Comparison of Attacking Plays by Setting the Number of Players in Small-Sided Games of Soccer

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The present study aimed to determine the effects of the number of players on the playing style of junior high school students in small-sided games (SSG). The participants were 40 young male soccer players (age: 12.73 ± 0.63 years). The number of SSG players was set at 3 vs. 3 + 2 goalkeepers (GKs), 4 vs. 4 + 2 GKs, and 5 vs. 5 + 2 GKs, and the attacking play was measured using notational analysis. Statistical analysis was performed by unpaired t-test and χ^2 test. 3 vs. 3 had more passes to the GK than 4 vs. 4. Additionally, the occurrence rate of "dribbling" in the process leading to shooting was higher than 5 vs. 5. 4 vs. 4 had a higher occurrence rate of "forward direction" passing than 3 vs. 3. 5 vs. 5 had a higher number of passes and consecutive passes than 3 vs. 3 and 4 vs. 4. Also, the occurrence rate of "one-touch" in the process of shooting was higher than in 3 vs. 3. These results propose that 3 vs. 3 is characterized by individual goal scoring and GK's participation in the attack, 4 vs. 4 is characterized by forward passing, and 5 vs. 5 is characterized by goal scoring with passing as a team.

Keywords: small-sided game, notational analysis, performance analysis

1. Introduction

Technical and tactical training in ball games is organized by working backward from the desired game image (Japan Coaching Association, 2019). Nakayama and Asai (2010) stated that, despite the diversity of soccer training methods, there has been little verification of training effectiveness. Additionally, they stated that "by analyzing the skills shown in individual training, it will be possible to develop training methods more effectively," showing the need for an extensive analysis of the effect of individual training.

Skills acquisition has been examined based on biological, environmental, and task constraints (Davids et al., 2008). According to Nakayama et al. (2007), adding a defender to the triangle pass, a training method for enhancing passing skills, primarily affected the rotation angle of the shoulders before receiving a pass, and that novices began doing similar movements to skilled soccer players. Natsuhara et al. (2017) also stated that "in actual teaching situations, training is conducted to enhance the perception and motor skills by constraining different conditions, such as the size of the playing area and the number of players." Additionally, following the Nakayama and Asai (2009), "by designing the environment and devising tasks based on the individual's biological features, learners can draw out their intended movements and obtain skills without awareness." These conditions, environment, and tasks during training are described as "organizing" in soccer (Japan Football Association (JFA), 2007), and comprises the size and shape of the grid, goal setting, and placement, number of players, the starting position, pitch distribution from the coach, setting of conditions and rules, defensive (offensive) control, time, and others. It consists of the grid's size and shape, setting and goal placement, the number of players, the starting position, the

pitches from the coach, condition settings and rules, defensive (offensive) control, time, and others. From the above, it can be concluded that one of the most essential factors in developing good players is the intentional manipulation of organization and training construction.

In soccer, "small-sided games (SSG)" (Aguiar et al., 2012), in which the number of players is reduced, and the pitch size is smaller than in an actual game, is used as a training to increase the frequency of play by the players while maintaining the physical, technical, and tactical elements required in an actual game. And SSG played with four players versus four players (4 vs. 4) is considered critical globally as the smallest unit that includes different elements of the soccer game (JFA, 2017). Most studies of SSG have examined the heart rate, subjective exercise intensity, physical fitness, and technical features (Aguiar et al., 2012; Owen et al., 2011, 2014). The subjects range from elementary school students to professional soccer players, and many studies had examined the difference in playing styles when the number of participants was adjusted (Brandes et al., 2012; Gabbett and Mulbey, 2008). Owen et al. (2011) compared the heart rate and technical behavior of 3 vs. 3 and 9 vs. 9 SSG in Scottish professional soccer players. They found that 3 vs. 3 had a higher percentage of high-intensity movements and a higher occurrence of dribbling, shooting, tackling, and personal ball contact, while 9 vs. 9 had a higher percentage of medium-intensity movements and a higher blocking occurrence of blocking, heading, and pass-cutting. Furthermore, the tendency to increase the percentage of high-intensity movements and the number of individual plays when the number of players is low is common in other studies (Katis and Kellis, 2009). This shows that training to show individual talents under high-intensity exercise needs fewer participants (Jones and Drust, 2007).

