

Prevalence and implementation of small-sided games in rugby union: a preliminary survey study

Koen Wintershoven^{1*}, Christopher Martyn Beaven¹, Nicholas David Gill^{1,2}, Daniel Travis McMaster^{1,3}

¹Te Huataki Waiora School of Health, University of Waikato - Adams Centre for High Performance, Tauranga, New Zealand

²All Blacks, New Zealand Rugby Union, Wellington, New Zealand

³All Blacks & Black Ferns Sevens, New Zealand Rugby Union, Wellington, New Zealand

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ABSTRACT

Small-sided games (SSG) are popular in team sports training because they are thought to promote physiological, kinematic, and tactical benefits. Researchers in the football codes often use this as a rationale for conducting SSG-related investigations. However, the prevalence of SSG has not been scientifically documented in rugby union (RU). Therefore, the purpose of this study was to examine the prevalence of SSG in RU and develop understanding of how SSG are implemented in RU practice. An anonymous, multiple-choice electronic survey including a proposed consensus definition was dispersed globally through email and several social media platforms. The survey was launched and re-distributed six times at regular intervals over a one-year period. One hundred and fifteen responses were collected from various RU coaching strata. The respondents ratified the proposed definition, identifying SSG as modifiable methods representative of the full game, which can be used to target various training outcomes. Ninety-nine percent of survey participants used SSG. The largest cohort was characterised by ≥ 5 years of coaching experience ($n = 76$; 66% of sample) in New Zealand ($n = 89$; 77%), fulfilling the role of head coach ($n = 61$; 53%) to male RU players ($n = 79$; 69%). Eighty-five percent of coaches ($n = 98$; 85%) reported using SSG every 1 to 3 sessions. 3v3 (top 1) and 5v5 (top 3) were the most popular formats. These formats were used to improve technique ($n = 30$; 26%) and promote fun ($n = 29$; 25%). SSG are widespread and frequently used by New Zealand RU coaches through involving different numbers of players. RU staff have a uniform conceptual understanding of SSG. The implementation of SSG is related to coaching roles. Meaningful differences in the implementation of SSG are plausible in RU practice depending on playing levels, coaching experience, player sex, and geographic location.

1. Introduction

Small-sided games (SSG) are modified versions of team sports, or non team sport-specific games, lauded and prescribed for their potential to concurrently enhance physiological, technical, tactical, as well as social qualities in a sport-specific manner (Aguiar et al., 2012; Davids et al., 2013; Fernández-Espínola et al., 2020; Gabbett et al., 2009a; Hammami et al., 2017; Kinnerk et al., 2018). Interest in SSG has increased in the last two decades as evidenced by the body of research examining SSG for general

use and in specific sports. Rugby union (RU), however, remains understudied in this research area (Aguiar et al., 2012; Bujalance-Moreno et al., 2018; Fernández-Espínola et al., 2020; Gabbett et al., 2009b; Halouani et al., 2014; Hammami et al., 2018; Harrison et al., 2015; Hill-Haas et al., 2011; Impellizzeri et al., 2006; Kinnerk et al., 2018; Sarmento et al., 2018).

Researchers in a variety of sports, including basketball, lacrosse, handball, Gaelic football, volleyball, soccer, and RU and league have consistently alluded to the popularity of SSG in training practice. This notion of common practice-based use has

*Corresponding Author: Koen Wintershoven, Te Huataki Waiora School of Health, University of Waikato - Adams Centre for High Performance, NZ, koenwintershoven@gmail.com

in fact generally served as a prelude to the scientific rationale for examining SSG outcomes (Abrantes et al., 2012; Belka et al., 2017; Conte et al., 2017; Gabbett, 2008; Gabbett et al., 2010; Hauer et al., 2018; Mangan et al., 2019; Weakley et al., 2019). The evidence shows that SSG generally improve various fitness, skill, and tactical markers (Hammami et al., 2017; Kinnerk et al., 2018). Yet the quantitative data available is not definitive on all accounts (Kinnerk et al., 2018), nor do SSG replicate match intensities in all contexts (Tee et al., 2016). Incorporating the specific performance context might mitigate the documented discrepancy between training and match demands (Campbell et al., 2018; Hartwig et al., 2011; Tee et al., 2016) in the pursuit of planned success (Tee et al., 2018).

RU is a highly demanding, physical, tactical, and skill-based team sport, which taxes all energy systems and requires a complete and position-specific movement arsenal (Deutsch et al., 2007; Duthie et al., 2003; Hogarth et al., 2016; McLean, 1992). Rugby competition is characterised by long-duration games (80 minutes), consisting of repeated intermittent bouts of short-duration high-intensity effort, interspersed with longer periods at lower intensity (Austin et al., 2011; Hogarth et al., 2016). The specific game demands consist of a multitude of activities including running, passing, tackling, mauling, kicking, jumping, and scrummaging (Deutsch et al., 2007).

The body of knowledge regarding rugby union SSG (SSG^{RU}) is still in its infancy, with only a limited number of studies focusing on the RU-specific population. Within this specific performance-context, the efficacy of SSG^{RU}, their design and constraint-factors, and the influence of player characteristics and feedback on internal and external loading, have been investigated (Chadwick et al., 2019; Gamble, 2004; Kennett et al., 2012; Taylor et al., 2020; Tee et al., 2016; Vaz et al., 2015; Vaz et al., 2016; Vaz et al., 2012; Weakley et al., 2019). The scarcity and heterogeneity of these studies severely limits inferences about the RU population regarding SSG. The presupposition of widespread use, as a scientific rationale, is in line with that of other team sports. However, here too, scant evidence of SSG^{RU} prevalence, or details of its usage in RU training practice are in fact available (Hogarth et al., 2016; Zanin et al., 2021). Moreover, Thomas and colleagues (2013) have shown that the on-field application of effective game-based training can be more challenging than the literature suggests; the inclusion of these training methods into practitioners' arsenals might not be self-evident. Thomas et al. (2013) suggest anchoring SSG into coaches' education through peer-based support, to ensure effective implementation (Thomas et al., 2013).

