI and interpreted using Clinical-Magnitude Based Inferences.[28] Ten per cent was considered the minimum effect, and threshold values for unlikely/harmful (25) and most/very unlikely (0.5)[28] were used to derive the OR for making clinical inference.

RESULTS

Overview

Eighty-one clubs were randomised to the intervention (n=41) or control (n=40) arm, of which forty clubs (intervention=19, control=21) dropped out or otherwise returned incomplete data. Forty-one clubs (intervention=22, control=19) returned complete data detailing 255 injuries averaging 5.5±5.7 injuries per intervention club and 7.0±5.1 injuries per control club. Total player match exposure was 19 560 hours (intervention=9900, control=9660 player match-hours), averaging 477±121 player match-hours per club. Across the 41 clubs, 222 different players sustained ≥1 injury. All injuries were reported as acute injuries, and the majority were associated with contact mechanisms (contact=199 (78%), non-contact=56 (22%)). Player demographic information is displayed in table 1.

Table 1 Player demographics (mean, SD and number) for participants in the intervention and control arms

Level	Age (years)	Mass (kg)	Height (cm)
All players	25.5 (5.6) (n=673)	94.4 (13.9) (n=1346)	181.6 (7.3) (n=1355)
Intervention	26.1 (5.7) (n=273)	93.6 (13.3) (n=675)	181.8 (7.5) (n=682)
Control	25.0 (5.5) (n=400)	95.2 (14.5) (n=671)	181.4 (7.1) (n=673)

Table 2 Incidence rate ratios by injury stratification (all injury, targeted injury) based on Poisson regression analysis adjusted for cluster and playing level

	Arm	Clubs (n)	Player match-hours	Injuries/days lost count	Rate per 1000 player match-hours (90% CI)	RR (90% CI)	Magnitude-based inference (beneficial/trivial/harmful) (%)
Overall Injury							
All incidence	Control	19	9660	133	13.8 (11.9 to 15.9)	0.9 (0.6 to 1.3)	Unclear (51/31/18)
	Intervention	22	9900	122	12.3 (10.6 to 14.3)		
Severe incidence	Control	19	9660	73	7.6 (6.2 to 9.2)	0.8 (0.6 to 1.3)	Unclear (63/25/12)
	Intervention	22	9900	62	6.3 (5.1 to 7.7)		
Injury burden	Control	19	9660	6918	716 (621 to 826)	0.8 (0.5 to 1.4)	Unclear (62/22/16)
	Intervention	22	9900	5783	584 (503 to 678)		
Targeted injury							
Injury incidence	Control	19	9660	96	9.9 (8.4 to 11.8)	0.6 (0.4 to 1.0)	Likely beneficial (92/7/1)
	Intervention	22	9900	62	6.3 (5.1 to 7.7)		
Severe incidence	Control	19	9660	56	5.8 (4.7 to 7.2)	0.6 (0.3 to 1.0)	Likely beneficial (92/6/2)
	Intervention	22	9900	33	3.3 (2.5 to 4.4)		
Injury burden	Control	19	9660	5288	547 (463 to 647)	0.6 (0.3 to 1.3)	Unclear (80/11/9)
	Intervention	22	9900	3472	351 (285 to 432)		

Overall injuries

Overall injury burden was 649 (90% CI 570 to 740) days/1000 player match-hours where the incidence (≥8 days time-loss) for both trial arms combined was 13.0 (90% CI 11.8 to 14.4) injuries/1000 player match-hours. There were 135 severe injuries (>28 days time-loss) with an incidence of 6.9 (90% CI 6.0 to 7.9) injuries/1000 player match-hours. Intention-to-treat analysis indicated no clear difference in overall injury burden (RR, 0.8; 90% CI 0.5–1.4), overall injury incidence (RR, 0.9; 90% CI 0.6–1.3) or severe injury incidence (RR, 0.8; 90% CI 0.6–1.3) for the intervention compared with control group (table 2 and figure 2).