Following the JFA (2017), the concept of training in the junior high school-age group (U-14) and the features of this age group include "the importance of repetition under severe defensive pressure," "training to show skills under high-intensity and top speed movements," and "significant growth of endurance ability." This shows that junior high school-aged players should repeatedly train at high-intensity to enhance their endurance to exhibit the skills they have acquired so far under more serious defensive severe pressure and at faster speeds. **Table 1** indicates the results of this study. As previously stated, SSG can ensure many ball contacts for individuals engaged in high-intensity exercise. From the above, it can be inferred that SSG is effective for the technical training of junior high school-age players.

As previously stated, many studies have been performed on SSG, and there are several findings on the change in playing style when the number of players increases or decreases. However, in most previous studies, the pitch size was changed along with the number of players. Therefore, it was challenging to conclude whether the variation in playing style was due to the number of players or the pitch size, which is a hurdle in the research on SSG (Aguiar et al., 2012). Additionally, although some studies have examined changes in the playing style by varying the pitch size with a fixed number of players (Kelly and Drust, 2009), few studies have examined changes in the number of players with a fixed pitch size (Sanchez-Sanchez et al., 2017). In practice, there are training methods, where the number of players is adjusted using the same pitch size; therefore, clarifying the variations in the aspect of play owing to changes in the number of players on a fixed pitch size would provide practical knowledge in determining the organization.

Additionally, owing to rule changes and tactical influences in modern soccer, goalkeepers (GKs) should be involved in attacks (Liu et al., 2015; Peráček et al., 2017). However, in several studies that analyzed SSG play patterns, the play patterns of GKs were undetermined, which is another issue. The purpose of this study is to determine the effects of the number of players on the playing style of junior high school students in SSG.

2. Materials and methods

2.1. Participants

The participants were male forty junior high school soccer players (age: 12.73 ± 0.63 years, height: 155.65 ± 7.82-cm, weight: 44.70 ± 7.39-kg). All participants belonged to the same team and received continuous professional soccer instruction. The prefectural soccer associations organize the teams that participate in the U-15 league (1st division). The playing style of the participant's team was more oriented toward a direct style rather than a possession style, emphasizing learning the principles of soccer.

2.2. Design

2.2.1. Pitch and goal size

According to Brandes et al. (2012), the pitch size was fixed at 33 m in length and 40.32 m in width (**Figure 1**). A regular-sized goal (2.44 m in length and 7.32 m in width) was used.
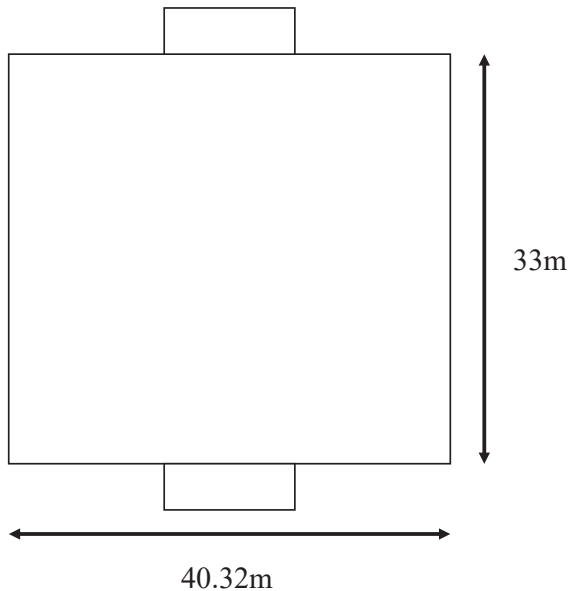

Figure 1 Pitch size

2.2.2. Number of players

The number of players was centered on 4 vs. 4, since "SSG played by four players against four players is the smallest unit that includes various elements of the soccer game" (JFA, 2017), and the following three types were set up by increasing or decreasing the number of field players by one. (1) 3 vs. 3 + 2 GKs, (2) 4 vs. 4 + 2 GKs, and (3) 5 vs. 5 + 2 GKs.

2.2.3. Number of matches and match duration

There were forty-five matches played in total, fifteen in each number set. The duration of the matches was four minutes per match, measured in running time, which did not stop when the ball left the pitch.