Despite the potential application of SSG to specific performance contexts, and the claims made about the widespread use of SSG in RU, the lack of evidence regarding its actual practice-based prevalence and implementation impinge on an evaluation of SSG^{RU} real-world efficacy. Clearly, evidence-based, effective application of SSG could provide important technical, tactical, and physical benefits, within specific performance contexts in RU. The purpose of this study was therefore to establish an understanding of the actual current application of these training forms to RU practice, and to identify differentiating factors within its implementation, as well as potential asynchrony with the literature. In so doing, optimisation can be sought for the application of SSG^{RU}, relative to their specific performance contexts.

2. Methods

This study entails descriptive research regarding the prevalence and implementation of SSG within the population of RU practitioners through stratification of the sample (n = 115) into various cohorts (Table 3). To this end, a questionnaire was developed according to methodological good-practice procedures for the development of surveys (e-survey), provided by Portney and Watkins (2009), as outlined below (Portney & Watkins, 2009).

2.1. Developmental procedure

The delineation of the research question was addressed by drafting six guiding questions to help direct the setup of the investigation (Table 1). These guiding questions were complemented by six hypotheses (Table 2), capturing the expected study outcome(s). The translation to a questionnaire outline was bound to the options available in the Qualtrics Online Survey Software (Qualtrics, 2019). Portney and Watkins (2009) was consulted regarding the identification and selection process of instruments (Portney & Watkins, 2009).

Qualtrics Survey Software was selected for methodological convenience and global reach. The design of the instrument was guided by the Qualtrics software workflow (Qualtrics, 2019). All preliminary drafts were presented to all co-authors for review and adjustments were made through discussion. Upon consensus, the pilot survey was presented to six peers, i.e., sport science researchers and coaches involved in RU, for testing and revisions. Feedback was incorporated to finalise the e-survey.

Table 1: Guiding questions for formalising the research question

Guiding questions
1. How widely spread is the use of SSG in RU training practice?
2. What are SSG ^{RU} generally used for in RU training practice?
3. How frequently are SSG used in RU training practice?
4. Which SSG ^{RU} formats are most popular?
5. What are the specific conditioning goals SSG ^{RU} are used for in training practice?
6. Is there a relationship between RU coaching characteristics and the interpretation and implementation of SSG ^{RU} ?

Table 2: Research question hypotheses

Hypotheses

1. SSG are used on every level in RU training practice.
2. SSG are used for multiple reasons, including match-specific conditioning, game skills development and fun experience/ motivation.
3. SSG are used more frequently with rising playing level.
4. Mid-range SSG (5v5 – 9v9) are most frequently used.
5. Match-specific aerobic conditioning is the main conditioning goal when applying SSG in RU training practice.
6. Implementation and interpretation of SSG in RU will be dependent on coaches' characteristics.

The final survey consisted of 24 multiple-choice questions, in which click-to-select for pre-formulated absolute or categorical options, drag-and-drop for top-x choice, sliding scale formats for percentages, and "Other" input boxes were provided, adhering to best-practice survey methodology (Portney & Watkins, 2009); ease of use (PC/smartphone), visual appeal, duration, and a uniform, yet non-identical ranking (randomisation) of available responses were built in. Multiple replies were possible for selected questions (e.g., top 5). The survey structure aimed at creating flow by first addressing simpler, participant-differentiating information, systematically followed by more topic-specific questions. Informed consent was integrated, and ethical approval was obtained through an institutional ethics committee (HREC[Health]2019#15). The survey concluded with an optional declaration of additional information.

2.2. Dispersion

RU coaching staff were selected as the target population, i.e., practitioners involved in the delivery of training to RU players. Initial dispersion was done on 07/08/2019, through email lists and social media (Facebook, Twitter, and LinkedIn) available from region coaches and staff involved in RU across a broad range of coaching levels. In addition, RU governing bodies, individual clubs, universities, and schools were randomly targeted via email in New Zealand, Australia, Argentina, South Africa, United Kingdom, mainland Europe, and Japan. These emails were re-distributed six times on a regular basis over the course of one year.

2.3. Analysis

Qualtrics Online Software was used for data processing. Primary results were reported descriptively, based on a selection of outputs; absolute total (participants or choice) counts, and percentages of total survey sample size or relative to substrata. Mean \pm SD were reported where appropriate. To identify any statistically significant relationships ($p \leq 0.05$), crosstabs were formed, and Pearson's Chi-squared test (χ^2) was run and reported with degrees of freedom (D_f). Cramér's V Effect Size [ES] was included for practical interpretation of the results. A 95% confidence interval (CI) was also reported for within category-comparison using the Wilson Score interval. For further analysis, including top one, two, and three sum choice count, and graphical outputs, data were exported to a Microsoft Excel 2016 spreadsheet.

3. Results*3.1. Definition*

The definition provided to the survey participants in order to establish an integral baseline understanding, referred to SSG^{RU} as: "Any modified version of the full game of rugby (15 v 15), whereby through alteration of design variables like player number, playing area, time, and rules, a specific training outcome is pursued. The games should still be identifiable as rugby-related (rugby ball, contact, basic plays)." All but one survey respondent (99%) agreed entirely with this definition. A single coach (1%) agreed with the definition but felt that it needed to include reference to the "constraints-based" approach and "ecological dynamics".

3.2. Sample characteristics

One test case and 115 responses ($n = 115$) were collected over a twelve-month period. Ninety-five respondents were still actively coaching. Eleven respondents coached on the international level, 7 professionally (e.g., Super Rugby, Pro14), 19 at national level, 34 locally, and 44 coached school teams. Of these respondents, 61 participants identified as head coach, 24 as strength and conditioning coaches, 19 as assistant coaches, and 2 as sport scientists. Nine identified as "other", including a combination role, director of rugby, and school rugby coach. Mean coaching experience was 4.0 ± 1.2 years. Respondents had predominantly been active in New Zealand and Europe. A minority had coached in North and South America, Africa, Australia, or Asia. No responses were received from the Pacific islands (PI). One respondent coached on several continents. The sample distributions regarding coaching level and role, experience, location, and age-based target group are reported in Table 3. Seventy-nine respondents coached male rugby union players (69%), whereas five coached female players (4%). The remaining 31 respondents coached both sexes (27%).

