

An Explorative Investigation of the Warm-up Practices of Professional and Amateur Rugby League Players

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Abstract

This study aimed to assess warm-up practices within professional and amateur Rugby League players, specifically to determine players' perceptions why particular methods were used and discover whether any differences existed in warm-up practices and perceptions between the two separate standards. The study used a 10-question online questionnaire to investigate 30 professional and 53 amateur players warm-up protocols and their perceptions behind their practices. To provide a richer understanding regarding the practices and perceptions surrounding warm-up protocols, the questionnaire was followed by two focus groups (professionals and amateurs), which included four participants in each. Following analysis of the questionnaire responses, it was discovered that professional players' warm-up protocols were significantly longer in duration than amateur players ($P = 0.009$). However, for all other variables assessed including; specific warm-up protocols, static stretch duration, and perceptions and beliefs concerning warm-up protocols, there were no significant differences between professionals and

amateurs. Overall findings demonstrated the widespread use of static stretching within warm-up for both professionals and amateurs; 71 of 83 players (86%) reported usage. It was also highlighted that injury prevention was the most commonly perceived benefit from performing a warm-up across both standards [(Professional; 15 of 30, 50%) (Amateur; 27 of 53, 51%)]. Findings from the focus group generally supported questionnaire responses, and it was identified that the warm-up practices and protocols of Rugby League players were influenced by others such as coaches and strength and conditioning coaches which emphasises the importance of the role of these practitioners.

Key words: Warm-up, Static Stretching, Questionnaire, Perceptions, Rugby League

Introduction

Rugby League players require a plethora of physical qualities for performance including; speed, power, strength and agility (16). Subsequently, in order to optimise performance for a Rugby League player, efforts should be made to enhance these qualities both longitudinally, through structured training and acutely via

a pre-game warm-up (16,36). A well-structured warm-up protocol has beneficial effects upon temperature and non-temperature related physiological mechanisms and can potentially aid performance and reduce risk of injury (6,13,15,18,43). The practice of pre-competition and pre-training warm-up can be observed across the majority of sports (18,27,36).

It is commonly accepted that a well-constructed warm-up protocol can aid performance, however, certain elements within a general warm-up protocol have come under critique (12,18,34). Researchers have reported impairments in maximal dynamic strength, jumping performance, sprinting and agility in sporting participants when acute bouts of static stretching are implemented into a warm-up protocol (4,8,9,23,28,29,42). However, the incorporation of dynamic warm-up protocols have generally led to significant benefits in the aforementioned physical qualities (10,11,12). Due to the impairments in performance that static stretching can cause, several researchers have suggested removing static stretching from warm-up regimes (12,33,34). Indeed, it has been suggested there has been a trend to remove static stretching from the warm-up regimes of various major sports (33). In the absence of static stretching, a series of sports specific movements known as a dynamic warm-up protocol and competition simulation drills are favoured due to the beneficial physiological effects such as an increase in core temperature, a decrease in stiffness within the muscle tendon unit and post-activation potentiation (18,34,36). The performance of a dynamic warm-up, featuring exercises such as walking lunges, leg swings and hamstring kicks, has also been shown to significantly increase range of motion to a

similar extent as a protocol of lower body static stretches within professional team sport athletes (23).

Although static stretching has been documented to impair physical attributes, many of which are desirable to possess for Rugby League match-play (4,8,9,23,28,29,42), a major consideration when playing a sport such as Rugby League is the ability to avoid injury (16). Static stretching has previously been associated with an increase in range of movement (5,21). Such effects may be perceived as having a positive impact on the reduction of injury prevalence, since common actions within Rugby League feature rapid dynamic lengthening of muscle groups through their full range of motion (16,33,34,38). However, research has revealed that static stretching prior to performance does not reduce the risk of injury in comparison to dynamic warm-up protocols (1,31,38).

The physiological effects of warm-up are well documented, however, it has also been acknowledged that warm-up provides athletes with the opportunity for mental preparation (7,34). Methods such as visualisation, attentional focus and self-talk have been implemented into athlete warm-up protocols to achieve optimal psychological state of preparedness for performance (37). With this considered any imposed disruptions in athlete warm-up practice by changing protocols may affect psychological preparation (24,34).