Targeted injuries

One hundred and fifty-eight injuries (62% of all injuries) across both trial arms met the 'targeted injury' definition with a burden of 448 (90% CI 393 to 510) days/1000 player match-hours and an incidence of 8.1 (90% CI 7.1 to 9.2) injuries/1000 player match-hours. There were 89 severe targeted injuries with an incidence of 4.6 (90% CI 3.8 to 5.4) injuries/1000 player match-hours. Poisson regression analysis indicated no clear difference (RR, 0.6; 90% CI 0.3–1.3) in targeted injury burden for the intervention (table 3 and figure 3) compared with the control group. A likely beneficial 40% (RR, 0.6; 90% CI 0.4–1.0) reduction in both overall targeted injury incidence and severe targeted injury incidence (RR, 0.6; 90% CI 0.3–1.0) was identified for the intervention compared with control group.

Specific body locations

There was a likely beneficial 70% reduction in both burden (RR, 0.3; 90% CI 0.2–0.7) and incidence (RR, 0.3; 90% CI 0.2–0.6)

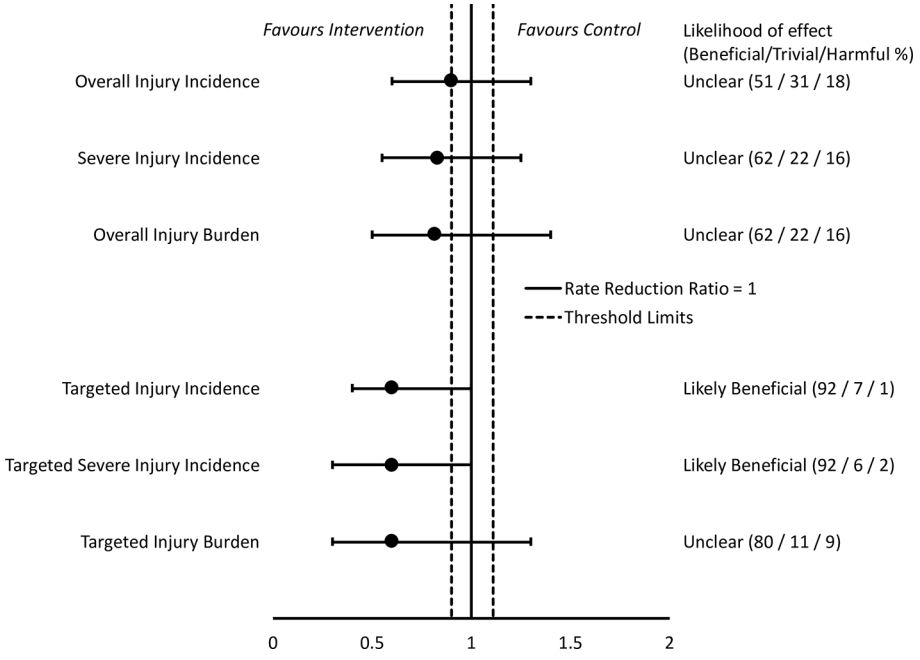

Figure 2 Rate reduction ratio (RR) and 90% CI of overall and targeted injury outcomes for the intervention group based on Poisson regression analysis adjusted for cluster and playing level. Clinical inference (right column) indicates the likelihood of effect. Vertical dashed lines represent 10% minimum effect thresholds, and the vertical solid line represents no effect compared with the control group.

Table 3 Incidence rate ratios for targeted injuries, stratified by region (head and neck, shoulder and lower limb) based on Poisson regression analysis adjusted for cluster and playing level

Target injury and arm	Clubs (n)	Player match-hours	Injuries/days lost count	IIR(90% CI)	RR (90% CI)	Magnitude-based inference (beneficial/trivial/harmful) (%)
Head and neck incidence						
Control	19	9660	35	3.6 (2.7 to 4.8)	0.3 (0.2 to 0.7)	Very likely beneficial (99/1/0)
Intervention	22	9900	12	1.2 (0.8 to 1.9)		
Concussion incidence						
Control	19	9660	33	3.4 (2.6 to 4.5)	0.4 (0.2 to 0.7)	Very likely beneficial (99/1/0)
Intervention	22	9900	12	1.2 (0.8 to 1.9)		
Shoulder Incidence						
Control	19	9660	10	1.0 (0.6 to 1.7)	1.7 (0.7 to 3.8)	Likely harmful (11/10/79)
Intervention	22	9900	17	1.7 (1.2 to 2.6)		
Lower-limb incidence						
Control	19	9660	50	5.2 (4.1 to 6.5)	0.6 (0.4 to 1.0)	Likely beneficial (89/9/2)
Intervention	22	9900	33	3.3 (2.5 to 4.4)		
Head and neck burden						
Control	19	9660	1164	120 (92 to 159)	0.3 (0.2 to 0.7)	Very likely beneficial (99/1/0)
Intervention	22	9900	378	38 (24 to 61)		
Concussion burden						
Control	19	9660	983	102 (76 to 136)	0.4 (0.2 to 0.8)	Very likely beneficial (97/2/1)
Intervention	22	9900	378	38 (24 to 61)		
Shoulder burden						
Control	19	9660	436	45 (27 to 76)	1.5 (0.6 to 3.7)	Possibly harmful (17/11/71)
Intervention	22	9900	673	68 (46 to 101)		
Lower-limb burden						
Control	19	9660	3688	382 (303 to 482)	0.6 (0.3 to 1.5)	Unclear (75/11/14)
Intervention	22	9900	2421	245 (184 to 326)		

