# Characteristics of Game Aspects due to Differences in the Number of Competitors in Rugby Football: Focusing on 10-a-side Rugby

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The purpose of this study is to clarify the characteristics of the game aspect depending on the number of players in rugby. We studied the world's top-level matches of 7, 10, and 15-a-side rugby games in recent years. The main results were as follows. 1) The greater the number of players, the longer the in-play time and out-of-play time per play, and the less frequent the number of playes. 2) The smaller the number of players, the higher the rate of try scoring, and also the higher the rate of tap-kick selection and the rate of source of tries from tap-kick. 3) The greater the number of players, the smaller the number of players, the smaller the number of players, the smaller the number of the origin of tries from the opponent area, and the smaller the number of players, the smaller the number of players were required a high level of various skills and tactics, since the game has a high frequency of various play activities, including off-load passes, and ball retention and continuation skills in set play and phase play are also important.

Keywords: number of players, game performance, 10-a-side rugby, elite

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# 1. Introduction

Recently, the number of rugby players has been decreasing. According to a report published by the All Japan High School Athletic Federation (2003, 2018), the number of registered players and high schools with male rugby clubs decreased from 30,419 players and 1,252 schools in 2003 to 21,702 players and 1,000 schools in 2018: in brief a decrease of 8,717 players (28.7%) and 252 schools (20.2%) took place over 15 years. Influence from a declining birth rate is one cause; however, because participation in soccer and handball increased during the same period, it is suspected that other factors may be involved. One reason is that rugby represents the largest number of players among the sports participating in the All Japan High School Athletic Federation. Until now, the main domestic tournament for high school and older students has been fifteen-a-side rugby (15s) with 15 players per team; therefore, if at least 15 players are not available, the team cannot be formed or participate in a game. Onishi (1999) states the

following regarding the value of sports categorized as self-intentional behavior: "For educational purposes, the most important thing about struggle is that you can control half the conflict on your own, when you can win if you beat your opponent and kick his head during a rugby game, being aware of the idea that, "Wait, this is a bad thing." This suggests that human growth is fostered and nurtured in the process of pursuing victory in the game. Shimazaki (2015) introduces the spirit and customs that are valued in rugby as educational values of rugby. These include the "no-side spirit" and "after-match function" which are established by complimenting one another's good performance after the game.

The above suggest that the actions and growth opportunities for achieving the goals of the team or individual occur along with the game itself as well as before and after the game, and that they can be felt and experienced through the game. In other words, if a game cannot be played, the value and attractiveness of sports will be greatly impaired, and the meaning and significance of continuing the sport may inevitably be lost.

The Japan Rugby Football Union organizes teams selected for each of its nine districts nationwide for schools that cannot participate as single teams in 15s tournaments and holds a 15s national tournament (KOBELCO CUP) from late July to early August. Furthermore, at the undercard of the Inter-high school championship's final in January, games between teams with players selected from the East and West districts for joint teams are held. In addition, since seven-a-side rugby (7s) was adopted as an official event from the 2016 Summer Olympic Games, the adult men's and women's events at the National Athletic Meet were changed to 7s from 15s, and new rugby tournaments such as the National High School Tournament and the Women's Taiyo Life Cup have been established and are being strengthened and promoted for 7s. Games and tournaments for 7s are easier than 15s to conduct because the problem of the number of players is reduced and game schedules can be set for a limited period.

Furthermore, district tournaments of ten-a-side rugby (10s) have been held for teams that cannot participate in 15s tournaments alone. The preamble of The Law of the Game (World Rugby, 2018) states that "The object of the game is that two teams of 15, 10 or seven players each, observing fair play according to the laws and sporting spirit, should by carrying, passing, kicking and grounding the ball, score as many points as possible, with the team scoring the greater number of points being the winner of the match", and specifies rugby to be played by 10 players. However, the lack of a 10s tournament at the World Cup and the Olympics may have affected this; and the level of recognition in Japan is lower than that of 7s or 15s. Worldwide, 10s tournaments such as the COBRA Rugby 10s (venue: Malaysia, founded: 1967,

date: November) and the Hong Kong Football Club 10s (venue: Hong Kong, founded: 1986, date: March-April) are held; however, the size of tournaments is smaller than those of 7s or 15s world competitions, and they are not widely featured in the media. Under such circumstances, a new 10s tournament called Brisbane Global Rugby 10s was set up in Brisbane, Australia in February 2017 with professional teams.

When the Olympics triggered the spread of 7s, research related to 7s also progressed. Even though the competition has been conducted with almost the same rules as 15s, differences in game aspects and physical load have been observed (Alex et al., 2015; Dean et al., 2014; Giampietro et al., 2013; Otsuka et al., 2013). The difficulty of playing in parallel has been reported. In fact, in many of the world's top countries, strengthening of 7s and 15s will be implemented separately, and this is an example of utilizing the knowledge obtained from research on the necessity of responding to the characteristics of the competition. However, little research has been conducted on the 10s, in which official competitions are held both domestically and internationally, although the scale differs. As with 7s, as the research on 10s progresses, it is expected that the potential for strengthening and popularization measures according to the characteristics of competition will increase. In other sports, research has been conducted on the effects of differences in competition space and number of people on physiological characteristics, etc. (Kajiyama et al., 2006; Tsuda et al., 2007); however, these were junior-level subjects and conducted under artificial conditions instead of on actual games.

The purpose of this study was to clarify the characteristics of 7s, 10s, and 15s competitions to compare and verify aspects of game performance. We used 65 world-class rugby 7s, 10s and 15s games\*

Table 1	Main rules	s of each	game
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Contents	75	105	155
Size of Field of Play	100m×70m	100m×70m	100m×70m
Number of FWs and BKs	3FWs, 4BKs	5FWs, 5BKs	8FWs, 7BKs
Number of Scrummagers	3	5	8
Game Time	14 min (7 min half)	20min (10min half)	80 min (40 min half)
Half Time	2 min or less	2min or less	15 min or less
Number of Replacements	5 or less	5 or less †	8 or less
Side of Kickoff after score	Team which scored	Team which scored	Team which conceded score
Kicking way of CG and PG	Dropkick Only	Dropkick Only	Place-kick or Dropkick
Limited time of CG and PG	within 30 sec (both)	within 30 sec (both)	within 90 sec (CG), 60 sec (PG)
Time of Sin-Bin	2min	3 min	10 min

Note, CG = Conversion goal; PG = Penalty goal

+ As a local rule of the Brisbane 10s, unlimited interchange is adopted for the number of replacements

1. In particular, the characteristics of 10s, which have not been studied to date, were also considered, and the elements required for the competition were examined.