3.3. SSG prevalence

No statistically significant relationships were found between frequency of SSG implementation in RU and playing level, coaching experience, player sex, or geographical location. Nor were any of the player age categories statistically significantly related to SSG frequency. There was however a strong relationship with staff role (Table 4). Eighty-five percent of

Table 3: Distribution of respondents by strata characteristics (n)

Coaching level	International		Professional		National		Local		School
	11		7		19		34		44
Coaching position	Head coach		Assistant		S&C		Scientist		Other
	61		19		24		2		9
Experience (years)	<1		1-3		3-5		5-10		>10
	2		16		21		22		54
Geographic location	NZ	Aus	Eur	Asia	Afr	SA	NA	PI	Multiple
	89	2	13	1	3	1	5	0	1
Age target group	U6	U8	U10	U12	U14	U16	U18	U21	Seniors
	7 [#]	12 [#]	22 [#]	32 [#]	25 [#]	21 [#]	39 [#]	19 [#]	39 [#]

Note: S&C = Strength and Conditioning coach; NZ = New Zealand; Aus = Australia; Eur = Europe; Afr = Africa; SA = South America; NA = North America; PI = Pacific islands; U(x) = Under (age group); # Of total 'choice count' (n = 216): multiple categories optional.

respondents (n = 97) reported using SSG regularly to very often, i.e., every one to three sessions. Only one school-level coach reported to be a non-user; thus, 99% of respondents reported using SSG in RU (Figure 1). Most international coaches (55%) used SSG every two to three sessions. Of the professional coaches, equal numbers (43%) used SSG every session and every two to three sessions. Forty-two and 47% of national-level coaches reported use of SSG every session and every two to three training sessions, respectively. The majority (71%) of local practitioners used SSG every session. School rugby coaches mostly used these training forms every session (41%), or every two to three sessions (41%) (Figure 3). With 44% (CI [31-57%]), local-level coaches were significantly overrepresented within the cohort of most frequent SSG users, whereas they were underrepresented with 14% (CI [7-28%]), in regular SSG use ($p \leq 0.01$).

Stratification by coaching experience for frequency of SSG implementation shows a practically meaningful ES (Table 4), indicating nuance between categories (Figure 4). Fifty-six percent of coaches with more than ten years of experience applied SSG every session, most often. In contrast, inexperienced coaches did not use SSG every session. Rather, they were inclined to a more

moderate use. Often and regular SSG use thereafter rises with mounting experience, to 83% by ten years of experience. These most experienced coaches are statistically underrepresented (9% [CI: 2-38%]) for moderate frequency SSG use ($\geq 1/5$ sessions) ($p \leq 0.01$), whilst those with 3 to 5 years of experience have significantly higher values (46% [CI: 21-72%]) than typical within this frequency category ($p \leq 0.05$).

Differences are evident between specific staff; 61% [CI: 48-72%] of head coaches applied SSG every single session, which is significantly more often than coaches in other roles ($p \leq 0.01$). Consequently, head coaches form 67% of the total amount of very frequent SSG users. This is compensated by an atypical low proportion of head coaches (28% [CI: 18-40%]) using SSG "regularly" ($p \leq 0.05$). The opposite was observed with strength and conditioning coaches [CI: 43-79%], 63% of which implemented SSG at least once per three training sessions, which is more than typical ($p \leq 0.01$). However, an atypically low value of 21% [CI: 9-41%] was found for every session-use ($p \leq 0.01$) within this role. Forty-two percent of assistant coaches used SSG training "very often" and 42% used it "regularly" [CI: 23-64%].

Table 4: Relationship between population sample characteristics and SSG prevalence

		Chi²	Df	p		[ES]
Playing level		21.00	16	0.179	0.214	Medium
Coaching experience		21.60	16	0.157	0.217	Medium
Staff role		49.00	16	<0.001*	0.326	Large
Player sex		7.57	8	0.477	0.181	Medium
Geographical location		23.60	28	0.700	0.227	Medium
Player age	U6	0.89	4	0.926	0.088	Small
	U8	1.18	4	0.881	0.101	Small
	U10	7.17	4	0.127	0.250	Medium
	U12	1.99	4	0.737	0.132	Small
	U14	5.31	4	0.257	0.215	Medium
	U16	5.10	4	0.277	0.221	Medium
	U18	1.94	4	0.747	0.130	Small
	U21	3.60	4	0.463	0.177	Medium
	Seniors	1.41	4	0.843	0.111	Small

Note: *statistically significant relationship

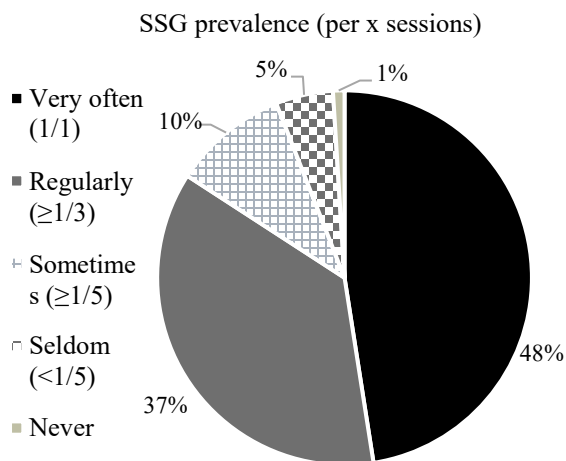


Figure 1: SSG prevalence (% respondents)

SSG formats were applied to all athlete age groups. One to two-thirds of coaches used SSG every training session within their respective target age group (Figure 5). Statistically different values were only seen in U10 coaches, who demonstrated disproportionately higher values for “seldom”, and lower values for “regular” SSG implementation than expected ($p \leq 0.05$). The lowest proportion of very often-users (36%) was found for U14 coaches. SSG usage every one to three sessions seemed to fall from U10 to U14 ($\leq 81\%$), when compared to 83 to 95% of coaches in other age categories. U21 coaches (95%) had the highest proportion of prevalent SSG users. In contrast, U10 and U14 (14% and 12%) coaches were most prone to never or barely apply SSG in training practice.