IIR, injury incidence rate; RR, rate ratio.

of head and neck injury for the intervention group over control group (figure 3 and table 3). Forty-five of 47 'head and neck' injury diagnoses were concussion, and there was a likely beneficial 60% reduction in burden (RR, 0.4; 90% CI 0.2–0.8) and incidence (RR, 0.4; 90% CI 0.2–0.7) for this specific diagnosis in the intervention compared with the control group. Overall, twenty-seven injuries were reported for the shoulder (table 3) where a possibly harmful 50% (RR, 1.5; 90% CI 0.6–3.7) higher injury burden and likely harmful 70% (RR, 1.7; 90% CI 0.7–3.8) higher injury incidence was found for the intervention group

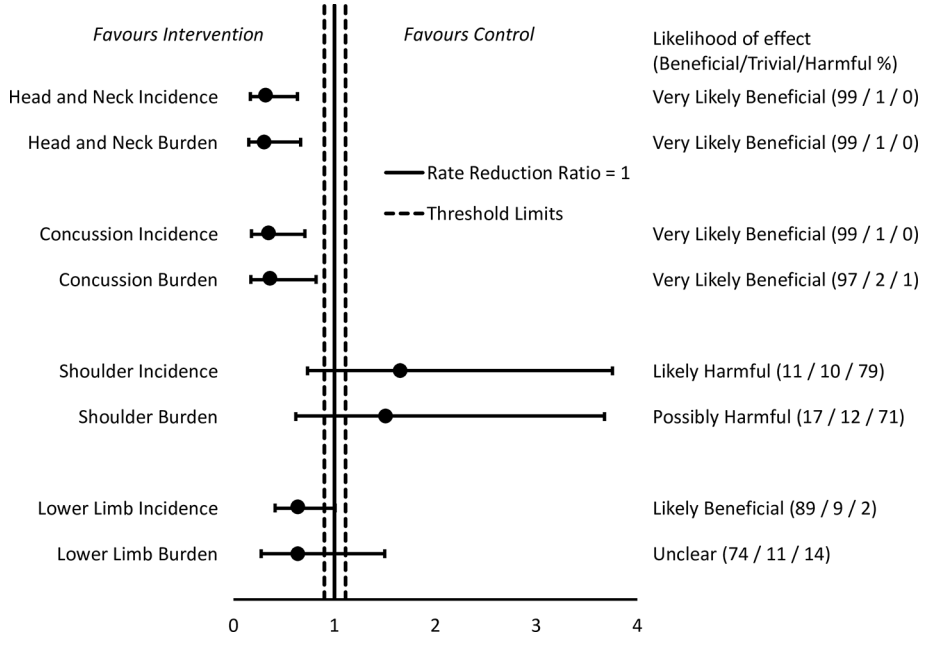

Figure 3 Rate reduction ratio (RR) and 90% CI for targeted injury outcomes stratified by location for the intervention group based on Poisson regression analysis adjusted for cluster and playing level. Clinical inference (right column) indicates the likelihood of effect. Vertical dashed lines represent 10% minimum effect thresholds, and the vertical solid line represents no effect compared with the control group.

over control. There was no clear difference (RR, 0.6; 90% CI 0.3–1.5) in lower-limb injury burden but likely beneficial 40% (RR, 0.6; 90% CI 0.4–1.0) reduction in lower-limb injury incidence for the intervention compared with the control group.