## 2. Method

### 2.1. Samples

This study targeted the world's top 7s, 10s, and 15s games. As representative samples, all final tournament matches of the World Rugby Sevens Series (WRSS) Hong Kong tournament (HK7s), the Brisbane Global Rugby 10s (BG10s), and the Super Rugby (SR15s) held in 2017 and 2018. Regarding 7s and 10s, matches where eight teams that advanced to the final tournament played against each other in the qualifying pool were included. The number of sample games was 65; namely, 30 HK7s games, 21 G10s games, and 14 SR15s games. Since there were no major changes in competition rules between 2017 and 2018, the results of the two seasons were pooled and analyzed, assuming that there were no essential differences in game performance trends and competition levels between the two seasons.

HK7s is one of the 10 WRSS tournaments that started in 1999; however, it has been held since 1976, well before the series began, and it is the oldest tournament in the current 10 series. There are 16 participating teams, including the world's top 15 teams, called core teams, and the top 8 teams from the results of the qualifying pool advance to the final tournament to compete for the championship. SR15s is the tournament in which 15 professional teams based in New Zealand, Australia, South Africa, and Argentina (participated since 2018) compete from February to July every year, and the top eight teams advance to the playoffs and compete for the championship. Many of the players from the four top 10 countries, including New Zealand, belong to each team. GB10s is the 10s tournament, in which many teams belonging to SR15s participate, held in 2017 and 2018 (10 out of 12 participating teams in 2017 and 9 out of 12 participating teams in 2018). These were tournaments in which the highest-level teams in the current tournament participated. From the above, the games used in this study were considered to be appropriate as samples representing the world's top level.

## 2.2. Analysis items

In this study, we analyzed play time and the number of plays, the number of set plays and play activities, scores, and tries, which are the basic items used to understand the game aspects of rugby. The details of the analysis items were created based on the method employed by Furukawa et al. (2012), who conducted a similar analysis. The following describes the contents and additional items newly added.

#### 2.2.1. Play time and number of plays

First, game time was divided into In-Play Time (IPT) and Out of Play Time (OPT). IPT was defined from the start of play to the referee's whistle, which indicates that play is stopped temporarily due to fouls, mistakes, line-touches, tries, etc.; and from that moment to the next play restarts are OPT. The start of IPT was the moment the scrum was combined, the lineout was the moment the thrower threw the ball; and the kickoff, dropout, penalty kick and tap kick from free kick were the moment the kicker kicked the ball. The time for conversion goals, penalty goals and touch-kicks from penalty kicks was defined as from OPT until the next kick-off or line-out. However, in the case of touch-kicks from the penalty kick becoming no touch or if PGs were missed, IPT started from the moment the kicker kicked. However, even if play was stopped by the referee's whistle or ball touch, if attacks were restarted with tap kicks or quick throws within 3 seconds, IPT was considered to have continued. The time during which the referee interrupts the match due to confirmation of judgment, replacement of players, handling of injured players, etc. was defined as referee interrupted time (RIT). Recently, television match officials have been able to accurately determine tries and fouls; and in some games, RIT exceeds 15 minutes. In some previous studies (Furukawa et al., 2012; Watanabe et al., 1999), it was found that running time including RIT was used as the frequency of play per time. When calculating the conversion value per time in this study, however, it is considered that the result would differ from actual play frequency. Therefore, play time excluding RIT, where the game was intentionally interrupted by the referee, from OPT was used. Using the above method, the time and number of each IPT, OPT, and RIT was recorded.

## 2.2.2 Number of set plays and play activities

Scrum (SC), line-out (LO), kick-off and 50m restart kick for restart of the game after scoring (KO), dropout (DO), tap kick (TK) and quick throw (QT) were recorded as set plays; and the number per game was calculated. Plays that were redone, such as resetting scrums, were included in the IPT; however, they were not included in the count for this item category.

Similarly, passes, off-road passes, rucks, mauls, punt kicks, touch kicks, penalty kicks (PK), and free kicks (FK) were recorded as play activities, and the number per game was recorded. Off-road passes were defined as plays in which the ball carrier tried to pass to a teammate while the ball carrier was in contact with opponents or fell to the ground due to contact. Touch kicks and punt kicks were defined as plays in which the ball held by the ball carrier was directly kicked from the hand. In addition, touch kicks were kicks that were kicked directly out of the playing area without the intention of reacquisition directly after kicks; and punt kicks were kicks in which the kicked ball was directly contested or bounced at least once in the playing area.

## 2.2.3. Scoring

As scoring plays, tries, conversion goals (CG), penalty goals (PG), and drop goals (DG) were recorded, and the number per game was calculated. Total score and the scores resulting from each try, CG, PG, and DG per game were also calculated.

#### 2.2.4. Tries aspects

As the source of possession for tries, the following 12 plays were recorded, and the number per game was calculated. The 12 plays consisted of SC, LO, KO, kick-off receive (KOR), DO, dropout receive (DOR), PK, FK, kick counter (KC), handling errors (HE), breakdown turnover (BDTO), and set play turnover (SPTO) which steals the opponent's ball in SC and LO.

Next, the origin of tries was recorded in the following four areas, and the number per game was calculated. Area 1: Opponent goal line-Opponent 22m line, Area 2: Opponent 22m line-Halfway line, Area 3: Halfway line-Own 22m line, Area 4: Own self 22m line-Own goal line. In this study, plays on the line of the adjacent area were included in the area behind (own side). The 22m line is a 22m area according to the rules, and the own 22m line is area 4 as per the

rules. However, the opponent's 22m line was recorded as area 2 according to the above method, where the rule was area 1.

The number of passes and phase attacks preceding tries was recorded in the following five and four groups, respectively, and the number per game was calculated for each. The number of passes was divided into five groups: 0, 1-3, 4-6, 7-9 and 10 passes or more; and the number of phase attacks was divided into four groups: 1st, 2nd-3rd, 4-5th, and 6th phases or more.

## 2.3. Data recording method

All game videos were recorded into PC and analyzed using Hudl's SportsCode (version 11.3.0). Analyses were performed by one person with experience playing and coaching rugby (15 years of playing and 25 years of coaching experience; including serving as national team staff) and who was engaged in rugby science research.