Practically meaningful distributional differences were noted for SSG implementation to players of different sexes (Table 4); 91% of respondents who worked with both male and female athletes implemented SSG at least once per three training sessions. In comparison, 84% of the cohort exclusively coaching males, and 60% of those solely coaching females used SSG “very often” or “regularly”.

No statistically significant differences were found for SSG prevalence in relation to geographic location. The following practical prevalence-ranking for SSG application (“very often” and “regular”, respectively) was observed for coaches active in; Africa (67% and 33%), Europe (54% and 46%), New Zealand (47% and 36%), North America (60% and 20%), and Australia (50% both). One survey participant active on several continents, and one in Asia, reported using SSG every two to three training sessions. Two of four coaches active in Australia, and two in South America declared having used SSG once every five sessions only.

3.4. SSG Application

The application of game-based training, in general, served multiple purposes according to RU staff (Figure 2). To pursue these aims using a single format, 3 v 3 was elected most frequently. Further in-depth questioning of participants showed 5 v 5, 3 v 3, and 7 v 7, in that order, to be preferred, when allowing for a top-JSES | <https://doi.org/10.36905/jses.2023.01.01>

three choice. Skill development, general aerobic and specific match conditioning were identified training goals of SSG. In addition, 1 v 1 was most preferred in terms of skill development, whilst 10 v 10 was applied almost equally for general aerobic, specific match conditioning, and skill improvement. A detailed view on all game formats is available in Appendix 1.

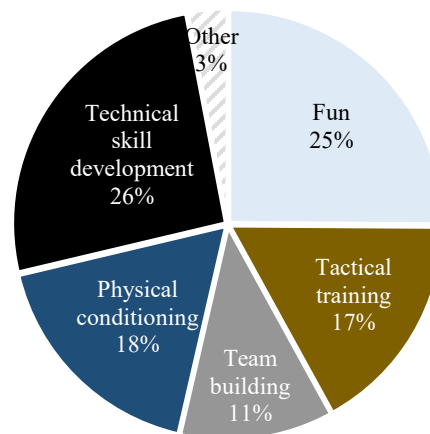


Figure 2: SSG training purpose in RU (% respondents)

4. Discussion

The widespread use of SSG in RU practice is an accepted notion amongst researchers, whilst SSG^{RU}-related research remains scarce. The evidence for this notion seems solely grounded in anecdote, at best referencing prior studies with similar statements. This study verifies these claims for the first time and maps out the practical application of SSG. The authors put forward, for the first time, a comprehensive RU-specific definition for SSG, which was virtually unanimously ratified by all participants.

Information was collected from coaches representing every level of play. Within the collected sample, school and local coaches accounted for over half the survey responses. This majority exemplifies the truism that more coaches are active on the lower levels of RU, as it is self-evident that more amateur than professional players participate throughout societal strata (World Rugby, 2020). The survey sample also shows RU staff are active worldwide, in line with RU’s global impact (World Rugby, 2020, 2021). A disproportionate return of survey responses from New Zealand, and in the second instance European-based coaches, might reflect geographical differences. This perceived imbalance might be symptomatic of the smaller role RU plays in other parts of the world, relative to other sports (*Biggest Global Sports: A statistics-based analysis of the world's most popular sports 2021*; TOTALSPORTEK.COM, 2021). Absolute population, socio-economic factors, and absolute numbers of participation (e.g., Pacific Island nations) could also play a role in the selective survey return. In contrast, when looking at the delivery across targeted age groups, coaching staff were more evenly distributed.

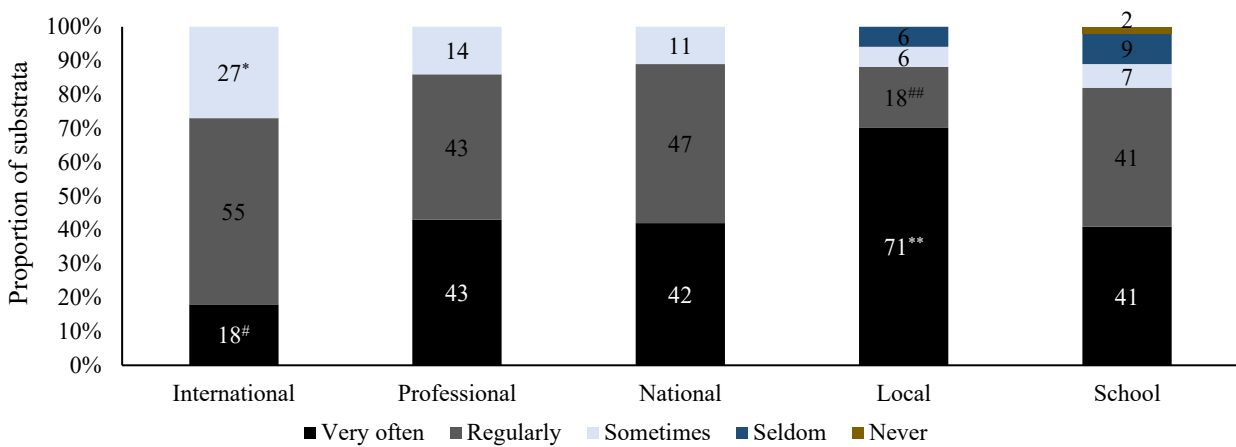


Figure 3: Playing level-dependent SSG use (% of substrata); significantly higher (^{**}), lower (^{##}) than typical ($p \leq 0.05$ / $p \leq 0.01$)