Programme compliance

Programme compliance was high and was similar in both intervention (2.1±0.7 sessions/week, median=85%, IQR=62–90) and control (2.2±0.6 sessions/week, median=83%, IQR=65–92) study arms. Four clubs (intervention n=3, control n=1) completed their programme less than once weekly, 8 clubs (intervention n=3, control n=5) completed their programme at least once but less than twice weekly and 29 clubs (intervention n=16, control n=13) completed their programme at least twice weekly.

For clubs that completed the exercise programmes at least once weekly (n=37), no clear difference in targeted injury burden (RR, 0.7; 90% CI 0.3–2.0) and likely beneficial 40% reduction (RR,0.6; 90% CI 0.4–1.0) in targeted injury incidence was found for the intervention compared with the control group.

Median compliance was used to divide clubs into higher (≥median) and lower (<median) compliance groups. Intervention clubs (n=11) with higher compliance displayed a very likely beneficial 60% reduction in both targeted injury burden (RR, 0.4; 90% CI 0.2–0.7) and targeted injury incidence (RR, 0.4; 90% CI 0.2–0.8) compared with the control clubs with higher compliance (n=9).

Within the intervention arm, comparison of clubs with higher compliance (n=11) to lower compliance (n=11) indicated a likely beneficial 50% reduction (RR, 0.5; 90% CI 0.2–1.2) in targeted injury burden with no clear difference (RR, 0.7; 90% CI 0.4–1.4) in targeted injury incidence for higher compliance clubs.

DISCUSSION

This is the first cluster randomised controlled trial to evaluate the efficacy of an injury prevention exercise programme to reduce injuries in adult men's community rugby players. No clear differences were found between intervention and control arms using intention-to-treat analysis and established clinical inference thresholds for overall injury burden, overall injury incidence or severe injury incidence. However, for injuries targeted by the intervention, overall injury incidence and severe injury incidence were both reduced by 40% in the intervention group compared with control, which were clear beneficial effects. Of particular note is that the intervention group benefited from a 60% reduction in concussion and a 40% reduction in lower-limb incidence compared with the control group.

Targeted injuries

Concussion was 60% lower for both incidence (1.2 vs 3.4 injuries/1000 player match-hours) and burden (38 vs 102 days/1000 player match-hours) in the intervention compared with the control group. This reduction is possibly a result of the isometric neck conditioning exercises included in every phase of the intervention programme. These exercises were included based on existing evidence that isometric neck exercises increase neck strength in male rugby players[29] and that higher neck strength is suggested to decrease head accelerations during rugby collision events associated with concussion.[30] For amateur rugby, this finding is very encouraging in the context of a proposed link between concussion sustained during a playing career and deficits in cognitive functioning in later life.[31] Given the magnitude of the difference in concussion incidence between the intervention and control groups in this study, this is evidence to suggest that all adult men's community rugby players should engage in weekly neck conditioning exercises.

A likely beneficial reduction of 40% was found for targeted lower-limb injury incidence for the intervention group over control group (3.3 vs 5.2 injuries/1000 player match-hours). The intervention programme incorporated lower-limb balance, proprioception and movement control exercises similar in nature to exercises in FIFA 11+,[32] indicating that this approach is also efficacious for reducing injury in rugby, despite the high proportion of contact-related injuries. Intention-to-treat analysis from a neuromuscular-control intervention study in community adult men's Australian Rules Football,[33] another sport with a high level of physical person-to-person contact, displayed a likely beneficial 20% reduction (RR, 0.8; 90% CI 0.6–1.0) in lower-limb injury incidence and a likely beneficial 50% reduction (RR, 0.5; 90% CI 0.3–1.0) in knee injuries. Given that ∼50% of all community rugby injuries are lower-limb injuries,[11] our findings support the completion of these lower-limb exercises as part of a warm-up before training and matches.

Shoulder injury incidence (1.7 vs 1.0 injuries/1000 player match-hours, respectively) and injury burden (68 vs 45 days/1000 player match-hours, respectively) was higher for the intervention group over control. Despite the higher rate of shoulder injuries, the intervention group had fewer shoulder dislocations (1 vs 5 dislocations) but more muscle/tendon injuries (15 vs 4 injuries) than the control group. There is no obvious explanation for the higher injury rate in the intervention group, though this trial was not powered to detect differences in shoulder injury rates as specific outcome. Reduced head and neck and lower-limb injuries likely resulted in greater individual player match exposure for players in the intervention arm. Greater player match exposure may have led to more shoulder contact events including tackles, thus increasing the risk for shoulder injury. All shoulder injuries were contact injuries and therefore may be harder to reduce via conditioning exercises alone. As reductions in both shoulder and head injury are likely achieved via good tackling technique,[34 35] it may be prudent that tackle education is recommended alongside implementation of this study's intervention.

