Load Characteristics of Mini Games in Soccer from the Viewpoint of Improvement in Physical Fitness: The Effect of Rule Changes

Ryosuke Tsuda*, Toru Shinozaki**, Kunio Goto*** and Kaoru Takamatsu***

*Graduate School of Comprehensive Human Sciences, University of Tsukuba
1-1-1 Tennodai, Tsukuba, Ibaraki 305-8574 Japan
tsuda@fitness.taiiku.tsukuba.ac.jp
**Ishige junior high school
1000-1 Motoishige, Ishigemachi Ibaraki 300-2707 Japan
***Institute of Health and Sport Sciences, University of Tsukuba
1-1-1 Tennodai, Tsukuba, Ibaraki 305-8574 Japan
[Received February 15, 2006 ; Accepted May 16, 2006]

This study focused on mini games, commonly used as teaching material in soccer classes, and examined the effects of rule changes on load characteristics from the viewpoint of the improvement in physical fitness. Eighteen male junior high school students participated in the present study. They played in three types of mini 4 vs 4 games: a free game, a pass game and a man to man game. The number of ball contacts, the ratio of appearance time of each movement speed (0-1, 1-2, 2-3, 3-4, 4-5, 5-6 m / sec), the total movement distance, heart rate and RPE during the game were measured. Questionnaires were conducted after all games. Skill tests (pass and dribble tests) and physical fitness tests (50m sprint, 250m sprint with a change of direction (25m × 10 sets with 30 sec rest), and 20m shuttle run) were also performed. The main results were as follows: 1) The number of ball contacts during the game was significantly greater in the pass than in the man to man games. 2) The ratio of movement at lower speeds (1~2m / sec) was significantly greater in the free than in the man to man games, whereas those at moderate and higher speeds (3~4, 4~5 and 5~6 m / sec) were significantly greater in the man to man than in the free games. 3) Total movement distance was significantly greater in the man to man than in the free games. However, there was no significant difference in heart rate and RPE among the three games. 4) The results of questionnaire showed partial significant differences in technique and fitness aspects among the three games, whereas no significant difference was observed in the psychological aspect. 5) In the free and man to man games, a significant correlation was observed between the number of ball contacts during the game and the results of the pass test, whereas no significant difference was observed in the pass game. These results suggest that the load characteristics of the soccer game from the viewpoint of improvement in physical fitness differ greatly when the rules of the mini games are changed. In addition, the pass game might be available to provide increased opportunity for unskilled children to participate in the games.

Keywords: performance response, physiological response, psychological response

[International Journal of Sport and Health Science Vol.5, 21-31, 2007]
and motor ability. In PE classes for over twenty years, exercise for the improvement of physical fitness has been considered as exercise for satisfying necessity (Hitsuyojusoku no undo, in Japanese), while sport and dance have been considered exercise for satisfying desire (Yokkyujusoku no undo, in Japanese) (Takahashi, 2005, p.15). However, it has been reported that exercise time allotted specifically for the improvement of physical fitness is extremely limited, and that a satisfactory level of fitness has not yet been achieved (Takahashi, 2005, p.15). Therefore, Takamatsu (2005, p.92-93) has suggested the necessity of establishing class content that also includes the improvement of physical fitness during sport and dance.

Ball games occupy over two-thirds of the total PE curriculum, and it is well-known that these are the most popular activity among children (Takahashi and Okade, 1999). As it is important to provide children with increased opportunities for ball contact and improve their technique and tactics with pleasure (Takii, 2001, p.48), games with a reduced number of players might be effective. Such games are commonly called mini games, and they are generally recognized as teaching material for the practice of techniques and tactics. However, it has been suggested that mini games enable children to improve their physical fitness if conditions for the games, such as the court area, player number, game time, and rules etc., are adjusted appropriately (Hoff, et al., 2002; Sian, et al., 1997; Takamatsu, 1994, p.19). In addition, on the teaching field, it has been necessary to change the court area, the number of players, time of games and rules according to children’s skill levels (MEXT, 1999a, pp. 44-53). The present study focused on rule modification under these conditions.