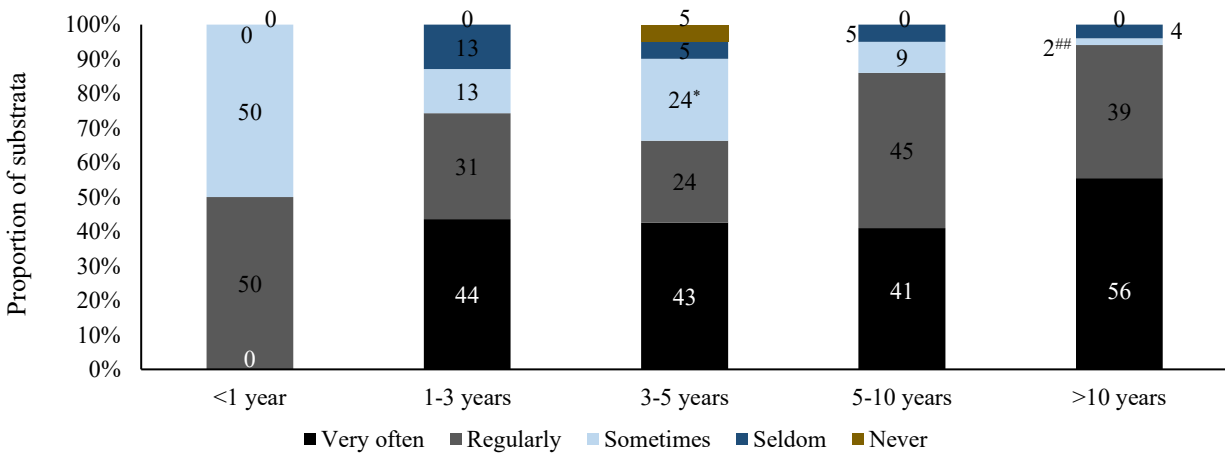


Figure 4: Coaching experience-dependent SSG use; significantly higher (^{**}), lower (^{##}) than typical ($p \leq 0.05$ / $p \leq 0.01$)

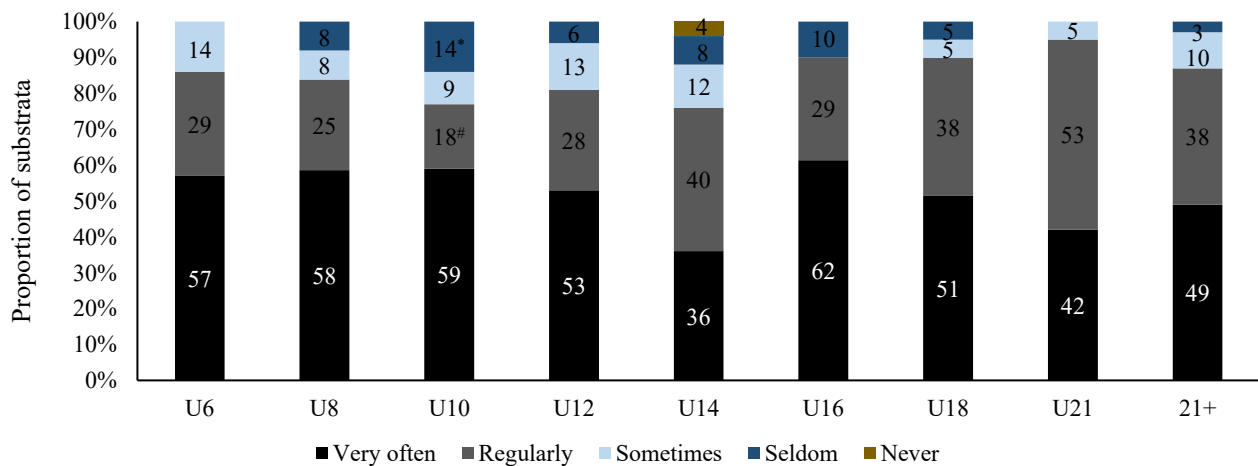


Figure 5: Age group-specific SSG use (% of substrata); significantly higher (^{**}), lower (^{##}) than typical ($p \leq 0.05$ / $p \leq 0.01$)

The results show SSG^{RU} are an every session staple for almost half the respondents. Only a small minority of practitioners (6%) implemented these training forms infrequently. Despite there being no clear relationship, RU coaches seem to favour the use of SSG increasingly throughout their careers; more experienced coaches implement this method more often. This observation is consistent with the notion that novice coaches take time to grow into the use of SSG (Kinnerk et al., 2018). A mentorship-approach has consequently been proposed to optimise the integration of game-based training methods in starting coaches (Kinnerk et al., 2018). As staff role strongly relates to SSG prevalence, it is of note that head coaches reported the highest amount of every session SSG use (61%), compared to other roles. This was also seen for practitioners operating on the local level (71%). As such, local-level and head coaches are the cohorts with the highest proportion of most frequent SSG use, within playing level and role-based stratification (44 and 67%, respectively).

The proclivity of head coaches to use SSG more frequently might be related to a larger array of responsibilities compared to other staff, thus selecting a more generalised and game-minded approach. The level-dependency is hypothesised to be due to necessity, belief favouring potential efficiency, and motivational efficacy with amateur players. Additionally, on the local level, rugby staff specialisation would be less likely. Aside from locally operating coaches, and based on slightly lower frequency (i.e., minimally once per three sessions), SSG prevalence was similar across all levels. Regardless of player age, SSG were most often implemented every training session. A slight drop in sessional SSG-application with older players might indicate more practice is directed towards compartmentalised and specialised drills. In contrast, 'fun experience' might be emphasised more in youth RU. The higher degree of frequent SSG usage observed in coaches working with both sexes and males as compared to female players exclusively, is noteworthy. Practically meaningful differences might exist. More evidence is needed to establish potential statistical differences.