## 2.4. Analysis items and statistical processing

First, for each analysis item, the average value and standard deviation of 30 7s games, 21 10s games and 14 15s games were calculated. Next, in order to make a direct comparison between each competitor, (1) the value of each analysis item in play time and number of plays, the number of set plays and play activities, and the score were all converted to the value when the game time was set to 80 minutes;, and the mean value and standard deviation were calculated for each value. (2) The ratio of IPT per play time (IPT ratio) was calculated by IPT for the total time of IPT and OPT for one game, and was calculated for each competitor. (3) For play activities, the ratio of the total number of offload passes to the total number of passes, the ratio of the total number of punt kicks and total number of rucks & mauls to the total number of passes & offload passes, and the number of TKs from the total number of TKs in set play to the total number of PKs & FKs, were calculated for each competitor. (4) Regarding the breakdown of scores, the ratio of tries, CGs, PGs, and DGs to the total score was calculated for each competitor. (5) Regarding the tries aspects, the ratio of the possession source of tries, the origin of tries, the number of passes, and the number of phase attacks to the total number of tries was calculated for each competitor. The non-parametric method

was used to test the difference between the number of competitors since the normality of the data was not guaranteed. The Kruskal-Wallis K test was used to compare the mean values in (1), and Bonferroni's method was used when significant differences were found. Fisher's exact test was used to determine the difference in ratios of (2) (3) (4) (5), and Tukey's WSD method was used when significant differences were found. The significance level was less than 5% (two-tailed test).

## 3. Results

## 3.1. Reliability of analyzed data

In order to confirm the reliability of the analysis records obtained by the method described in the analysis items, the same analysis was done a total of three games, one for each sample of 7s, 10s and 15s. The analysis was performed by one person with rugby playing experience (11 years of playing experience; including experience in the highest league in Japan) and who was engaged in rugby scientific research.

From the analysis results, the error rate was obtained for the analysis items of play time and the

number of plays, the number of set plays and play activities, the total score, and the number of scoring plays. For the analysis items of the origin of tries, the κ coefficient was calculated for each area, number of passes, and number of attack phases. As a result, the value of each item for which the error rate was calculated was 0-2.9%, and the value of each item for which the  $\kappa$  coefficient was calculated was 1.00, 1.00, 0.91. From the above, it can be concluded that the analysis records in this study have a sufficiently acceptable level of reliability.

# **3.2.** Results of analysis of play time and number of plays

Table 2-1 summarizes the results of analysis regarding play time and number of plays. Comparison of the conversion values in Table 2-1 revealed no significant difference in the length of IPT and OPT between the number of competitors; however, 7s and 10s were significantly higher in number of inplay and out-of-play than 15s was. Therefore, in the average time of IPT and OPT, 15s was significantly shorter than 10s and 7s were.

Table 2-2 shows the ratio of the frequency of IPT and the IPT ratio when IPT is divided into units of

 Table 2-1
 Results of time and number of plays

	Actual	tual Measurement Value												Corresponding Value for an 80 min. Game					
	7s				105				15s				75		105		15s		
	Mean	SD	Max.	Min.	Mean	SD	Max.	Min.	Mean	SD	Max.	Min.	Mean	SD	Mean	SD	Mean	SD	*p<.05, **<.01
IPT (min:sec)	6:51	1:06	10:18	5:11	10:12	1:28	13:36	8:06	33:48	3:22	40:56	29:15	31:24	5:00	33:17	5:09	29:59	2:52	ns
OPT (min:sec)	10:39	1:38	13:32	6:11	14:29	2:39	23:25	11:06	56:25	3:46	1:00:59	48:22	48:36	5:00	46:43	5:09	50:01	2:52	ns
RIT (min:sec)	1:50	1:08	4:06	0:15	3:03	2:11	10:55	0:27	8:40	3:35	18:00	4:15	8:06	4:28	9:29	5:29	7:39	3:05	ns
Number of In-Plays	15.6	1.9	19	13	21.6	2.5	26	17	51.5	5.0	58	42	71.9	9.4	70.3	8.8	45.7	4.4	**7s, 10s > 15s
Number of Out of Plays	14.9	2.0	19	12	20.4	2.5	25	16	50.1	5.0	56	40	68.6	9.4	66.5	8.7	44.5	4.4	**7s, 10s > 15s
Average IPT (sec)	26.8	6.1	44.1	18.8	28.8	5.8	46.7	21.1	39.9	6.8	52.4	31.8	26.8	6.1	28.8	5.8	39.9	6.8	**15s > 7s, 10s, *10s > 7s
Average OPT (sec)	43.3	7.4	58.3	23.2	43.0	8.9	73.9	32.7	68.0	6.7	84.1	59.1	43.3	7.4	43.0	8.9	68.0	6.7	**7s > 10s > 15s
	20				24														

Note. IPT = In-play time; OPT = Out of play time; RIT = Referee interrupted time

 Table 2-2
 Results of time and number of plays

	Percentag	je								
IPT	7s	105	15s	*p<.05, **<.01						
<20 sec	49.0%	43.0%	37.0%	<b>**</b> 7s > 15s						
<40 sec	30.0%	35.0%	25.0%	<b>**</b> 10s > 15s						
<60 sec	15.0%	13.0%	18.0%	ns						
≥60 sec	7.0%	9.0%	20.0%	<b>**</b> 15s > 7s, 10s						
<40 sec	79.0%	78.0%	62.0%	<b>**</b> 7s, 10s > 15s						
≥40 sec	22.0%	22.0%	38.0%	<b>**</b> 15s > 7s, 10s						
IPT ratio	39.1%	41.2%	38.0%	<b>**</b> 105 > 155						
Note IPT ratio - In-play time ratio (- IPT / (IPT + OPT))										

Note, IPT ratio = in-play time ratio ( = IPT / (IPT + OPT))

20 seconds, and when the IPT is divided into units of less than 40 seconds and into units of more than 40 seconds. From the comparison of the ratios in **Table 2-2**, 7s played significantly less than 20 seconds and 10s played 20-40 seconds significantly more frequently than 15s did. Conversely, 15s played 60 seconds. The above play frequency was significantly higher than the others were. Regarding the IPT ratio, 10s was significantly higher than 15s was.

# **3.3.** Results of analysis of the number of set plays and play activities

**Table 3-1** summarizes the results of analysis of the number of set plays and play activities. From the comparison of the conversion values in **Table 3-1**, regarding set plays, LO were significantly less in 7s than in 10s and 15s, while KO and TK were greatest in 7s. As the number of competitors increased, the result decreased significantly. Regarding play activities, 7s and 10s were significantly greater in pass, off-road pass, and PK than 15s was. Conversely, rucks and mauls were significantly greater in 15s. (See Table 3-1 for details on the relationship between these). Table 3-2 summarizes the results of analysis of the ratio of play activity analysis items. From the results of passes and off-road passes, 10s and 7s have a significantly higher ratio of off-road passes to passes than 15s does, and the larger the number of competitors, the higher the ratio of punt kicks, rucks & malls to passes & off-road passes is. Calculating the TK selection rate from the number of TKs per the number of PKs for each 7s, 10s and 15s shows that 7s was 77% (number of PKs: 178, TK selection: 137), 10s was 52% (number of PKs: 166, TK selection: 86), and 15s was 13% (PK number: 235, TK selection: 30), which is significant when Fisher's exact test is used to test the difference in ratio by the number of competitors. In addition, as a result of Tukey's WSD method, the smaller the number of players, the higher the TK selectivity.