2.2.4. Rules

When the ball goes off the pitch, the waiting players quickly replenish the ball to shorten the match's interruption. For this similar reason, corner and free kicks (including penalty kicks) are not adopted. In these cases, the game is restarted from a goal kick by the attacking team's GK, and offside rules are not adopted. The goal kick by the GK of the attacking team was used to restart the game. There was no intervention or feedback given during or between games. The teams were randomly selected because the opposing teams had the same ratio of students in the same grade. The coaches discussed and fine-tuned the teams to avoid extreme skill and physical strength differences. After one match was completed, another group of players played against each other until the number of matches was reached. All players played in all number settings.

2.2.5. Location and date

The experiment was conducted on an artificial turf soccer field owned by the participants' team. The dates and times were the mornings of July 24, 25, and 26, 2017. To account for fatigue, we conducted 3 vs. 3 + 2 GKs on July 24, 4 vs. 4 + 2 GKs on July 25, and 5 vs. 5 + 2 GKs on July 26. There was no significant difference in climate as it was sunny on all days.

2.2.6. Recording method

A digital video camera was used to capture images of the entire pitch from 10 m and at the height of 10 m. Each item was measured by playing and pausing the recorded video using the playback player function. To reduce the error in measuring game performance from the video, a stadium scale map used in the descriptive analysis (Hughes, 2003), a method that has been widely used in game analysis was applied, to obtain location information, according to Suzuki et al. (2019).

2.3. Measurement items

To set the measurement items, factors related to attacking performance were initially obtained based on previous studies (Casamichana and Castellano., 2010; Dellal et al., 2011). Three specialists with experience in soccer coaching and who were involved in research activities added elements, and the results were thoroughly analyzed the results. Additionally, the validity of the measurement items was improved through via final confirmation by the other two experts. The following is a description of each measurement item.

2.3.1. Number of plays per player in a game

The total number of plays in a game was divided by

the total number of players, including the GK, from the moment a teammate or opponent first touches the ball to the moment it was lastly touched by another player or before it went out of play.

2.3.2. Ball touches per play
The number of times a player touches the ball in a single play.

2.3.3. Number of passes
The number of times a teammate touches a ball from the ball carrier, except for goal kicks by the GK and throw-ins when the ball has gone off the sideline.

2.3.4. Passing direction
A line drawn parallel to the goal line from the ball carrier's player at the moment of the pass is 0°. The ball is classified into three types based on the angle of the pass. (1) "Forward": passes to teammates in the range of 45° to 135° relative to the offensive direction, (2) "Lateral": passes to teammates in the range of 135° to −135° and 45° to −45°, and (3) "Backward": passes to teammates in the range of −135° to −45 ° (**Figure 2**).
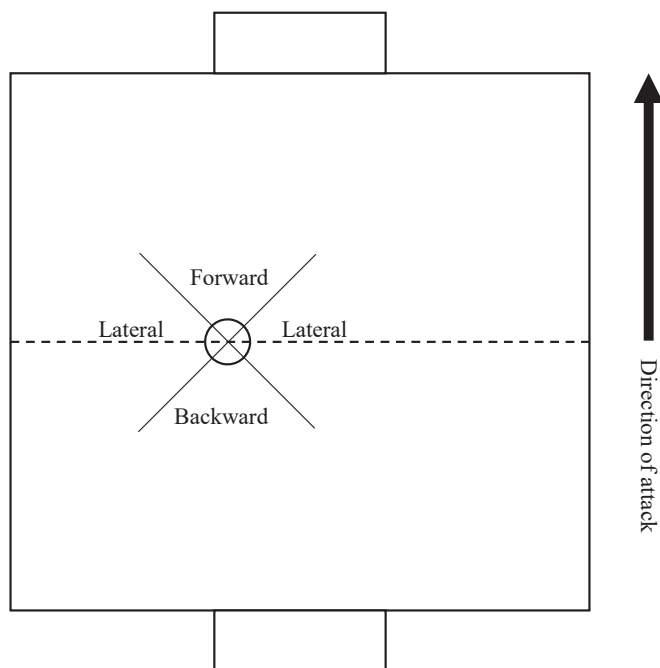

Figure 2 Passing direction

2.3.5. Number of consecutive passes
The number of consecutive passes is the number of passes connected by the ball-carrying team when one team has possession of the ball, before a player of the non-ball-carrying team touches the ball. It is classified into three categories: (1) one to three passes, (2) four to six passes, and (3) seven or more passes, referring to Barreira et al. (2016).