The majority of studies on mini games have focused on techniques and tactics, factors determining skill level as well as interest, and the volition and attitude required to enable children to understand the characteristics (Kawashiro, 1994, pp.42-44; Kobayashi, 1999, pp.13-15; Siedentop, pp.35-46). However, under the current Japanese physical education curriculum, it has been necessary to enhance physical fitness even in sport and dance exercises for improvement in physical fitness (MEXT, 1999a, pp.30). From this point, it is important to examine the load characteristics of mini games in terms of physical fitness.

The present study focused on mini games in soccer as PE class teaching material. We examined the effects of rule changes on load characteristics from the viewpoint of improvement in physical fitness. The present study will show that mini games aiming for the development of techniques and tactics are also effective for the improvement of physical fitness that contributes to the development of soccer skills if they are designed appropriately.

2. Methods

2.1. Participants

PE classes in the present study consisted of a ball game –soccer (football)– in 6 class periods from October 28th to December 16th (the second semester of 2004). The aim of the classes was to enable students to learn the way of practice as well as to improve soccer skills. In each class, students were informed about the aim of the classes, and they performed warm-up exercises. Then, students played mini games. Lastly, the content of learning was summarized and students performed cool-down exercises. Participants were 18 male students in the second year of I junior high school located in Ibaraki Prefecture (Age: 14.4 ± 0.5yrs, Height: 155.7 ± 5.7cm, Weight: 47.6 ± 7.3kg). To perform games with 4 players, students were divided into four teams; Team A consisted of 5 players, Team B of 4 players, Team C of 5 players, and Team D of 4 players. Classification was based on the results of a skill test (see below) that assured equal skill levels among the teams. Team A was paired with Team B, and Team C was paired with Team D throughout the research period. To ensure participation of all students, member changes were conducted during games when the number of players on each team exceeded four players. Students who had not participated in all games due to member changes or health reasons were excluded from the data. As a result, 12 students were analyzed.

Prior to the research, the school principal, PE teachers and all students were informed about the research aims, study procedure and security of this study. Subsequently, informed consent was obtained from all participants.

2.2. Mini Games

It has been suggested that the acquiring of basic
techniques is a critical factor in enjoying soccer (Takii, 1993, pp.52-53). The basic techniques of soccer are generally divided into four categories: kicking the ball, controlling the ball, getting the ball and dribbling (Matsumoto, 1994). The present study focused specifically on kicking the ball and controlling the ball as attacking skills and getting the ball as a defending skill. We did not focus on dribbling because the opportunity for ball contact for unskilled children is restricted by skillful children, resulting in a reduced chance for improvement (Kobayashi, 1999, p.13). In order to facilitate the learning of these points during the game, the present mini games consisted of three types of 4-player-versus-4-player games with different rules: a) a free game, b) a pass game, and c) a man to man game.

The free game has no specific rules and is the most common game on the teaching field. The pass game, in which a player is able to achieve ball contact fewer than three times per one play, was used to improve kicking and controlling the ball. The man to man game, in which the defense movement was promoted to marking the ball holder, was used to improve the ability of getting the ball. Base conditions were decided as follows: the court area was 30 m long 20 m wide; game time was 6 minutes × 2 sets with a 5-minute rest interval between sets. These conditions were applied for the following reasons: 1) approximately one-sixth of the regular court area is suitable for small sized games (Matsumoto, 2002); 2) a game for 6 minutes × 2 matches with a moderate rest interval is commonly used (Takii, 2001, p.50). Two separated playing fields were prepared on a school ground, and games were conducted on respective courts. When the ball went out of bounds during a game, it was immediately replaced with another ball. One PE class played only one of the three games, and the students played games in a sequential order of free game, the pass game, and man to man game on separate days.