Compliance and injury risk

Clubs' compliance rates were high, reflected by median compliance of 85% for the intervention group and 83% for the control group, where on average clubs implemented the programmes at least twice/week. Between-group comparison for clubs that completed the programme at least once/week during the season indicated a 40% reduction in targeted injury incidence for the intervention group over the control group. As some clubs only train once/week, it is encouraging to find that injury incidence was reduced provided clubs implemented the intervention once weekly. In soccer, higher FIFA 11+ compliance produced a very likely beneficial 35% reduction in injury rates compared with intermediate FIFA 11+ compliance.[8] In the present study, comparison between intervention clubs with higher compliance to lower compliance (≥85% to <85% of possible sessions) indicated a likely beneficial 50% reduction in targeted injury burden. This indicates that additional benefit can be achieved when the intervention is implemented in the majority of training sessions and before matches.

The control exercises reflected normal 'good practice' for this level of rugby and consisted of dynamic stretching and non-targeted

resistance exercises. Overall injury incidence in the control group was 13.8 (90% CI 11.9 to 15.9) injuries/1000 player match-hours, which is 18% lower than the incidence previously reported for similar populations of adult men's community rugby players (16.9 injuries/1000 player match-hours; 90% CI 14.9–16.5).[11] Control exercises may have offered better physical preparation for players than current 'normal practice', which is supported by feedback from pilot study delivery agents (unpublished data; Attwood, 2017). Results may indicate that there is a need to improve warm-up practices in this population.

Implementation in the 'real-world' setting is needed before intervention effectiveness can be determined.[36] The full potential of this intervention programme will only be realised if it is adopted, executed correctly and maintained[36 37] by community rugby clubs. The RFU has identified player welfare as a strategic priority and is ideally placed to disseminate the intervention to community rugby clubs in England with its employed, field-based workforce. However, this will not be without its challenges and following nationwide dissemination, intervention programme effectiveness will need to be evaluated using the RE-AIM framework.[38]

Strengths and limitations

Random checks of club compliance through unannounced visits were not made, which would have increased the validity of the compliance results. Regarding compliance, it was assumed participants must 'do as they are told'[39] and thus completed their programme in full as was designed. The efficacy of the intervention reflects reductions in musculoskeletal injury and concussion found in schoolboy rugby[40] using a similar intervention.[41] A cluster randomised controlled trial reduces biases associated with the results and the pragmatic, coach (delivery agent)-led delivery approach increased the generalisability of the study results. This coach-led, club-based warm-up intervention programme, which included balance and proprioception exercises, resistance and perturbation exercises and sport-related landing, cutting and plyometric exercises, is efficacious in reducing overall targeted injury and severe injury in adult men's community rugby and should be implemented nationwide.

What are the findings?

- This study is the first to demonstrate the efficacy of an injury prevention exercise programme in adult men's community rugby.
- Performing at least one movement control session per week led to reduced injury rates.
- Lower-limb injury, head and neck injury and concussion were reduced, but shoulder injuries were increased in the intervention group undertaking exercises during warm-ups at training and before matches.
- Higher compliance with the intervention programme was associated with the greatest injury reduction.

How might it impact on clinical practice in the near future?

- The injury prevention exercise programme should be performed prior to training and matches in all adult men's rugby union.
- Given the evidence for the efficacy of this and similar injury prevention exercise programmes, practitioners should consider the content of the 'warm-up' and consider employing the principles of these exercise programmes regardless of which sport they are working in.

CONCLUSION

This is the first cluster randomised controlled trial to examine the efficacy of a movement control injury prevention programme in adult men's community rugby players. The intervention programme demonstrated clear beneficial effects by reducing concussion incidence by 60% and lower-limb injury incidence by 40% compared with control. It is recommended that adult men's rugby players complete the intervention programme exercises prior to training and match play.

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