2.3.6. Number of passes to GK
The number of passes made by a field player to his teammate's GK.

2.3.7. Number of dribbles
The number of times a ball is dribbled when the ball carrier makes three or more touches.

2.3.8. Number of shots
The number of shots in each game.

2.3.9. The process leading to the shot
The plays leading to a shot were classified into four types and measured. (1) Pass receive (one-touch): shooting with one-touch after a pass from a teammate, (2) Pass receive (two touches): shooting with the second touch after a pass from a teammate, (3) Dribbling: taking three or more touches before shooting, and (4) Others: when a player takes the ball from an opponent and shoots it within two touches, or shoots a ball that is stopped by the GK or hits the goal post, or other situations that do not fall under (1) to (3).

2.4. Statistical analysis

2.4.1. Objectivity
Hirashima et al. (2014) and Landis and Koch (1977) were used as references to examine the objectivity of the measurement items, and the degree of agreement of the analysis records between the two analysts was investigated. The author and another person with expertise in playing and coaching soccer, who is involved in scientific studies on soccer, performed the same analysis of three matches. Based on the results of these two analyses, intra-class correlation coefficients were calculated for continuous variables and kappa coefficients for categorical variables.

2.4.2. Comparison in each player setting
A one-way analysis of variance was performed for the number of plays per player, the number of ball touches per play, the number of passes, the number of consecutive passes, the number of consecutive passes

in an attack that led to a shot, the number of passes to the GK, number of dribbles, and number of shots in a match. When significant differences were detected, multiple comparisons were performed as a backward test using Ryan's method. A χ^2 test was conducted for the other items, and when a significant difference was found, the residual analysis was conducted as a subtest. The level of statistical significance was set at less than 5% for all items.

2.5. Ethical considerations

This study was conducted after an application to the university's Research Ethics Committee where the author belongs, for a review of the research plan, etc. (including the research purpose, procedures, analysis methods, and matters concerning the handling of materials and personal information). After the strict review procedures were completed, approval from the Ethics Committee and the university's president was obtained (Approval No.: 21010).

3. Results

3.1. Agreement of the analytical records

The kappa coefficients of the analytical records ranged from 0.93−1.00 for all items, with a high average of 0.96. The intra-class correlation coefficients ranged from 0.87−1.00 for all items and were as high as 0.98 on average (**Table 1**).

3.2. Measurement items

The number of plays per player in a single game was significantly higher in 3 vs. 3 than in 4 vs. 4 and 5 vs. 5 (F = 37.708, df = 2, p < 0.05), (F = 37.708, df = 2, p < 0.05). The number of passes per game in 5 vs. 5 was significantly higher than in 3 vs. 3 and 4 vs. 4 (F = 13.14, df = 2, p < 0.05). In the passing direction, 4 vs. 4 had a significantly greater occurrence rate of "forward" direction than 3 vs. 3, and 3 vs. 3 had a significantly higher occurrence rate of "lateral" direction than 4 vs. 4 and 5 vs. 5. There was no significant difference in the "backward" direction (χ^2 = 7.965, df = 4, p < 0.05). In the occurrence rate of "1–3 passes," 4 vs. 4 was considerably greater than 5 vs. 5, while 5 vs. 5 was significantly higher than 4 vs. 4 in the occurrence rate of "4–6 passes" (χ^2 = 16.919, df = 4, p < 0.05). The number of passes to the GK was significantly higher in 3 vs. 3 than in 4 vs. 4 (F = 5.196, df = 2, p < 0.05). In the process leading to the shooting, it was discovered that 5 vs. 5 had a significantly greater occurrence rate of "one-touch" than 3 vs. 3, and 3 vs. 3 had a significantly higher occurrence rate of "dribbling" than 5 vs. 5 (χ^2 = 13.933, df = 6, p < 0.05). The number of ball touches, dribbles, shots, and shooting area did not differ significantly (F = 6.305, df = 2, p = 0.053, F = 1.698, df = 2, p = 0.195, F = 1.779, df = 2, p = 0.181, F = 2.691, df = 2, p = 0.079, χ^2 = 4.087, df = 4, p = 0.394).