2.3. Measurement Parameters and Methods

2.3.1. Movement, Physiological and Psychological Responses to Mini Games

1) Movement Response to Mini Games

The number of ball contacts, the ratio of appearance time for each movement speed (0-1, 1-2, 2-3, 3-4, 4-5, 5-6 m / sec) and the total movement distance in the three types of mini games were analyzed. These were used as indices reflecting the load for improvements in techniques (or coordination), anaerobic power, and aerobic capacity, respectively. These indices were applied for the following reasons: 1) practical opportunities for children to learn skills in PE classes are necessary (Takii, 2001, p.48); 2) children’s bodies demand intensive exercise of short duration (Kagaya, 2005, p.3); 3) an adequate amount of activity is necessary in PE classes (Kagaya, 2005, p.3). Movement during the game was recorded with a digital camcorder placed on the rooftop of a school building located approximately 20 m high and 15 m away from the center of the touch line. The number of ball contacts during the game was analyzed by reviewing the recordings. In this analysis, one ball contact was determined as a sequential pass play from one player to another player. Additionally, the ratio of the appearance time of each movement speed and the total movement distance per game were analyzed by the two-dimensional DLT method utilizing a motion analysis system (Frame – DIAS II, DKH Co., Ltd). In order to examine measurement errors in the analysis, a correlation coefficient between the length of the court on the screen and the actual length was calculated. As a result, a strong correlation was obtained (r = 0.99).

2) Physiological Response to Mini Games

The heart rate and the RPE during the three types of mini games were measured. A close relation between heart rate and RPE has been recognized, and these are commonly used as indices reflecting aerobic capacity (Yamaji, 1981). Therefore, as indices reflecting the load for an improvement in aerobic capacity, we considered these indices as well as total movement distance during the game. The heart rate was recorded at every 5-second intervals throughout the game using a wireless automatic heart rate monitor (ACCUREX plus, POLAR Co., Ltd). The mean value of the respective sets was used as the representative value. Data for two students were excluded due to inadequacy of the equipment. RPE was determined by Borg scale comprised of a 15-point rating scale (6 to 20). The mean value of the respective sets immediately after a game was used as the representative value.

3) Psychological Response to Mini Games

Questionnaires were conducted after all of the games (Table 2). These consisted of 14 questions
on aspects of techniques, physical fitness and psychology. The content of the questionnaire regarding techniques (or coordination) (8 questions) covered both on-the-ball-movement and off-the-ball-movement, while questions on physical fitness (3 questions) focused on energy-related physical fitness components. The content covering psychology (3 questions) related to student interest, volition and attitude, in accordance with the Formative Evaluation Method by Children presented by Takahashi (1994, pp.233-245). Students answered all of the above questions using a 5-point-scale (1: “Completely inapplicable” to 5 “Completely applicable” with 3 “Not applicable”), and responses were converted into scores.

2.3.2. Skill Tests

A pass test and a dribble test were conducted in the first class of the unit to evaluate the students’ basic soccer skills (Figure 1). One student failed to participate due to poor physical condition.

1) Pass Test

In the Pass test, students kicked a ball placed on the penalty spot with the inside of their kicking foot, and the accuracy of the kick was measured. The accuracy of the kick was judged by the position of passing among five zones prescribed by equal interval. For trials in which the ball traveled through the center of the goal, one point was awarded. When the position of passing was away from the center of the goal, an additional point was awarded. For trials in which the ball did not travel through the prescribed zones, zero points were awarded. Each student kicked 10 times, 2 rounds in the following order: the center of the goal (1 point); the left side of the center (2 points); the right side of the center (2 points); the left corner (3 points); the right corner (3 points). The total score of the ten kicks was recorded.

2) Dribble Test

Three cones were positioned to form a triangle with intervals of 5m, 6m and 7m. Students dribbled around the cones, and the time required to complete the circuit was measured. The trial was conducted twice, and faster time was regarded as the representative value.

2.3.3. Physical Fitness Test

The physical fitness test consisted of a 50m sprint, a 250m sprint with a change of direction, and a 20m shuttle run as indices of anaerobic power, anaerobic endurance capacity and aerobic capacity, respectively. The 50m sprint and 20m shuttle run were conducted in full accordance with the method of the new physical fitness test (Shintairyokutesuto, in Japanese). The 250m sprint with a change of direction consisted of a 25m sprint with a change of direction × 10 sets with 30-sec rest intervals (Sakai, et al., 2000). Data for one student was not measured due to poor physical condition.
2.4. Statistical Analysis

All measurement parameters were shown as mean ± standard deviation. Differences between the means were evaluated by one-way analysis of variance. When a significant F-value was found, a multiple comparison was conducted by the Scheffe method. Additionally, a correlation coefficient between two variables was calculated using the Pearson’s product moment correlation analysis. P values of less than 0.05 were considered to be statistically significant.