Despite the depth of research investigating the positive and negative effects that warm-up can have on performance, injury occurrence and mental preparation there is little explorative research investigating actual warm-up practices of athletes within their sport. Therefore, this study aimed to firstly investigate the warm-up

practices of both amateur and professional Rugby League players and secondly to investigate the players' perceptions and beliefs behind their warm-up practices.

Methods

Experimental Approach

The study used a mixed methods approach to data collection which required the participants to firstly complete an online questionnaire detailing their warm-up practices, followed by two separate focus groups with amateur and professional players respectively. A cross-sectional research design was adopted for this study; this was appropriate since a random sample of Rugby League players of both professional and amateur standard were selected. The chosen design enabled identification of similarities and differences between individual players and the two separate playing standards (30). An inductive approach was also adopted so that no preconceived bias manipulated the participants' answers to any of the questions posed.

Participants

In total 83 of 99 contacted participants completed and submitted an online questionnaire, giving a response rate of 84%. Rugby League players from both amateur and professional backgrounds (mean \pm standard deviation, age; 26 ± 8 years, playing experience; 12 ± 12 years) were invited to take part in this study and were contacted via social media, word of mouth and also through approaching rugby clubs in person (Professional players, $n = 30$; Amateur players, $n = 53$). Professional players involved in the study performed in several different leagues from England which included the 'Super

League', 'Championship' and 'League One' representing the top three tiers in the English professional ranks. Amateur players involved in the study played within the 'English National Conference League', the 'Australian Mackay District League' and the 'BUCS University League'. The study received ethical approval from the institutional ethics committee in line with the Helsinki Declarations for research with human volunteers. In addition, all featured participants provided informed consent to participate in the online questionnaire ($n = 83$) and the subsequent focus groups ($n = 8$).

Research Instruments and Procedures

Online Questionnaire

The participants were initially required to complete a short 10-question online questionnaire that was constructed and created by the authors. Most of the questions were of a categorical nature, whilst the remainder required short depictive responses from the participants. The process of creating and piloting the questionnaire followed procedures described by McGowen et al. (26), Swinton et al. (40) and Gee et al. (17) to ensure the content within the questionnaire was comprehensible. The first part of the questionnaire was designed to ascertain what standard and Rugby League club the participants played for, the content of their warm-up protocols and the typical duration of overall warm-up and featured protocols. The final section of the questionnaire was created with the intention of discovering the participants' perceptions behind their warm-up protocol. Specifically, the similarity of the warm-up protocol over career-span, the primary perceived benefit of warm-up

protocol and the source of perceptions and beliefs concerning the warm-up protocol.

Focus groups

Focus groups were adopted in this study to provide a deeper and richer understanding of the perceptions and protocols of the participants, to compliment the data gathered in the questionnaire. Two separate focus groups were conducted for amateurs and professionals, each group consisted of a recommended number of four participants (22). The focus groups followed a semi-structured script, which ensured that the discussion was relevant to the subject in hand, it also gave all participants involved the opportunity to contribute and to have an input as well as allowing for additional questions from the researcher (30). Most of the questions asked in the focus groups were open-ended questions, allowing respondents a substantial amount of freedom when answering the questions in the hope of enabling a free-flowing conversation and for idiosyncratic opinions to surface (39).

Statistical Analysis

Questionnaires

The data gathered from the questionnaire allowed for both a statistical and descriptive analysis. A number of categorical questions were of a nominal nature and were analysed using SPSS (IBM SPSS statistic, version 22) and the Pearson's chi-square test, the remaining questions were ordinal in nature and required a Mann-Whitney U test. Statistical significance was accepted as $P < 0.05$. These tests were chosen to highlight possible differences in warm-up protocols and perceptions between both the two standards.

Focus groups

The focus groups were transcribed verbatim and coded using thematic analysis. Initially all the data was read carefully by the researcher leading the study which helped produce raw data, higher-order themes and general dimensions by adopting an inductive content analysis. Once the lead researcher generated the themes the remaining co-authors (two UK Strength and Conditioning Association accredited coaches) validated the data by using deductive analysis to ensure all raw data themes were represented (30). The coding process used a technique suggested by Ryan and Bennard (35) to discover themes; key phrases and word repetitions that are focused on.