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 Table 3-1
 Results of frequency of set pieces and play activities

	Actual N	Neasur	ement '	/alue									Correspomding Value for an 80 min. Game						
	75				105				15s				<b>7</b> 5		105		15s		
	Mean	SD	Max.	Min.	Mean	SD	Max.	Min.	Mean	SD	Max.	Min.	Mean	SD	Mean	SD	Mean	SD	*p<.05, **<.01
Set Pieces																			
SC	3.1	1.6	8	0	4.4	1.9	10	2	11.9	2.6	17	8	14.3	7.4	14.3	5.9	10.5	2.1	ns
LO	2.6	1.5	6	0	6.6	2.2	10	3	23.5	3.4	29	19	12.1	7.0	21.4	7.1	20.9	3.1	**10s, 15s > 7s
KO	6.8	1.6	10	4	6.0	1.5	10	4	11.4	2.9	15	4	31.4	8.0	19.9	5.6	10.1	2.6	**7s > 10s > 15s
DO	0.0	0.2	1	0	0.1	0.5	2	0	1.8	1.7	7	0	0.1	0.7	0.5	1.6	1.6	1.5	**15s > 7s, 10s
TK	5.0	2.2	12	1	4.1	2.7	10	1	2.4	1.6	5	0	22.5	9.0	13.6	9.0	2.1	1.5	**7s, 10s > 15s, *7s > 10s
QT	0.2	0.6	3	0	0.2	0.5	2	0	1.7	1.1	4	0	0.9	2.6	0.8	1.8	1.5	0.9	**15s > 7s, 10s
Play Activities																			
pass	60.2	12.5	87	37	89.2	29.6	164	21	276.4	30.3	326	228	276.7	59.1	290.0	94.8	245.6	30.0	*10s > 15s
offload pass	8.6	3.7	17	3	13.0	5.5	25	2	14.6	6.2	26	4	39.5	16.1	42.6	18.2	13.0	5.6	**10s, 7s > 15s
ruck	21.8	4.9	29	9	38.5	9.4	58	18	174.0	26.2	224	142	99.8	22.6	124.8	29.1	154.2	21.8	**15s, 10s > 7s, *15s > 10s
maul	0.0	0.2	1	0	0.5	0.9	3	0	7.5	2.1	12	5	0.2	0.9	1.5	2.9	6.7	1.9	**15s > 10s, 7s
punt kick	1.7	1.1	4	0	8.9	3.9	20	4	33.4	15.6	77	18	7.8	5.2	29.3	14.8	29.5	13.5	**15s, 10s > 7s
touch kick	2.1	1.4	6	0	4.6	2.7	11	1	20.4	2.8	25	14	9.6	6.5	14.6	8.4	18.2	2.7	**15s > 7s
PK	5.9	2.8	14	3	7.9	3.0	12	2	16.8	4.6	23	7	27.1	11.8	25.6	9.9	14.9	4.2	**7s, 10s > 15s
FK	0.4	0.6	2	0	0.1	0.3	1	0	0.5	0.7	2	0	1.8	2.8	0.3	1.0	0.5	0.6	ns
n	30				21				14				30		21		14		

Note, SC = Scrum; LO = Lineout; KO = Kickoff; DO = Dropout; TK = Tap kick; QT = Quick throw

 Table 3-2
 Results of proportion and ratio of each play activities

Percentage of each Play Activity	7s	105	15s	*p<.05, **<.01
OLP / pass	14.3%	14.6%	5.3%	<b>**</b> 7s, 10s > 15s
punt / (pass + OLP)	2.5%	8.7%	11.5%	<b>**</b> 15 > 10s > 7s
(ruck + maul) / (pass + OLP)	31.7%	38.1%	62.4%	<b>**</b> 15 > 10s > 7s
Ratio of each Play Activity	7s	105	15s	
pass : OLP	7.0:1	6.8:1	18.9:1	
(pass + OLP) : punt	40.5:1	11.5:1	8.7:1	
(pass + OLP) : (ruck + maul)	3.2:1	2.6:1	1.6:1	
Note; OLP = Offload Pass				

## 3.4. Results of scoring analysis

**Table 4** summarizes the results of score analysis. Comparison of the conversion values in **Table 4** revealed that the smaller the number of competitors, the greater the total score and the number of tries. Although the number of PG and DG was small in 7s and 10s (the score by PG is 0 in 7s, 2 in 21 games in 10s, DG is 0 in both), PG is significantly greater in 15s than in the others. Comparing the percentages of the score breakdown, the scores of tries were significantly higher in 7s and 10s than in 15s, and the percentage of the total score exceeded 80%. On the other hand, the score by PG and DG was significantly higher in 15s than in the others, and the score by PG accounted for 1/4 of the whole.

# 3.5. Results of aspects of tries

**Table 5** summarizes the results of an analysis of aspects of the origin of tries. DO and DOR were evaluated together because of their small numbers, and HE, BDTO, and SPTO, which had characteristics similar to attack after taking the opponent's ball. Comparison of the ratios by origin of tries in **Table 5** 

reveals that 15s was significantly higher in LO than in the others; and in KO and KOR, 7s was significantly higher than in 15s. In addition, 7s showed significantly higher TK and significantly lower KC than others did.

Table 6 summarizes results regarding the origin of tries, the number of passes and attack phases preceding tries of try aspects. Comparison of the ratios of the area of the origin of tries shows 15s to be significantly higher than 7s in area 1, which is closest to the opponent's goal, and 7s to be significantly higher in the own area 3 than the others. Comparison of the ratios of passes building up to tries shows that 7s was significantly higher than 15s in 1-3 passes, and 15s was significantly higher than the others in 10 or more passes. Comparison of the ratio of attack phases leading to tries reveals that 7s was higher in the first phase attack, and 10s and 7s were significantly higher in the 2-3 attack than 15s was. On the other hand, 15s was significantly higher than the others in the 6th or greater attack phases. There was no significant difference between 7s and 10s; however, both had a high try ratio of over 85% within the third phase attacks.