Table 1 Agreement rate of measurement items

Measurement items	κ coefficient
Passing direction	0.93
Number of consecutive passes	0.96
Shooting area	1.00
The process leading to the shot	1.00

Measurement items	Intraclass correlation coefficient
Number of plays per player in a game	1.00
Ball touches per play	0.87
Number of passes	1.00
Number of passes to GK	1.00
Number of dribbles	1.00
Number of shots	1.00

Table 2 Comparison of measurement items

|	3vs.3				4vs.4				5vs.5				
	M	SD	MIN	MAX	M	SD	MIN	MAX	M	SD	MIN	MAX	*p<.05
Number of plays per player in a game	7.1	0.6	6.2	8.0	5.6	0.6	4.5	6.8	5.3	0.7	4.1	6.6	*3vs3>4vs4, 5vs5
Ball touches per play	2.9	0.2	2.5	3.3	2.8	0.3	2.3	3.2	2.7	0.3	2.1	3.1	n.s.
Number of passes	21.1	3.4	14.0	26.0	22.1	4.6	11.0	29.0	29.8	6.7	16.0	39.0	*5vs5>3vs3, 4vs4
Number of passes to GK	4.0	1.3	2.0	7.0	2.2	1.9	0.0	8.0	2.9	1.3	0.0	5.0	*3vs3>4vs4
Number of dribbles	20.7	3.5	15.0	26.0	20.2	4.3	15.0	28.0	22.8	4.0	13.0	28.0	n.s.
Number of Shots	10.3	2.9	6.0	19.0	11.3	1.5	9.0	14.0	9.5	1.6	6.0	12.0	n.s.
Number of passes leading to the shot	1.2	0.6	0.5	2.3	0.9	0.4	0.5	1.6	1.2	0.6	0.3	2.0	n.s.
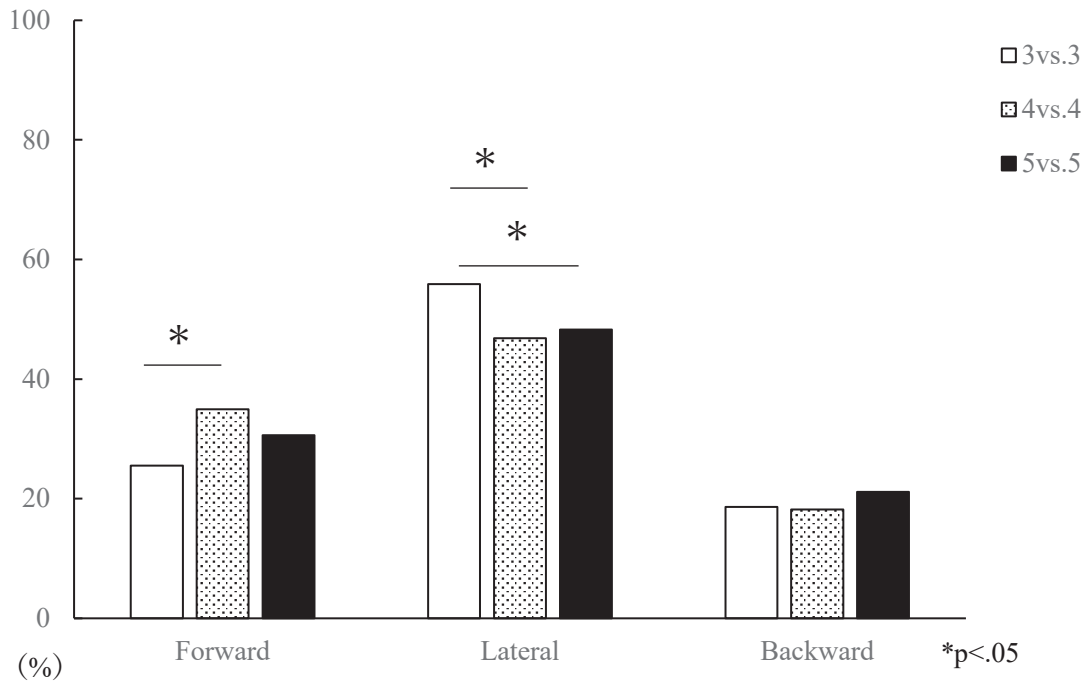
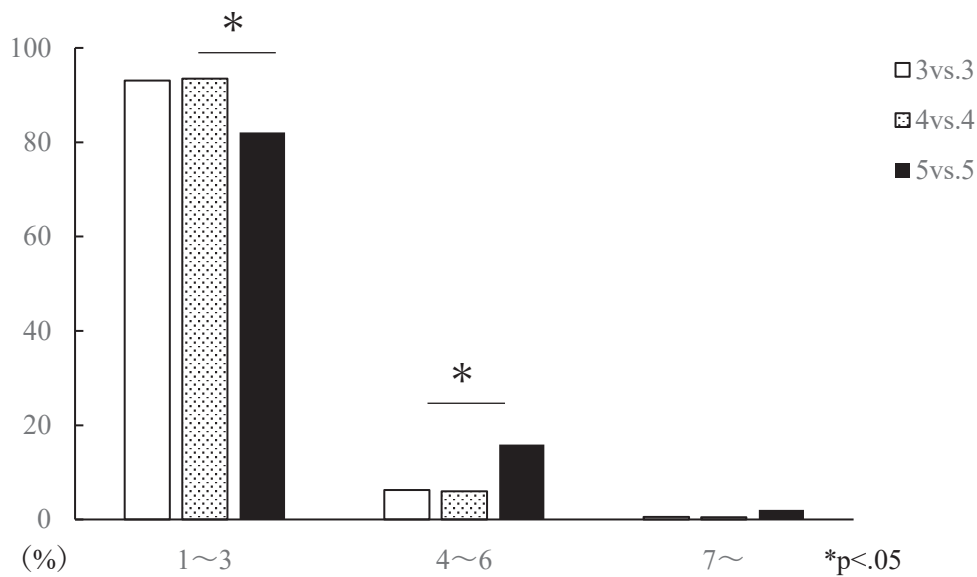**Figure 3** Comparison of passing direction