Results

Questionnaire

Duration of warm-up

There was a significant difference within the duration of the warm-up between the two separate standards ($P = 0.009$). It was discovered that the professional warm-up protocols were considerably longer in duration in comparison to amateur protocols. In total 20 of 30 (67%) of professional players performed their warm-up protocol for '15 min plus', whereas only 22 of 53 (42%) of amateur players claimed to warm-up for '15 min plus'. Warm-up durations of '10-15 min' [(Professional: 9 of 30, 30%) (Amateur: 18 of 53, 34%)], '5-10 min' [(Professional: 1 of 30, 3%) (Amateur: 11 of 53, 21%)], and '0-5 min' [(Professional: 0 of 30, 0%) (Amateur: 2 of 53, 4%)] were reported less frequently across both standards.

Preparatory activity

Almost all players surveyed performed a preparatory activity aimed to increase heart rate at the beginning of warm-up; 29 of 30 (97%) of professional and 52 of 53 (98%) of amateur players claimed to perform a preparatory activity.

Prevalence of stretching

There was no difference between the standards regarding prevalence of stretching ($P = 0.375$). The majority of professional (29 of 30, 97%) and amateur (51 of 53, 96%) players questioned performed dynamic stretching in their warm-up protocol. In addition static stretching was also highly prevalent, with a large proportion of professional (27 of 30, 90%) and amateur (44 of 53, 83%) players utilising static stretching within their warm-up protocols. Regarding warm-up order of stretching activities, 41 of the participants claimed to perform dynamic stretching before static stretching, whereas, only 22 participants performed static stretching before dynamic stretching.

Static stretch duration

There was no difference in the static stretch duration practices of professional and amateur players ($P = 0.058$). Most players professionals held stretches for '0-15 s' [(Professional: 15 of 27, 56%) (Amateur: 33 of 44, 75%)], a lower proportion held stretches for '15-30 s' [(Professional: 7 of 27, 26%) (Amateur: 9 of 44, 20%)], with a limited number of players holding stretches for '30-60 s' [(Professional: 4 of 27, 15%) (Amateur: 2 of 44, 5%)] and '60 s plus' [(Professional: 1 of 27, 4%) (Amateur: 0 of 44, 0%)].

Similarity of the warm-up protocol over career-span

There was no statistical difference between the two standards regarding whether the participants believed their warm-up protocol had changed throughout their playing careers ($P = 0.074$). However, it was revealed that 18 of 30 (60%) professional players consider their protocols to have changed throughout their Rugby League playing career, whereas only 21 of 53 (42%) of amateur players believe their protocol have changed.

Perceived benefit of warm-up protocol

There was no significant difference between the two standards in regards to the primary perceived predominant benefit of their warm-up protocol ($P = 0.721$). In total 15 of 30 (50%) professional, and 27 of 53 (51%) amateur players believed the predominant benefit of warm-up to be 'Injury prevention'. Other perceived benefits such as 'Physical preparation' [(Professional: 9 of 30, 30%) (Amateur: 17 of 53, 32%)], 'Performance enhancement' [(Professional: 5 of 30, 17%) (Amateur: 5 of 53, 9%)], and 'Mental preparation' [(Professional: 1 of 30, 3%) (Amateur: 4 of 53, 8%)], were selected by a lower proportion of players.

Source of perceptions and beliefs concerning warm-up protocol

There was no significant difference between the two standards regarding the source of perceptions and beliefs of their warm-up ($P = 1.000$). In total, 21 of 30 (70%) professional and 38 of 53 (72%) amateur players claimed their beliefs were influenced by the 'Following others opinions (i.e. Strength & Conditioning coach, Rugby League coach)'. A lower proportion attributed their beliefs to their own 'Personal educated opinion' [(Professional: 8 of 30, 27%) (Amateur: 13 of 53, 25%)] with a small number

attributing to ‘Personal uneducated opinion (guess)’ [(Professional: 1 of 30, 3%) (Amateur: 2 of 53, 4%)].

‘Similarity of warm-up protocol’, ‘The reason for perceived benefits’.