Coaches indicated that this game-based training methodology is important to them for pursuing technical development and fun-experiences, especially. Player motivation and enjoyment has been found to be superior when employing SSG (Kinnerk et al., 2018). Greater engagement might consequently lead to better training outcomes. These training outcomes were identified to be differentially related to specific game formats (Appendix 1); the larger the game format, the more it was used for general and match-specific conditioning, whereas smaller game formats were employed for technical development. In view of the importance of the anaerobic component in rugby performance, practitioners need to consider repeated high-intensity efforts (Austin et al., 2011; Duthie et al., 2003). To that end, coaches used large-sided games (LSG) less than SSG to target repeated sprint ability. It is furthermore remarkable that no specific format was reserved for recovery purposes. In general, the variety of SSG^{RU} formats implemented seems to centre around 3-, 5-, and 7-a-side, complemented by individual settings (1 v 1) and LSG (10 v 10). The data cumulatively shows certain trends exist in training practice, and indicate that among RU coaches, SSG are perceived as multi-purposeful, in accordance with the literature (Bujalance-Moreno et al., 2019; Davids & Araújo, 2010; Davids et al., 2013; Davids et al., 2012; Fernández-Espínola et al., 2020; Ford et al.,

2009; Gabbett et al., 2009a; Hammami et al., 2017; Harrison et al., 2015; Hoff et al., 2002; Kinnerk et al., 2018; Kirk & MacPhail, 2002; Ward et al., 2007). Increases in technical skill and fun seem to be targeted primarily by coaches.

This survey identified a wide range of participants. The collected demographics allowed for the classification into a variety of substrata, within which specific emphasis exist for SSG implementation. Experienced New Zealand-based head coaches were the most prevalent. Game-based training was predominantly used to improve technical skill and fun, and applied most commonly with (young) adult male RU players. This study provides evidence indicating that SSG^{RU} are used frequently in New Zealand and likely in Europe. The results show that game-based training is prevalent throughout the developmental pathway, on all levels of play. Therefore, we can affirm the plausible and frequent claims in the football codes literature, that to date have been anecdotal and empirically practice-based, yet scientifically unsubstantiated (Abrantes et al., 2012; Aguiar et al., 2013; Dellal et al., 2011; Fleay et al., 2018; Mangan et al., 2019; Owen et al., 2012; Vaz et al., 2016). Considering the surge in research regarding SSG in the football codes (Bujalance-Moreno et al., 2019; Fernández-Espínola et al., 2020; Hammami et al., 2017; Hill-Haas et al., 2011; Reilly & Gilbourne, 2003; Sarmiento et al., 2018), a factual perspective on practice-based SSG^{RU} usage is indispensable. To our knowledge, this survey is the first to quantify SSG prevalence in RU.

5. Conclusion

This study identified the use of SSG by rugby union practitioners. To the authors' knowledge, this is the first survey investigating the application of SSG in rugby union training practice. Rugby union staff agreed with the proposed definition of SSG and provided evidence of its use. SSG are prevalent throughout age groups and playing levels in New Zealand rugby union. The use of SSG with various target groups is differentiated by practitioners' characteristics. SSG implementation is dependent on staff role and practically meaningful differences might exist for playing levels, coaching experience, player sex, and geographic location; head coaches and coaches in local competitions implement SSG most frequently. Skill enhancement and enjoyment are important reasons for which practitioners apply SSG, which commonly incorporate between three to seven players a side. To optimise rugby union training, a larger body of evidence is required for establishing a more definitive evidence-based perspective on the existing differences in SSG application.

6. Key points

- Point 1 – RU coaches interpret SSG similarly and are adherent to RU-specificity when implementing SSG.
- Point 2 – SSG are used across all levels of play and age groups in RU-practice.
- Point 3 – Skill and fun are important drivers for the use of SSG and differences in SSG-implementation are cohort-dependent.

7. Limitations

Despite extensive exposure through several electronic platforms, a disproportionate proportion of survey responses was from New Zealand, and in the second instance Europe. Consequently, the findings may not generalise beyond those geographic cohorts. Furthermore, the range of respondents within strata might not fully represent experience, role, target group, or playing level. This should be considered when interpreting the results, making inferences, and extrapolating.

Conflict of Interest

The authors declare no conflict of interests.