 Table 4
 Results of scoring profiles

	Actual N	Лeasur	ement V	/alue									Corre	spondii	ng Value	for an 8	30 min. G	ame	
	7s				105				15s				7s		105		15s		
	Mean	SD	Max.	Min.	Mean	SD	Max.	Min.	Mean	SD	Max.	Min.	Mean	SD	Mean	SD	Mean	SD	*p<.05, **<.01
Total Points	36.9	10.3	57	17	28.0	10.9	59	12	49.4	15.5	73	17	169.9	48.4	92.2	39.8	44.0	14.3	**7s > 10s, 15s, *10s > 15s
Number of Tries	5.9	1.7	9	3	4.6	1.7	9	2	5.9	2.3	10	2	27.3	8.1	15.1	6.1	5.2	2.2	**7s > 10s > 15s
Number of CGs	3.6	1.4	7	1	2.4	1.7	7	0	4.1	2.1	7	0	16.6	6.3	8.0	5.9	3.7	2.0	**7s > 10s, 15s
Number of PGs	0.0	0.0	0	0	0.1	0.3	1	0	3.8	1.6	6	1	0.0	0.0	0.3	1.0	3.4	1.5	**15s >10s, 7s
Number of DGs	0.0	0.0	0	0	0.0	0.0	0	0	0.1	0.4	1	0	0.0	0.0	0.0	0.0	0.1	0.3	*7s < 15s
n	30				21				14				30	)	21		14		
	Actual N	Neasur	ement V	/alue									Proport	ion					
	75				105				15s				75		105		15s		
	Mean	SD	Max.	Min.	Mean	SD	Max.	Min.	Mean	SD	Max.	Min.							*p<.05, **<.01
Points of Tries	29.7	8.4	45	15	22.9	8.3	45	10	29.3	11.7	50	10	80.3%	, )	81.6%		59.3%		**7s, 10s > 15s
Points of CGs	7.3	2.8	14	2	4.9	3.4	14	0	8.3	4.3	14	0	19.7%	,	17.3%		16.8%		ns
Points of PGs	0.0	0.0	0	0	0.3	0.9	3	0	11.4	4.9	18	3	0.0%		1.0%		23.0%		**15 > 105 > 75
Points of DGs	0.0	0.0	0	0	0.0	0.0	Ó	0	0.4	1.1	3	0	0.0%	,	0.0%		0.9%		**15 > 7s
n	20				21				14				20		21		14		

Note, CGs = Conversion goals; PGs = Penalty goals; DGs = Drop goals

Table 5Results of possession sources of tries

	Actual	Actual Measurement Value												Percentage			
	75			105			15s				7s	105	15s				
	Mean	SD	Max.	Min.	Mean	SD	Max.	Min.	Mean	SD	Max.	Min.				*p<.05, **<.01	
SC	0.7	0.7	2	0	0.4	0.6	2	0	0.9	1.1	4	0	12.4%	8.3%	15.9%	ns	
LO	0.8	0.8	2	0	1.0	0.9	3	0	2.5	1.2	5	1	12.9%	21.9%	42.7%	**15s > 10s, 7s	
КО	0.5	1.1	4	0	0.0	0.2	1	0	0.0	0.0	0	0	7.3%	2.1%	0.0%	*7s>15s	
KOR	0.7	1.0	4	0	0.4	0.6	2	0	0.0	0.0	0	0	11.8%	8.3%	0.0%	**7s > 15s, *10s > 15s	
DO, DOR	0.0	0.0	0	0	0.1	0.2	1	0	0.1	0.3	1	0	0.0%	0.0%	1.2%	ns	
ТК	1.9	1.3	4	0	0.8	0.6	3	0	0.5	0.5	1	0	32.0%	15.6%	8.5%	**7s > 10s, 15s	
КС	0.1	0.3	1	0	0.5	0.9	3	0	0.7	0.8	2	0	2.2%	11.5%	12.2%	**15s, 10s > 7s	
HE, BDTO, SPTO	1.1	0.8	3	0	1.4	1.2	4	0	1.1	1.0	4	0	12.4%	21.9%	13.4%	ns	
n	30				21				14				30	21	14		

Note, SC = Scrum; LO = Lineout; KO = Kickoff; KOR = Kickoff receive; DO = Dropout; DOR = Drop out receive; TK = Tap kick; KC = Kick counter HE = Handling error; BDTO = Breakdown (ruck and maul) turnover; SPTO = Set play (scrum and lineout) turnover

	Actual I	Measu	irement	Value			Percentag			
	7s		105		15S		7s	10S	15S	
	Mean	SD	Mean	SD	Mean	SD				*p<.05, **<.01
Origin of Tries										
Area 1 (0-22m)	1.2	1.1	1.5	1.2	2.3	1.3	20.2%	33.3%	39.0%	**15s > 7s
Area 2 (22-50m)	1.4	1.3	1.3	1.2	2.1	1.3	23.6%	29.2%	35.4%	ns
Area 3 (50-78m)	2.6	1.9	1.0	0.9	1.3	0.9	42.7%	21.9%	22.0%	**7s > 10s, 15s
Area 4 (78-100m)	1.2	1.3	0.4	0.7	0.8	0.8	13.5%	15.6%	3.7%	*10s, 7s > 15s
Number of Passes										
o pass	0.8	0.9	1.0	0.9	1.3	1.3	9.0%	16.7%	18.3%	ns
1-3 passes	2.5	1.6	1.5	1.3	1.1	1.0	44.9%	35.4%	22.0%	**7s > 15s
4-6 passes	1.5	1.2	1.2	1.0	1.4	1.3	25.8%	27.1%	23.2%	ns
7-9 passes	0.7	0.7	0.4	0.7	1.2	0.8	12.4%	12.5%	15.9%	ns
10+ passes	0.5	0.7	0.4	0.8	0.9	0.8	7.9%	8.3%	20.7%	<b>**</b> 15s > 7s, <b>*</b> 15s > 10s
Number of Phases										
1 phase	3.1	1.7	1.9	1.4	2.0	1.7	51.7%	40.6%	34.1%	*7s > 15s
2-3 phases	2.2	1.6	2.1	1.0	1.1	1.2	38.2%	46.9%	19.5%	**10s, 7s > 15s
4-5 phases	0.5	0.7	0.5	0.8	1.2	1.0	9.6%	11.5%	20.7%	*15s > 7s
6+ phases	0.1	0.6	0.0	0.2	1.5	0.9	0.6%	1.0%	25.6%	<b>**</b> 15s > 10s, 7s
n	30		21		14		30	21	14	

 Table 6
 Results of possession origin location of tries, Number of passes and phases in build up to tries