Focus groups

The thematic analysis of the focus groups highlighted seven general dimensions rich in information and relevant themes, these themes were; ‘Duration of warm-up’, ‘Preparatory activity and type’, ‘Contents and order of warm-up’, ‘Static stretch duration’, ‘Perceived benefits of warm-up’,

Duration of warm-up

The general dimension ‘Duration of warm-up’ (Table 1), witnessed typical responses from the amateur participants explaining that their warm-up protocol can be unorganised and rushed on occasions, which can affect the duration of the warm-up protocol, whereas, the professional participants were concise and consistent when detailing their warm-up duration.

Table 1. Duration of warm-up

High order themes	Number of responses		Select raw data representing responses to the question
	A	P	
Between 15-30 min	1	0	-‘You probably go out about 15-30 min before, and then come back in again’. (Amateur)
Between 20-30 min	0	4	-‘Yes 20-30 min’. (Professional)
Over 30 min	3	0	-‘Some days it can be a bit rushed, depending on the circumstance at the time. Normally the average would be about 35 min’. (Amateur)

A = Amateur, P = Professional (applies to all tables)

Table 2. Preparatory activity and type

High order themes	Number of responses		Select raw data representing responses to the question
	A	P	
Simple forms of running	3	0	-‘Jogging around the field that is sometimes intermittent in pace, so it might be sprinting the widths and jogging the length of the field’. (Amateur)
Simple forms of running incorporating a ball handling drill	1	4	-‘Quick jog from under the posts and then we get the ball through the hands for a bit in teams of four’. (Amateur) -‘Getting into groups of four and get the ball in our hands and pass it along the line whilst jogging up and down the field’. (Professional).

Preparatory activity and type

Both amateur and professional players commonly practice a preparatory activity within their warm-up procedure as evidenced by the questionnaire results. However, through a richer description of their preparatory activity (Table 2), it became apparent that the professional players tend to incorporate a ball handling drill into their preparatory activity whereas

as the amateur players generally take part in jogging activities alone.

Contents and order of warm-up

The focus groups concurred with the questionnaire in regards to the order in which the static and dynamic elements of the warm-up are implemented, with the tendency for static stretching to follow dynamic stretching (Table 3).

Table 3. Contents and order of warm-up

High order themes	Number of responses		Select raw data representing responses to the question
	A	P	
Dynamic stretches, rugby specific drills, static stretch, rugby specific drills	1	0	-‘A bit of dynamic stretching, then ball through hands in teams of fours, then we’d break down into static stretching, then after that move into a bit of good ball sets’. (Amateur)
Dynamics stretches, static stretches, rugby specific drills	2	1	-‘Some dynamic stretching or we do it as like a corner drill so every time you get to like a corner on the field, you add your dynamic stretching to get your body warm. Then into a giant circle for static stretching, then we get into a passing drill in groups in teams of four’. (Amateur) -‘Some dynamic movements, warm-ups, starting to get different muscle groups fired up and after that move onto some static stretching if you feel that you need to’. (Professional)
Dynamic stretches, rugby specific drills	1	0	-‘We would go under the posts in lines of fours, we’d do dynamic stretches, lunges, calf raisers just try and get the muscles warm, and then we’ll jump back into lines of four again, just soft hands. After that we will get into a square, that’s just another ball handling drill, just to get the ball through our hands, and then we will run through some good ball sets’. (Amateur)
Statics stretch, rugby specific drills	0	1	-‘Come in for a stretch then get back into groups again and get the ball in our hand and practice our moves, and get our body used and legs used to the change of direction. Maybe get on the pads, get your body used to taking the hits that you’re going to take during the game’. (Professional)
Rugby specific drill, static stretches, rugby specific drills	0	2	-‘Going the width of the fields in fours passing the ball down the line. Then we will come back in a do some position specific stuff, like splitting up positions. Then go in for a stretch start off with a full group stretch and then do an extra 30 s to a min on your own to stretch whatever feels tight, and then end up with a bit of contact, a bit of tackling just to warm-up the shoulders and that’s it’. (Professional)

Static stretch duration

In line with the questionnaire findings, there was a tendency for players from both standards to hold static stretches for short duration, with 10-15 s being attributed most frequently (Table 4). In addition, the focus groups revealed that all bar one of

the participants from the two groups repeated their stretch on each muscle group more than once. This dimension also identified the high prevalence of static stretching within Rugby League players' warm-up protocols.