References

- Abrantes, C. I., Nunes, M. I., Maçãs, V. M., Leite, N. M., & Sampaio, J. E. (2012). Effects of the number of players and game type constraints on heart rate, rating of perceived exertion, and technical actions of small-sided soccer games. *Journal of Strength and Conditioning Research*, 26(4), 976-981.
- Aguiar, M. V., Botelho, G., Lago, C., Maças, V., & Sampaio, J. (2012). A review on the effects of soccer small-sided games. *Journal of Human Kinetics*, 33, 103-113. <https://doi.org/10.2478/v10078-012-0049>
- Aguiar, M. V., Botelho, G., M., Goncalves, B., S., & Sampaio, J., E. (2013). Physiological responses and activity profiles of football small-sided games. *Journal of Strength and Conditioning Research*, 27(5), 1287-1294. <https://doi.org/10.1519/JSC.0b013e318267a35c>
- Austin, D., Gabbett, T., & Jenkins, D. (2011). Repeated high-intensity exercise in professional rugby union. *Journal of Sports Sciences*, 29(10), 1105-1112. <https://doi.org/10.1080/02640414.2011.582508>
- Belka, J., Hulka, K., Machova, I., Safar, M., Weisser, R., Bellar, D. M., . . . Judge, L. W. (2017). Effects of environmental context on physiological response during team handball small sided games. *International Journal of Exercise Science*, 10(8), 1263-1274.
- Biggest Global Sports: A statistics-based analysis of the world's most popular sports* (2021). <http://www.biggestglobalsports.com/>
- Bujalance-Moreno, P., Garcia-Pinillos, F., & Latorre-Roman, P. A. (2018). Effects of a small-sided game-based training program on repeated sprint and change of direction abilities in recreationally-trained soccer players. *The Journal of Sports Medicine and Physical Fitness*, 58(7-8), 1021-1028. <https://doi.org/10.23736/S0022-4707.17.07044-X>
- Bujalance-Moreno, P., Latorre-Roman, P. A., & Garcia-Pinillos, F. (2019). A systematic review on small-sided games in football players: Acute and chronic adaptations. *Journal of Sports Sciences*, 37(8), 921-949. <https://doi.org/10.1080/02640414.2018.1535821>
- Campbell, P. G., Peake, J. M., & Minett, G. M. (2018). The specificity of rugby union training sessions in preparation for match demands. *International Journal of Sports Physiology & Performance*, 13(4), 496-503.
- Chadwick, L., Page, R. M., & Langley, B. (2019). Quantifying the physical demands of small sided games in rugby union: contact vs. non-contact. *Central European Journal of Sport Sciences and Medicine*, 26(2), 5-13.
- Conte, D., Favero, T., Niederhausen, M., Capranica, L., & Tessitore, A. (2017). Effect of number of players and maturity on ball-drills training load in youth basketball. *Sports*, 5(3), 1-11. <https://doi.org/10.3390/sports5010003>
- Davids, K., & Araújo, D. (2010). The concept of 'Organismic Asymmetry' in sport science. *Journal of Science & Medicine in Sport*, 13(6), 633-640. <https://doi.org/10.1016/j.jsams.2010.05.002>
- Davids, K., Araújo, D., Correia, V., & Vilar, L. (2013). How small-sided and conditioned games enhance acquisition of movement and decision-making skills. *Exercise and Sport Sciences Reviews*, 41(3), 154-161.
- Davids, K., Araújo, D., Hristovski, R., Passos, P., & Chow, J. Y. (2012). *Ecological dynamics and motor learning design in sport*. Routledge.
- Dellal, A., Hill-Haas, S., Lago-Penas, C., & Chamari, K. (2011). Small-sided games in soccer: amateur vs. professional players' physiological responses, physical, and technical activities. *Journal of Strength & Conditioning Research*, 25(9), 2371-2381. <https://doi.org/10.1519/JSC.0b013e3181fb4296>
- Deutsch, M. U., Kearney, G. A., & Rehrer, N. J. (2007). Time – motion analysis of professional rugby union players during match-play. *Journal of Sports Sciences*, 25(4), 461-472.
- Duthie, G., Pyne, D., & Hooper, S. (2003). Applied physiology and game analysis of rugby union. *Sports Medicine*, 33(13), 973-991. <https://doi.org/10.2165/00007256-200333130-00003>
- Fernández-Espínola, C., Abad Robles, M. T., & Giménez Fuentes-Guerra, F. J. (2020). Small-sided games as a methodological resource for team sports teaching: A systematic review. *International Journal of Environmental Research and Public Health*, 17(6), 1884. <https://doi.org/10.3390/ijerph17061884>
- Fleay, B., Joyce, C., Banyard, H., & Woods, C. T. (2018). Manipulating field dimensions during small-sided games impacts the technical and physical profiles of Australian footballers. *The Journal of Strength & Conditioning Research*, 32(7), 2039-2044.
- Ford, P. R., Ward, P., Hodges, N. J., & Williams, A. M. (2009). The role of deliberate practice and play in career progression in sport: the early engagement hypothesis. *High Ability Studies*, 20(1), 65-75.
- Gabbett, T. (2008). Do skill-based conditioning games offer a specific training stimulus for junior elite volleyball players? *Journal of Strength & Conditioning Research*, 22(2), 509-517.
- Gabbett, T., Jenkins, D., & Abernethy, B. (2009a). Game-based training for improving skill and physical fitness in team sport athletes. *International Journal of Sports Science & Coaching*, 4(2), 273-283.
- Gabbett, T., Jenkins, D., & Abernethy, B. (2009b). Game-based training for improving skill and physical fitness in team sport athletes. *International Journal of Sports Science & Coaching*, 4. <https://doi.org/10.1260/174795409788549553>
- Gabbett, T., Jenkins, D. G., & Abernethy, B. (2010). Physiological and skill demands of 'on-side' and 'off-side' games. *Journal of Strength and Conditioning Research*,