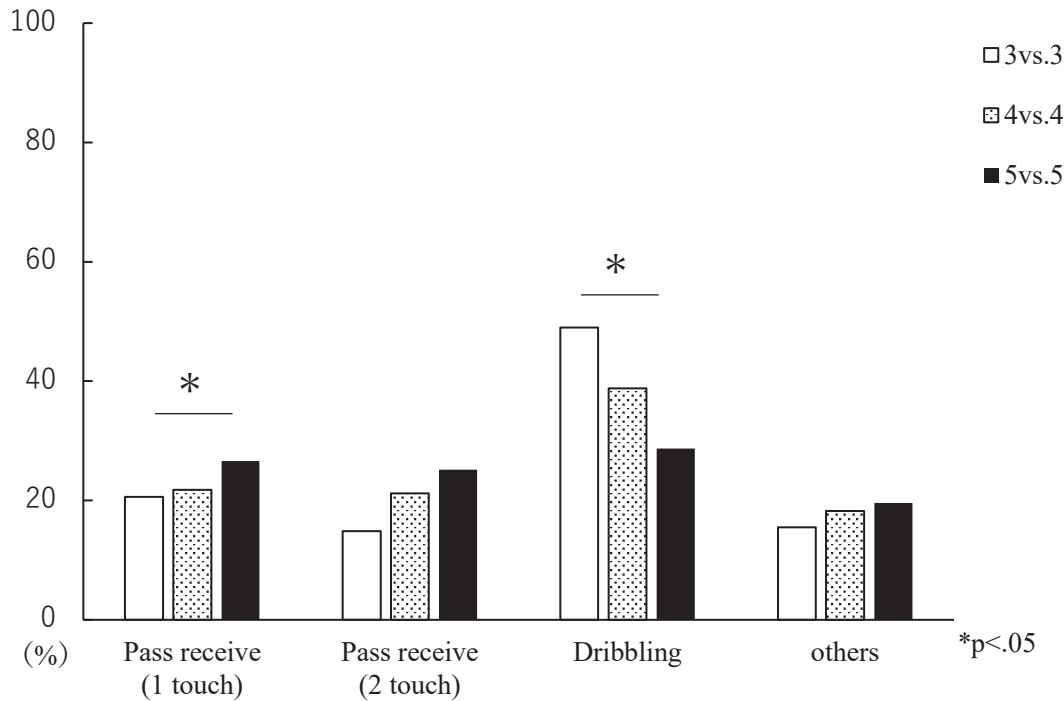**Figure 4** Comparison of Number of consecutive passes

Figure 5 Comparison of the process leading to the shot

4. Discussion

This study determined the effects of the number of players on the playing style of junior high school-aged students in SSG. First, the number of plays per player in a single game was significantly higher in 3 vs. 3 than in 4 vs. 4 and 5 vs. 5 (**Table 2**). Jones and Drust (2007) reported that the number of plays per player was significantly higher in 4 vs. 4 than in 8 vs. 8, showing that fewer players may be more effective in acquiring skills by increasing the number of plays. The results of this study support the findings of a previous study. However, in this study, there was no significant difference in the number of plays between 4 vs. 4 and 5 vs. 5. Therefore, it was inferred that the number of players should be decreased to 3 vs. 3 from 5 vs. 5 if the number of plays is increased.