Table 4. Static stretch duration

High order themes	Number of responses		Select raw data representing responses to the question
	A	P	
10-15 s, repeated twice or more	3	2	- 'Between 10-15 s, and then I'd probably repeat every stretch twice on each leg'. (Amateur) - 'I hold each side for 10-15 s, probably do that 4 to 6 times at each side'. (Professional)
15-30 s	0	1	- 'Probably 15-20 s and just once on each leg'. (Professional)
30 s and longer, repeated twice or more	1	1	- 'I'd probably say 30 s to a min.... 3 per leg if you're doing like quadriceps'. (Amateur) - 'I'd say about 30 s and then depending on if you're feeling tight or not I might do it twice'. (Professional)

Perceived benefits of warm-up

As with questionnaire findings, the focus groups also attributed that injury prevention was the most popular perceived benefit of a warm-up protocol (Table 5). However, both focus groups

highlighted that all four themes (Mental preparation, Physical preparation, Performance enhancement and Injury prevention) are perceived to benefit from a warm-up.

Table 5. Perceived benefits of warm-up

High order themes	Number of responses		Select raw data representing responses to the question
	A	P	
Mental preparation	3	1	-‘You’re in a big circle as a team, you sort of just talk about your opponents, talk about how the game is going to go today. Anything that’s on your mind really, just looking to motivate one and other, preparing yourself mentally’. (Amateur) -‘Having done that, obviously mentally you’re feeling better about yourself, because you feel like you have prepared for it rather than just going out without doing it’. (Professional)
Physical preparation	3	3	-‘If you haven’t done your static stretches you won’t be able to run after 20 min, because your legs would just be stiff and you won’t be able to perform properly’. (Amateur) -‘Just generally getting your body prepared for the game, get blood flowing and get your muscles loose so you’re ready to go’. (Professional)
Performance enhancement	2	1	-‘Getting ball through hands would probably be quite important, because that prepares yourself for the game and it prepares you for catching the ball and just ball handling in general’. (Amateur) -‘Obviously performing, if your warmed up you feel like you can perform at a higher level rather than just going into it cold’. (Professional)
Injury prevention	3	3	-‘The static stretching, I think I feel, I wouldn’t go on the pitch without stretching because it helps stop injuries’. (Amateur) -‘I’ve had bad experiences before with not warming up properly and picking up injuries so obviously, I take it a lot more serious now than I previously have’. (Professional)

Similarity of warm-up protocol

The dimension ‘Similarity of warm-up protocol’ derived from the focus groups revealed that amateur players perceive their warm-up to be very similar since they began playing Rugby League whereas, professional players considered their warm-up to have changed throughout their playing career (Table 6). These changes were considered by the professional participants to be; the inclusion of dynamic movements, more specific movements / drills and warm-up duration (longer). These findings supported the questionnaire outcomes, whereby a non-significant numerical trend of difference was found between the two standards, regarding whether players considered their warm-up to be similar or different throughout the course of their Rugby League career.

The reason for perceived benefits

The dimension ‘The reason for perceived benefits’ affirmed that all participants from both focus groups believed that their perceived benefits of their warm-up have been shaped by the influences of others (e.g. the coach or the strength and conditioning coach) (Table 7). This finding also complemented the findings from the questionnaire. It was discovered that in the professional focus group, all but one player considered after being taught different warm-up methods, they discover what method they prefer and which they perceived to benefit them the most, hence the theme ‘Influences of others and personal opinion’. All the amateur and one professional participant considered ‘The reason for their perceived benefits’ to be purely because of other opinions and influences.

Table 6. Similarity of warm-up protocol

High order themes	Number of responses		Select raw data representing responses to the question
	A	P	
Similar	4	0	-‘Everything really, I think even the way it’s run, so from having a little bit of a jog, maybe when you were younger, bit more of a half lap then a full lap, and then you go into your static stretching that’s led by your coach. Then you go into your run through just to make sure everyone’s knows what you’re doing’. (Amateur)
Different	0	4	-‘I’d say from when you just start in under 8s, all round warm-up, is just like get a ball between you and go running up and down and that’s it, and then your straight into training or a game. Obviously the older you get and the more professional clubs you go to the warm-up’s get longer and specific’. (Professional)