# 4. Discussion

## 4.1. Play cycle

A comparison of play time and number of plays by number of competitors (Table 2-1) reveals that 7s and 10s tend to be similar, and that play time aspects differ from 15s. First, in the number of in-plays converted into 80 minutes, 7s and 10s were approximately 70 times, whereas 15s was only approximately 45 times. On the other hand, the average IPT time was about 27 seconds for 7s and 10s, whereas 15s was significantly longer at just under 40 seconds. In addition, comparison of the hourly frequency of IPT (Table 2-2) showed that 7s played less than 20 seconds, and 10s played more frequently for 20-40 seconds compared to 15s. However, in both 7s and 10s, less than 40 seconds accounted for about 80%, whereas 15s was about 60%, the frequency of more than 60 seconds was 20%. Secondly, the average OPT time was about 45 seconds for 7s and 10s, while the average time for 15s was significantly longer at 68 seconds. It is thought that the difference in the average time due to the difference in the number of competitors is related to the time limit of CG and PG and play choice from the opponent's foul play. In 15s, CG after tries is performed within 90 seconds, and PG is within 60 seconds after indicating the intention, whereas 7s and 10s are within 30 seconds for both CG and PG (Table 1). Also, based on the score and the

a relatively long OPT until restart of the next play. On the other hand, since 7s and 10s exhibit a high rate of selecting TK from the opponent's offense, it is thought that the time until play resumes will be short. However, 15s has approximately 6 tries per game and approximately 4 PGs, so there are about 10-15 long OPTs by kick, and it is thought that OPTs excluding these are shorter than the average. Actually, excluding the time from OPT to tries and PG & DG to the restart of the next play in this study, the average time of each of 7s, 10s and 15s was 20.2 seconds, 20.7 seconds, 41.1 seconds. Times were shorter than the respective IPTs for 7s and 10s, and almost the same for 15s. For these reasons, 7s and 10s have a short play cycle per IPT and OPT, while 15s has a long play cycle. Although there were some differences in actual time, the relationship between the play cycle of 7s and 15s was similar to that of a previous study (Furukawa et al., 2012). It was found that 10s had almost the same aspects as 7s. In addition, the IPT ratio is significantly higher than in 15s, suggesting that 10s is a high-load game in terms of time aspects. Based on the above, when planning training that

number of set plays (**Tables 3-1** and **4**), 15s has many play selections, such as PG or selection of LO from touch kick, to play after an opponent's foul, which is

is conscious of the play cycle, 7s and 10s should be performed with high-load menus of 30 seconds or more at intervals of 20 seconds or less. On the other hand, it is thought that 15s approaches the actual game load by performing high-load menus of 40 seconds or more at intervals of 40 seconds or less. However, since these are the average values of the entire game, when aiming to acquire fitness in a higher dimension, it is necessary to plan training based on data for the time zone with the highest IPT ratio. Since the ratio of IPT to running time of 15s in recent years is approximately 45% (World Rugby, 2007, 2011, 2015), the IPT ratio of the samples used in this study was not high.

### 4.2. Set Plays and Play Activities

LO had characteristics resulting in the number of set plays (Table 3-1). 7s was 12 times lower than the 21 times for 10s and 15s in 80-minute conversion values. Considering the play activity, it is thought that this result is due to kick play including the TK choice from the opponent's offense and the punt kick. The greater the number of competitors is, the shorter the distance between defenders becomes, making it difficult for the attacker to advance beyond the defense line. Since rugby is a battle game, the defender generally arranges players near the gain line according to the number of attackers so as not to pass the gain line. However, since rugby cannot pass forward, it takes at least 6 seconds to move the ball from one end of the ground to the other with the pass, so defenders located far from the ball are near the gain line. Instead, it is possible to take a formation that fills the space behind the kick attack. Normally, the 15s defense system consists of two or more athletes in the rear space in preparation for kick attacks by the attacker and moves forward if the number of defenders in front runs short. In 7s, it is often observed that there is no more than one player in the space behind the defender. Aggressive attack by passing run becomes possible. According to the actual play activity ratio (Table 3-2), 7s and the 10s have one off-road pass for every 7 passes, which is approximately three times that of 15s. This is thought to be due to the difficulty of double tackle between defenders. On the other hand, 15s has a large number of defenses, making it difficult for attackers to easily create spaces and overlaps. Therefore, it is thought that there are many play choices in which the ball is carried to the gain line with as little backward ball movement as possible and breaks the defense with quick attacks. In fact, the ratio of passes and offroad passes to racks and mauls is 1.6, which means

that the number of passes was smaller than that of 7s and 10s, and the number of rucks and malls was large. Furthermore, since defense tactics have been developed in recent years in 15s, it is difficult to break the defense with pass-and-run attacks alone. Therefore, it is necessary to use the pass and kick to attack the space front and back so as not to focus on the defender. In fact, the ratio of passes and offroad passes to punt kicks is 8.7, and the ratio of kicks to passes is 4.7 times that of 7's at 40.5. However, if kicks are used, it is reported that the re-acquisition rate is 50% even for contestable kicks, and 30% or less for uncontestable kicks (Yamashita, 2015). If advance by passing attacks are possible, the priority of kick selection becomes lower. It is presumed that this is affecting the difference in kick play frequency between 7s and 15s.

From the above, the characteristic of 10s is in between 7s and 15s, and the space near the gain line and the space behind the defense line appear appropriately. Therefore, tactics and play selection for attacks on space will be more important. Actually, the TK selection rate from the opponent's foul is considered to be one index to determine whether the emphasis is on territory or pass-run attack. However, the results of this study showed that the smaller the number of competitors is, the higher the TK selection rate becomes (7s: 77%, 10s: 52%, 15s: 13%). In 10s, when foul plays occur, there is almost no difference between situations in which there is space where the pass-run attacks are judged to be effective around the play restart point and situations in which they are not judged to be effective. In the results of play activities (Table 3-1), it is presumed that situations in which the defense occupying the space around the ball carrier is dense or sparse is not significantly biased because extremely low frequency plays are not seen in passes, off-road passes, rucks, and punt kicks. In addition, the aspects of 10s and 15s in kick plays are similar and considered to be proportional to the frequency of LO.

## 4.3. Scoring Tactics

From the result of tries in 80 minutes (**Table 4**), it can be seen that the smaller the number of competitors is, the higher the frequency of tries becomes. Regarding the ratio of each score to the total score, in 10s, the score by PG is approximately 1.0%; however, the score by try exceeds 80% of the whole, and it resembles 7s. On the other hand, in 15s, the

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percentage of tries is low at 60%, and score by PG occupies almost 1/4. The results of frequency of play (Table 2-1) and number of tries (Table 4) show that 7s has 5.9 tries in 15.6 plays per game, or a try rate of 37.8%. A minimum of one try has occurred in three plays. Since the number of tries per game is around 6, if the opposing team makes 4 tries (the other team has 2 tries), at least 3 PGs are required to tie; however, both teams attack. If the number of attacks is equal, that number is approximately 8 each; and it is difficult to imagine that intentionally accumulating 3 attacks at 3 points of PG is an effective measure. Similarly, in 10s, the rate of try scoring is 21.3% and the number of tries is 4-5 when the number of attacks is around 11 for both. Therefore, the three points of PG are effective only if the number of tries is the same or 1 behind (3 tries vs. 2 tries), and at least one CG is not successful. On the other hand, in 15s, both teams have approximately 26 attacks, and the rate of try scoring is 11.5%, which means that one try occurs in 10 attacks. In 15s, score management, which converts PG chances into points, is likely to have an effect on winning or losing. In other words, in 7s and 10s where the match time is short and the rate of try scoring is high, the three points of PG are effective only in the case where the match time is less than two points and the remaining time is short. Therefore, it is more important to increase the success rate of CG than PG. This seems to be one of the factors that makes 7s and 10s scoring tactics that do not rely heavily on PG.