- 24(11), 2979-2983. <https://doi.org/10.1519/JSC.0b013e3181e72731>
- Gamble, P. (2004). A skill-based conditioning games approach to metabolic conditioning for elite rugby football players. *Journal of Strength & Conditioning Research*, 18(3), 491-497. [https://doi.org/10.1519/1533-4287\(2004\)18<491:ASCGAT>2.0.CO;2](https://doi.org/10.1519/1533-4287(2004)18<491:ASCGAT>2.0.CO;2)
- Halouani, J., Chtourou, H., Gabbett, T., Chaouachi, A., & Chamari, K. (2014). Small-sided games in team sports training: A brief review. *The Journal of Strength and Conditioning Research*, 28(12), 3594-3618.
- Hammami, A., Gabbett, T. J., Slimani, M., & Bouhleb, E. (2018). Does small-sided games training improve physical fitness and team-sport-specific skills? A systematic review and meta-analysis. *The Journal of Sports Medicine and Physical Fitness*, 58(10), 1446-1455. <https://doi.org/10.23736/S0022-4707.17.07420-5>
- Harrison, C. B., Gill, N. D., Kinugasa, T., & Kilding, A. E. (2015). Development of aerobic fitness in young team sport athletes. *Sports Medicine*, 45(7), 969-983. <https://doi.org/10.1007/s40279-015-0330-y>
- Hartwig, T. B., Naughton, G., & Searl, J. (2011). Motion analyses of adolescent rugby union players: A comparison of training and game demands. *Journal of Strength and Conditioning Research*, 25(4), 966-972. <https://doi.org/10.1519/JSC.0b013e3181d09e24>
- Hauer, R., Tessitore, A., Binder, N., & Tschan, H. (2018). Physiological, perceptual, and technical responses to continuous and intermittent small-sided games in lacrosse players. *PLOS One*, 13(10), e0203832. <https://doi.org/10.1371/journal.pone.0203832>
- Hill-Haas, S. V., Dawson, B., Impellizzeri, F. M., & Coutts, A. J. (2011). Physiology of small-sided games training in football: a systematic review. *Sports Medicine*, 41(3), 199-220. <https://doi.org/10.2165/11539740-000000000-00000>
- Hoff, J., Wisløff, U., Engen, L. C., Kemi, O. J., & Helgerud, J. (2002). Soccer specific aerobic endurance training. *British Journal of Sports Medicine*, 36(3), 218-221.
- Hogarth, L. W., Burkett, B. J., & McKean, M. R. (2016). Match demands of professional rugby football codes: a review from 2008 to 2015. *International Journal of Sports Science Coaching*, 11(3), 451-463. <https://doi.org/10.1177/1747954116645209>
- Impellizzeri, F. M., Marcora, S. M., Castagna, C., Reilly, T., Sassi, A., Iaia, F., & Rampinini, E. (2006). Physiological and performance effects of generic versus specific aerobic training in soccer players. *International Journal of Sports Medicine*, 27(6), 483-492. <https://doi.org/10.1055/s-2005-865839>
- Kennett, D. C., Kempton, T., & Coutts, A. J. (2012). Factors affecting exercise intensity in rugby-specific small-sided games. *Journal of Strength and Conditioning Research*, 26(8), 2037-2042. <https://doi.org/10.1519/JSC.0b013e31823a3b26>
- Kinnerk, P., Harvey, S., MacDonncha, C., & Lyons, M. (2018). A review of the game-based approaches to coaching literature in competitive team sport settings. *Quest*, 70(4), 401-418.
- Kirk, D., & MacPhail, A. (2002). Teaching games for understanding and situated learning: Rethinking the Bunker-Thorpe model. *Journal of Teaching in Physical Education*, 21(2), 177-192.
- Mangan, S., Collins, K., Burns, C., & O'Neill, C. (2019). An investigation into the physical, physiological and technical demands of small sided games using varying pitch dimensions in Gaelic football. *International Journal of Performance Analysis in Sport*, 19(6), 971-984.
- McLean, D. A. (1992). Analysis of the physical demands of international rugby union. *Journal of Sports Sciences*, 10(3), 285-296.
- Owen, A. L., Wong, D. P., Paul, D., & Dellal, A. (2012). Effects of a periodized small-sided game training intervention on physical performance in elite professional soccer. *The Journal of Strength & Conditioning Research*, 26(10), 2748-2754.
- Portney G, L., & Watkins P, M. (2009). Surveys and Questionnaires In M. Cohen (Ed.), *Foundations of Clinical Research- Applications to Practice* (3rd ed., pp. 325-355). Levin A, Julie.
- Qualtrics. (2019). *Online Survey Software*. <https://www.qualtrics.com/au/core-xm/survey-software/>
- Reilly, T., & Gilbourne, D. (2003). Science and football: a review of applied research in the football codes. *Journal of Sports Sciences*, 21(9), 693-705. <https://doi.org/10.1080/0264041031000102105>
- Sarmento, H., Clemente, F. M., Harper, L. D., Costa, I. T. d., Owen, A., & Figueiredo, A. J. (2018). Small sided games in soccer – a systematic review. *International Journal of Performance Analysis in Sport*, 18(5), 693-749. <https://doi.org/10.1080/24748668.2018.1517288>
- Taylor, R. J., Sanders, D., Myers, T., & Akubat, I. (2020). Reliability and validity of integrated external and internal load ratios as measures of fitness in academy rugby union players. *The Journal of Strength & Conditioning Research*, 34(6), 1723-1730.
- Tee, J. C., Ashford, M., & Piggott, D. (2018). A tactical periodization approach for rugby union. *Strength and Conditioning Journal*, 40(5), 1-13. <https://doi.org/10.1519/SSC.0000000000000390>
- Tee, J. C., Lambert, M. I., & Coopoo, Y. (2016). GPS comparison of training activities and game demands of professional rugby union. *International Journal of Sports Science & Coaching*, 11(2), 200-211.
- Thomas, G., Morgan, K., & Mesquita, I. (2013). Examining the implementation of a Teaching Games for Understanding approach in junior rugby using a reflective practice design. *Sports Coaching Review*, 2(1), 49-60.
- TOTALSPORTEK.COM. (2021). *25 World's Most Popular Sports (Ranked by 13 factors)*. <https://www.totalsportek.com/worlds-popular-sports-26/>
- Vaz, L. M. T., Figueira, B. E. N., & Gonçalves, B. S. V. (2015). Classifying youth rugby union players by training performances. *International Journal of Performance Analysis in Sport*, 15(1), 159-171.
- Vaz, L. M. T., Gonçalves, B. S. V., Figueira, B. E. N., & Garcia, G. C. (2016). Influence of different small-sided games on physical and physiological demands in rugby union players. *International Journal of Sports Science and Coaching*, 11(1), 78-84. <https://doi.org/10.1177/1747954115624823>
- Vaz, L. M. T., Leite, N., Joao, P. V., Gonçalves, B. S. V., & Sampaio, J. (2012). Differences between experienced and novice rugby union players during small-sided games.

- Perceptual & Motor Skills: Exercise & Sport*, 115(2), 594-604.
<https://doi.org/10.2466/30.10.25.PMS.115.5.594-604>
- Ward, P., Hodges, N. J., Starkes, J. L., & Williams, M. A. (2007). The road to excellence: Deliberate practice and the development of expertise. *High Ability Studies*, 18(2), 119-153.
- Weakley, J. J. S., Read, D. B., Fullagar, H. H. K., Ramirez-Lopez, C., Jones, B., Cummins, C., & Sampson, J. A. (2019). "How am I going, coach?"-The effect of augmented feedback during small-sided games on locomotor, physiological, and perceptual responses. *International Journal of Sports Physiology and Performance*, 15(5), 1-8.
<https://doi.org/10.1123/ijsp.2019-0078>
- World Rugby. (2020). *Year in Review 2019: Participate*. <http://publications.worldrugby.org/yearinreview2019/en/66-1>
- World Rugby. (2021). *Membership & Growth*. Retrieved 8 January from <https://www.world.rugby/organisation/about-us/membership-growth>
- Zanin, M., Ranaweera, J., Darrall-Jones, J., Weaving, D., Till, K., & Roe, G. (2021). A systematic review of small sided games within rugby: Acute and chronic effects of constraints manipulation. *Journal of Sports Sciences*, 39(14), 1-28.

Appendix 1: Differentiated training goals for coaches' top-five SSG formats preference (% SSG-specific choice)