Table 7. The reason for perceived benefits

High order themes	Number of responses		Select raw data representing responses to the question
	A	P	
Influences of others	3	1	<p>-‘Yeah all mine are pretty much based upon what I’ve just been told from a young age’. (Amateur)</p> <p>-‘I’d say it’s the physios and conditioners. At first you don't know what the warm-ups are, but once your physios and conditioners have told you what they are for, then you learn of them really when they tell you’. (Professional)</p>
Influences of others and personal opinion	1	3	<p>-‘You go to training and the coach gets you to do static warm-ups, jogs and dynamic warm-ups, but as you get older, I think things like experience. If you don't get a full warm-up in you will feel more stiff the next day and you will feel it in your body and then you will remember that you have got to do your warm-up properly you've got to get everything in’. (Amateur)</p> <p>-‘Obviously the coaching staff and the conditioning coaches and physios and everything like that. Obviously you pick things up yourself as well, you know what’s better for you and things like that’. (Professional)</p>

Discussion

To the authors knowledge this is the first study to investigate both professional and amateur Rugby League players warm-up protocols and their perceptions behind their practices. It was discovered that a significant proportion of amateur and professional players currently perform a less than optimal warm-up protocol in relation to evidence-based and theoretical recommendations (12,18,34,36). A high prevalence of static stretching was also observed within both professional and amateur player protocols, which contradicts the observations of Pratt (33) that static stretching has been removed from the warm-up regimes of various major sports.

Based on the questionnaire responses there was a significant difference in warm-up duration between the two standards, with professionals' warm-up protocols being generally longer in duration in comparison to amateurs. This may be due to more organised and detailed structuring of training practices at the professional level (16). This notion is supported by the focus group responses made by the amateur participants, describing that their warm-up protocol can be unorganised on occasions. In addition, physiological demands of match-play have been shown to be higher at the professional level, therefore potentially justifying a longer warm-up protocol (16). Professional participants were more concise when describing the duration of their warm-up protocol. All four focus group professional participants recorded their warm-up to last between 20-30 min, this warm-up duration may detrimentally affect certain performance factors notably speed (34). Pringle et al. (34) recorded significantly

faster 40 m sprint times within elite Rugby League players performing a 16 min high intensity warm-up compared to when they performed a lower intensity 22 min warm-up (5.26 s v 5.34 s, $P = 0.033$). The authors concluded, that a warm-up high in intensity and a maximum of sixteen min in duration will benefit the athlete due to an increase in core temperature and blood flow to the musculature (12,34,42). In addition, Frikha et al. (14) discovered that an active warm-up of 15 min resulted in significantly greater peak power and mean power in the Wingate test compared to an active warm-up lasting 20 min. These studies provide rationale for the warm-up duration of ~15 min.

In total 81 of 83, Rugby League players, took part in a preparatory activity before the main body of a warm-up protocol. Accordingly, this is considered an essential element of a warm-up protocol (44). However, through further analysis of professional and amateur player protocols via the focus groups, it was apparent that all but one of the amateur players took part in simple jogging activities as a preparatory activity whereas, the professional players incorporated a ball handling drill into their preparatory activity. The implementation of a ball handling drill, whilst simultaneously running at a submaximal pace, may have additive benefits to essential coordination patterns needed for a complex sport such as Rugby League, in addition to the desired effect of increasing core temperature (6,16,18,34,42). This is in accordance, with recommendations regarding the inclusion of skill based 'pulse raising' activities at the initiation of a warm-up protocol (20).

It was apparent that both standards included key Rugby related drills within

their warm-up protocols and that static stretching is still highly prevalent in both standards, therefore, against the notion that static stretching has been removed from major sports (33). The questionnaire and focus groups highlighted the similarity of the ordering of the dynamic and static procedures of a warm-up protocol in both standards. The dynamic element of the warm-up was more consistently placed before the static stretching element. Then subsequently sport-specific Rugby League practice would commonly follow static stretching. Research has identified that static stretching can have a detrimental effect on certain physical attributes such as strength, power, speed and agility (8,9,23,29,32,37,42). However, when a warm-up including static stretching is followed up by a dynamic stretching, the impairments created by static stretching may be reduced (7,37). Hence it would be advised that if Rugby League players perform static stretching, this should be performed prior to dynamic stretching, which is obviously contrary to practices adopted by the majority of the present study's cohort. Furthermore, inclusion of high intensity potentiating activities to conclude a warm-up, may offer benefit to subsequent high intensity actions, such as sprinting, during a Rugby League training session (18,36). However, none of the eight interviewed players, within the focus group cohort, reported inclusion of such activities within their warm-up protocols. High intensity actions such as short distance sprints or low volume jumps have been suggested as appropriate 'potentiate' drills to prescribe within a warm-up protocol and have been shown to have positive effects on sprint and jump performance (18,20,36).