From the result of possession source of tries (Table 5), 15s LO was remarkably high at 42.7%; however, the number of TK increased as the number of competitors decreased. As mentioned earlier, the smaller the number of competitors is, the greater the space between defenders becomes; however, it is expected that 10s will not easily gain by passing attacks compared to 7s. Therefore, since the selection of plays in response to opponent fouls is not limited to TK but also includes touch kick, it is conceivable that the number of tries from LO would increase, and the number of tries from the opponent's half affects more than 60%. Generally, the closer to the opponent's goal, the more defenders fill the area around the gain line. Therefore, the space between defenders is narrower, making gains more difficult. In particular, 15s is considered to be greatly affected by this. Koyanagi (2019) emphasized the importance of play selection other than pass-run attacks in the opponent

area because the winner uses more punt kicks in the opponent's area than the loser in the top 15s in Japan rugby. Recently, BK as well as FW participated in maul attacks from LO in front of the goal in many cases; and in 14 of the 15s games sampled in this study, 16 out of 35 tries were from LO mauls. Even in 10s, LO, together with TO, is an important possession source of tries that account for more than 20% of all tries; however, out of the 21 tries, only one was from LO maul. In other words, it is presumed that LO in 10s are not set pieces in forming mauls, but rather possession sources for scoring tries. Compared to 15s, the attack space is larger; therefore, actual score tries are in plays other than mauls.

According to the results of original location of possession source of tries (Table 6), approximately 40% of tries occurred from within the opponent's 22m area (Area 1), and 75% from the opponents half in 15s. 10s also exceeds 60% from the opponents half, and the tendency is that the closer possession sources are to the opponent's goal, the easier it is to score tries. On the other hand, in 7s, score tries from within the area of the 22m line from the halfway line (area 3) exceed 40%; and tries from the own half accounted for 55% or greater. This indicates for the specificity of 7s that it is highly possible to score tries from any area. Regarding the number of phase attacks preceding tries, 7s attempted more than 50% of tries in the first phase attack. It is 40% even in 10s and tries within the third phase attack account for almost 90% of the total. This suggests that pass-run attacks or off-road passes could be used to break through the line of defense without forming rucks. It can be said that this is characteristic is very advantageous for the side holding and attacking the ball. On the other hand, in 15s, the try ratio in the first phase attack is 1/3 of the total; however, this is largely due to sign play that takes advantage of the maul and set play in front of the goal. Since the ratio of tries after the second phase attack is 20-25% and no significant difference is apparent, it is presumed for 15s that tactics through which the attack order is systematically repeated while passing, contacting and further kicking to break the opponent's defense are needed. The number of passes, phase attacks preceding tries tend to be similar between 7s and 10s; however, 10s and 15s have no passes (16.7%, 18.3%) and the number of tries from area 1 (33.3%, 39.0%) is 1.5-2 times that of 7s. It can be considered for 10s and 15s that the power play, which cannot be seen in 7s, affects the offense's

ability to move forward with one pass or carry the ball directly from the rucks in front of the opponent's goal.

# 4.4. Characteristics of 10s and required abilities and skills

Based on the results and considerations thus far, 7s has few attacks starting from areas gained by kick or SC and LO, and is characterized by attacks mainly from passes and runs from all areas. In 15s, since the number of tries increases as possession sources of the attack approach the opponent's goal, there is a strong tendency to select plays that gain the area by kicking. Although there are many tries from LO in 15s, the number of phase attacks (rucks) before scoring tries is greater than in 7s and 10s; therefore, the importance of contact play is increased. On the other hand, as with 7s, 10s has play aspects of pass-run attacks between defenders or spaces; however, the number of rucks and off-road passes occurs more than in 7s. Therefore, it is necessary to balance speed and contact skills. If the defender fills the area around the gain line when playing pass and run attacks, the number of defenders is not as great as 15s; however, interrupting the defense by using a punt kick to the space created behind the defense line is also effective. Therefore, the need for control kicks that accurately transport the ball to the intended point is higher than for long kicks, which are often seen in 15s and whose main purpose is distance. Also, as with 7s, other than drop kicks, CG and PG are prohibited in 10s, making drop kicks the only scoring method other than a try. In addition, since the frequency of play is higher than that of 15s, it is an important skill used in restart kicks, including kick-off, which accounts for approximately 10% of the possession source of tries (7s is approximately 20%). It is necessary to acquire skills that focus on accuracy rather than distance. And, in set plays, there are many LOs, and taking advantage of the battle here will lead to the initiative of the game. 10s has more FW players than 7s does; therefore, the tactical options, including the number of players making up the LO, increase, and the importance of LO skill increases. Furthermore, since the number of plays per game is approximately 11, scrum ball acquisition also affects the outcome. The scrum is performed by 5 people; however, because there are two rows in front and back, there are many cases in which props and hookers of 15s, which have specialized training, are

assigned. However, in the phase play after set plays, situations called "mismatch" occur, situations in which players face the opponents' backs. Therefore, speed and endurance are required to move in a large space, and the ability and skill to balance at an advanced level are also required. Extremely slow or weak contact plays are likely to be a major weakness of the team.

# 5. Conclusion

# 5.1. Characteristics by number of competitors

The purpose of this study was to clarify the characteristics of 7s, 10s, and 15s competition to compare and verify aspects of game performance. We examined 65 world-class rugby 7s, 10s and 15s games. As a result, the following conclusions were obtained:

- 1) As the number of competitors increases, the inplay time per game increases. 7s played 50% of the time in less than 20 seconds, and 15s played more than 60 seconds in 20%. 7s and 10s both played within 40 seconds at 80%, similar in play time and frequency.
- 2) The smaller the number of competitors is, the higher the rate of try scoring per play time becomes. In addition, the smaller the number of competitors is, the higher the rate of tap kick selection becomes; therefore, the percentage of try from tap kicks is high. On the other hand, it became clear that the larger the number of competitors is, the greater the increase in the ratio of punt kick as well as ruck and maul to passes becomes.
- 3) The larger the number of competitors is, the more likely the origin of tries tends to occur in front. 15s had 40% of the total tries from within the opponent's 22m area and 75% form the opponent's half, whereas 7s had 40% inside of the area from the own 22m line to the halfway and 55% from the opponent's half. Both showed conflicting results in the superiority of the area.
- 4) The smaller the number of competitors is, the more likely the number of phase attacks preceding tries is to be small. In 7s, tries from the first phase attack exceeded 50% of the total. 10s had the highest number of tries in 2-3 attacks, with 47%. 15s had 25% of tries from 6 or more attacks, which are rarely seen in 7s and 10s.