In the process leading to the shooting, the occurrence rate of "dribbling" was significantly higher in 3 vs. 3 than in 5 vs. 5, and the occurrence rate of "one-touch" was significantly higher in 5 vs. 5 than in 3 vs. 3 (**Figure 5**). This may be because the number of ball touches per play in 3 vs. 3 was significantly higher than in 5 vs. 5 (**Table 2**). In this study, "dribbling" was defined as having three or more ball touches. Therefore, the higher the number of ball touches, the higher the occurrence rate of dribbling. Owen et al. (2011) analyzed the differences in skills

between 3 vs. 3 and 9 vs. 9 players in the Scottish Premier League and reported that 3 vs. 3 players had more touches and dribbles per player per game than 9 vs. 9 players. The results of this study exhibited a trend similar to the previous study. Alternatively, 3 vs. 3 is characterized by a high number of ball touches per player and a high dribbling rate. The increase in the number of touches per player in 3 vs. 3 is that one player occupies more space in 3 vs. 3 than in 5 vs. 5, and there are fewer teammates, so there are fewer passing courses. These factors could have made dribbling easier, increasing the number of ball touches per player. These factors could have made dribbling an easier choice, increasing the number of ball touches per player. However, there are more pass routes in a 5 vs. 5 game because there are more players on the same side, but each player occupies less space, and the distance between them is shorter, making them more likely to be pressured by opponents. Under intense pressure from opposing players, the offense must make quick decisions (Power et al., 2017). Therefore, 5 vs. 5 needs quick decision-making and a more skillful play than 3 vs. 3, and the number of touches on the ball is decreased, resulting in a higher shooting rate with one-touch.

The number of passes and the occurrence rate of "4–6" consecutive passes was significantly higher in 5 vs. 5 than in 3 vs. 3 and 4 vs. 4 (**Table 2** and

Figure 4). In the case of 5 vs. 5, the number of passes was significantly higher than in 3 vs. 3 and 4 vs. 4. According to Owen et al. (2014), the number of passes was higher in 4 vs. 4 than in 5 vs. 5. However, in this previous study, 4 vs. 4 used a 30 × 25 m pitch and 5 vs. 5 used a 46 × 40 m pitch, so the space occupied by one person was 94 m^2 in 4 vs. 4 and 184 m^2 in 5 vs. 5, which was larger in 5 vs. 5. In this study, the space occupied by one person was 150 m^2 in 4 vs. 4 and 120 m^2 in 5 vs. 5, which was smaller in 5 vs. 5. However, it can be inferred that if the space occupied by one player is too small, it will be challenging to connect passes; therefore, future research should include an analysis of games with more players on the pitch size of this study. Furthermore, Silva et al. (2014) compared the tactical behavior of Portuguese U-11 players in 3 vs. 3 and 6 vs. 6. They discovered that 6 vs. 6 had a higher incidence of play that prioritized ball retention than 3 vs. 3. This is because the smaller the number of players, more one-on-one situations there are. The more goal-oriented play there is in the attacking phase, while the larger the number of players, the more tactical actions are taken to balance the defensive organization. The attacking team prioritizes passing and ball retention. In this study, the occurrence rate of "4–6" consecutive passes in 5 vs. 5 was higher than in other settings, possibly due to the same factor. Abrantes et al. (2012) reported no significant difference in the number of passes between 3 vs. 3 and 4 vs. 4; and this study revealed the same result. This previous study also yielded similar results. However, since the number of consecutive passes may be affected by the team's attacking style, it is necessary to verify this in detail by increasing the number of target teams in the future.