The questionnaire results demonstrated that most of the amateur and professional

Rugby League players attributed to holding static stretches for no longer than 15 s. This short static stretch duration has been considered to reduce the potential performance impairments caused by longer duration static stretching, and may also improve essential ranges of movement needed in a game such as Rugby League (33,41). However, from the focus groups it was apparent that several professional and amateur players performed repeated sets of 10-15 s static stretches. Therefore equating to an overall extended static stretch volume duration per muscle group. This volume and duration of static stretching may impair desirable attributes Rugby League players require such as speed and power (8,9,16,23,29,32,34,37,42).

Both the focus groups and questionnaire found a similarity between the two separate standards regarding the primary perceived benefit of a warm-up which was 'Injury prevention'. Since static stretching was highly prevalent within the warm-up protocol of study's cohort: the questionnaire participants may reason this part of warm-up is paramount to reducing the risk of injury. This notion is further supported by focus group responses. However, research indicates that static stretching prior to performance does not reduce injury prevalence, despite positive effects on range of motion (1,13,19,31,41). Even though 'Injury prevention' was the most popular chosen predominant benefit from the questionnaire responses, the focus groups highlighted that all four themes within the 'Perceived benefits of warm-up' dimension were each perceived to offer benefit by several players.

Although no significant difference was found from the questionnaire responses regarding whether players believed their

warm-up protocol had changed throughout their playing career, there was a proportionate difference between the two standards (professional 60% vs amateur 42%). In addition, within the focus groups all four professionals attributed their protocols to have changed over their playing career, whereas all four amateurs reasoned that protocols have stayed similar. This trend for difference between the two standards warm-up protocol throughout their career may be due to the influences of others (support staff), which is supported by both the questionnaire and focus group; General dimension – ‘The reason for perceived benefits’. Both standards believe that their perceptions are based upon the opinions of others (i.e. Rugby League coach, Strength and Conditioning coach). This is supported by the literature (2,24) which suggests that the beliefs of a coach sculpts and influences a player’s personal thoughts and beliefs. Although the study’s findings indicate some suboptimal approaches within professional players warm-up protocol as previously mentioned, their warm-up protocol seemingly changes more readily than that of amateur players. This may be due to influence and adaption of practices via a wider range of professional practitioners which are generally employed in higher numbers at the professional level (16,34,36).

A limitation of the study is the larger number of amateur players (n = 53) who completed the questionnaire in comparison to the number of professional participants (n = 30). This was due to the difficulty in contacting professional players and clubs. However, 30 participants is comparable to previous survey cohorts of athletes and coaches (17,40). Hence this number of participants was deemed sufficient to interpret inferences from the

obtained questionnaire responses. A potential limitation within the focus groups may have been the influences the participants had on one another’s answers. Interindividual influences on observed answers have been reported to occur within focus groups (32). However, the data gathered from the focus groups demonstrated a significant amount of personal opinion. The authors recommend that further research needs to be carried out on the warm-up protocols of other major sports, to identify whether the findings of the present study are also prevalent across other sports.

In conclusion, this study explored the warm-up practices and perceptions of both professional and amateur rugby league players. There was a significant difference in the duration of warm-up adopted between the two standards, with professionals adopting a longer warm-up protocol. Although no other significant differences existed from obtained questionnaire responses between the two standards, a notable trend for difference within the results existed for ‘Similarity of the warm-up protocol over career-span’, which was further supported by the thematic discussion from the focus groups. Obtained responses, emphasise the high prevalence of static stretching during warm-up at both professional and amateur levels, which contradicts the notion that static stretching has been removed from warm-up protocols of many major sports such as Rugby League. The findings indicate that various suboptimal aspects are being practiced by players regarding evidence-based protocol design, notably regarding the order of stretching practices, with static stretching being commonly performed directly before sport-specific practice.

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