## 5.2. Features and future of 10s

Finally, we summarize the competitive characteristics and future prospects of 10s, which had not been studied to date, from the results of research on the world's top-level games.

10s has features that show the game aspects of starting with a set play from the area gained by kicking seen in 15s; however, once plays begin, scoring tries by pass and run attack are continuously and aggressively seen in 7s. In front of the opponent's goal, there are few maul attacks, which is one of the main tactics of 15s; however, power plays such as repeated pick attacks and one-pass attacks from rucks that cannot be seen in 7s are performed. In addition, 10s has greater set plays and play activities, making games more multifaceted with many skills and tactics employed. 10s is a game in which the characteristics of 15s and 7s coexist.

At present, 10s is not major in terms of popularization in domestic and overseas penetration; however, the skills and abilities required for competition, including 7s and 15s, are considered to have very useful characteristics in current and near future rugby competitions. In Japan, 10s is being used as an alternative to 15s for a limited age and target; however, it covers many of the skills and tactics required for 7s and 15s; and it is suggested that there is great potential for the development of rugby players.

## Notes

1. In this paper, similar to Nakagawa (2011), the term "game" or "rugby game" is used to represents the abstract concept of rugby football played according to formal rules, and the term "match" refers to what actually appears.

#### Reference

- Alex, R., Nicholas D. G., and John, B. C. (2015). A comparison of the match demands of international and provincial rugby sevens. Int. J. Sports Physiol. Perform., 10: 786-790.
- Dean, G. H., Will, G. H., David, B. P., and Judith, M. A. (2014). Performance indicators related to points scoring and winning in international rugby sevens. J. Sports Sci. Med., 13: 358-364.
- Furukawa, T., Shimasaki, T., Nishimura, K., and Nakagawa, A. (2012). Game aspect of sevens rugby at world top-level in recent years: Examination through comparison with fifteen-aside rugby. Football Science., 9: 25-34. (in japanese)
- Foundation of All Japan High School Athletic Federation. 2003

Membership Registration Status. https://www.zen-koutairen. com/pdf/reg-15nen.pdf. (accessed 2019-08-06). (in japanese)

- Foundation of All Japan High School Athletic Federation. 2018 Membership Registration Status. https://www.zen-koutairen. com/pdf/reg-15nen.pdf. (accessed 2019-08-06). (in japanese)
- Giampietro, G., Tim, J. G., Gianluca, B., Johnny, P., Antonio, B., Stefano, D., and Bruno, R. (2013). Match analysis and temporal patterns of fatigue in rugby sevens. J. Strength Cond. Res., 28: 728-734.
- Kajiyama, T., Kurokawa, T., Furuta, H., Ooe, J., Hori, K., Matsuo, C. (2006). Time course and estimation of the heart rate during and after mini-soccer games. Journal of Methodology of Sports., 19: 21-30. (in japanese)
- Koyanagi, R. (2019). A study of rugby punts in Japan's top level league: Case studies of winning teams. Football Science., 16: 10-15.
- Nakagawa, A. (2011). A review of studies using notational analysis of game performance in rugby union football. Bull. Inst. Health & Sport Sci., Univ. of Tsukuba., 34: 1-16. (in japanese)
- Ohtsuka, D., Kurokawa, T., Kajiyama, T., Deguti, T., Moriki, G., Nishiyama, K. (2013). Exercise intensity of rugby sevens from the viewpoint of heart rate and RPE. The Japan Journal of Coaching Studies., 27: 33-43. (in japanese)
- Onishi, T. (1999). "Toso no rinri, sports no hongen wo tou" [Ethics of fight, Ask the principal of sports] (pp.89-93). Chuokoronsha Inc., Tokyo. (in japanese)
- Shimazaki, M. (2015). "Rugby no kyouikuteki kachi" [Educational Value of Rugby Football]. The Journal of Japanese Society of Science and Football., 10: 26-31. (in japanese)
- Tsuda, R., Shinozaki, T., Goto K., Takamatsu, K. (2007). Load characteristics of mini games in soccer from the viewpoint of improvement in physical fitness: The effect of differences in court area and the number of players. International Journal of Sports and Health Science., 5: 42-53. (in japanese)
- Watanabe, I., Saito, T., Katsuta, T., Miyao, M., Kono, I. (1999). A study on the game aspect of seven-a-side rugby: Analysis of in-play time and out of play time in international competitions. Reports on Sports Science., 1: 135-141. (in japanese)
- World Rugby (2007). Rugby World Cup 2007 Statistical Report. World Rugby Game Analysis. http://playerwelfare.worldrugby. org/?documentid=156. (accessed 2019-08-06).
- World Rugby (2011). Rugby World Cup 2011 Statistical Report. World Rugby Game Analysis. http://playerwelfare.worldrugby. org/?documentid=156. (accessed 2019-08-06).
- World Rugby (2015). Rugby World Cup 2015 Statistical Report. World Rugby Game Analysis. http://playerwelfare.worldrugby. org/?documentid=156. (accessed 2019-08-06).
- World Rugby (2018). Law of the game. World Rugby House: Ireland, (p.2). (in japanese)
- Yamashita, K. (2015). A study on the transition of playing aspects and the efficiency of "contest kicks" in rugby union. 2015 Master's Thesis in Master's programs in Health, Physical Education and Sport Sciences, the University of Tsukuba. (in japanese)



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#### Main Works:

- Game aspect of sevens rugby at world top-level in recent years: Examination through comparison with fifteen-a-side rugby. Football Science., 9, 25-34, 2012.
- Practical applications and possibility of GPS technology in rugby coaching. The Japan Journal of Coaching Studies., 26, 187-196, 2013.
- Study on the score aspect of sevens rugby football game in men and women. The Japan Journal of Coaching Studies., 33, 161-173, 2020.

#### Membership in Learned Societies:

- Japan Society of Physical Education, Health and Sport Sciences
- The Japan Society of Coaching Studies
- Japanese Society of Science and Football