In terms of passing direction, 4 vs. 4 was significantly higher than 3 vs. 3 in the "forward," and 3 vs. 3 was significantly higher than 4 vs. 4 and 5 vs. 5 in the "lateral" (**Figure 3**). JFA (2012) cited "width and depth" as an attack principle. The appropriate horizontal and vertical distance between players can create space, provide good support, and increase the possibility of a breakthrough. Furthermore, Hayashi (2012) recommends taking a "diamond" position to effectively connect vertical, horizontal, and backward passes with the appropriate "width and depth." A diamond is a rectangle formed by two players, one standing toward the opponent's goal and one toward their own goal, with an appropriate width between them. To form a diamond in 3 vs. 3, the GK must be

involved in the attack. Still, suppose the GK passes the ball to a player standing toward the opponent's goal and loses the ball. In that case, it is difficult for the other players to defend presently, and the GK must be able to defend himself. There is a high risk of creating a one-on-one situation with the GK. In 4 vs. 4, the risk is lower than in 3 vs. 3 because players other than the GK can form the "diamond" formation, and even if a pass to a player standing toward the opponent's goal is intercepted, the player who passed from behind can defend. This shows that 4 vs. 4 had a higher occurrence of "forward" passes than 3 vs. 3.

Furthermore, 3 vs. 3 has a higher incidence of dribbling than 4 vs. 4 because the space occupied by one player is more significant. It is possible that the players selected dribbling more often as a means of advancing, coupled with fewer passing courses. In soccer, forward passes are less successful than lateral and backward passes, but they are more likely to generate goals and scoring opportunities (Power et al., 2017; Hughes, 1980). Therefore, increasing the number of forward passes is vital in an attack, and that 4 vs. 4 may be more effective than 3 vs. 3 as a training tool.

The number of passes to the GK was significantly higher in 3 vs. 3 than in 4 vs. 4 (**Table 2**). This may be because 3 vs. 3 needs the GK to participate in the attack to form the "diamond" formation mentioned earlier. In terms of the frequency of goalkeeping plays during a match, GKs are usually involved in attacks (Peráček et al., 2017) than in defending the goal (e.g., shot-stopping), and GKs of higher-ranked teams have a higher success rate in passing than GKs of other teams (Liu et al., 2015). This indicates that GKs in modern soccer are needed to protect the goal in a match and to be involved in attacking plays, such as passing plays, at a high level. To learn such attacking skills of GKs, 3 vs. 3 with much participation by GKs could be adequate training. In the SSG of 33 m (length) and 40 m (width), the differences in the playing style between the two types of players were shown.

5. Conclusion

This study determined the effects of the number of players on the playing style of junior high school students in SSG. Therefore, the following conclusions were obtained: First, the number of plays per player 3 vs. 3 was higher than in 4 vs. 4 and 5 vs. 5, and

the "lateral" occurrence was higher. in the passing direction was higher. Additionally, the number of passes to the GK was higher than in 4 vs. 4. Also, the 4 vs. 4 had more ball touches per play than 5 vs. 5 and a higher occurrence of "dribbling" during the shooting process. Second, in the passing direction, the 4 vs. 4 had a higher incidence of "forward" than 3 vs. 3. Third, the number of passes and consecutive passes was higher in 5 vs. 5 than in 3 vs. 3 and 4 vs. 4. Additionally, the rate of "one-touch" in the process of shooting was higher than 3 vs. 3. These results indicate that the following playstyle features exist in each group setting: 3 vs. 3, individual goal scoring and GK's participation in the attack; 4 vs. 4, forward passing; and 5 vs. 5, goal scoring with passing as a team. Based on the results of this study, setting the number of players in relation to the purpose of training one helpful method of constructing practical training that can be applied to actual matches. However, the participants of this study were junior high school students from the prefectural league, and it is inferred that the category affected the number of players.

Furthermore, the games studied in this research were basic settings, and it is highly possible that the game aspect may change due to changes in the rules and other factors. In addition, since the games were played on different days with different numbers of players, the order effect was not considered. Furthermore, this study did not include a detailed analysis of shooting, such as distance and angle. Since the analysis of shooting and scoring is one of the most critical perspectives at the field level, a detailed analysis of shooting by using a player tracking-system or a global positioning system is an issue for the future. Considering the above, it is necessary to clarify gameplay differences in detail by examining the order effect, conducting a detailed analysis of shooting and scoring, increasing the number of categories to be experimented with, and changing the rules.

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