3. Results

Table 1 shows the movement and physiological responses in three types of mini games. The number of ball contacts during the game was significantly greater in the pass than in the man to man game. There were differences in the ratio of movement speed at 1-2, 3-4, 4-5, and 5-6 m/sec. The ratio of movement at lower speeds (1-2 m/sec) was significantly greater in the free than in the man to man game. The ratios of movement at moderate and higher speeds (3-4, 4-5 and 5-6 m/sec) were significantly greater in the man to man than in the free game. Total movement distance was significantly greater in the man to man than in the free game. However, there was no significant difference in the heart rate and the RPE among the three games.

Table 2 shows the results of the questionnaires conducted for the three types of mini games. There were significant differences in techniques (or coordination); “Could you get the ball frequently?” and in energy-related physical fitness component (aerobic capacity); “Could you move continuously during the game?”. These values were significantly greater in the man to man than in the pass game. However, the answers for the psychological questions (interest, volition and attitude) showed no significant difference among the three games.

In the skill tests, the result of the pass test was 8.5 ± 4.4 points and the dribble test was 13.7 ± 2.3 sec. In the physical fitness tests, the result of the 50m sprint was 7.8 ± 0.4 sec, the 250m sprint with a change of direction was 72.3 ± 0.3 sec, and the 20m shuttle run was 109.2 ± 16.9 times.
Table 2  The results of subjective evaluation in three types of mini games.

<table>
<thead>
<tr>
<th>Technique (or Coordination)</th>
<th>Free game</th>
<th>Pass game</th>
<th>Man to Man game</th>
<th>difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Could you play game according to the task of the game?</td>
<td>(Achievement of Task)</td>
<td>3.3±1.0</td>
<td>3.2±1.0</td>
<td>3.3±0.8</td>
</tr>
<tr>
<td>2 Could you do what you have been unable do during the game until now?</td>
<td>(Outcomes)</td>
<td>3.3±1.1</td>
<td>3.3±1.4</td>
<td>3.0±1.0</td>
</tr>
<tr>
<td>3 Could you contact the ball frequently?</td>
<td>(Contacting the ball)</td>
<td>3.8±1.2</td>
<td>4.0±1.2</td>
<td>3.8±0.8</td>
</tr>
<tr>
<td>4 Could you kick the ball (pass, shoot) frequently?</td>
<td>(Kicking the ball)</td>
<td>3.8±1.1</td>
<td>4.0±1.1</td>
<td>3.9±0.8</td>
</tr>
<tr>
<td>5 Could you control the ball frequently?</td>
<td>(Controlling the ball)</td>
<td>3.8±1.2</td>
<td>3.1±1.1</td>
<td>3.3±0.9</td>
</tr>
<tr>
<td>6 Could you dribble frequently?</td>
<td>(Dribble)</td>
<td>3.7±1.1</td>
<td>2.7±1.0</td>
<td>3.3±0.9</td>
</tr>
<tr>
<td>7 Could you get the ball frequently?</td>
<td>(Getting the ball)</td>
<td>3.3±1.0</td>
<td>2.5±1.0</td>
<td>3.6±0.8</td>
</tr>
<tr>
<td>8 Could you perform helpful movements for teams when you were away from the ball?</td>
<td>(Positioning)</td>
<td>3.5±1.2</td>
<td>2.8±0.8</td>
<td>3.3±0.8</td>
</tr>
</tbody>
</table>

Physical fitness

| 9 Could you perform speedy play for a few seconds during game very frequently? | (Anaerobic power) | 3.6±1.1 | 2.9±1.1 | 3.3±0.8 |
| 10 Could you perform hard play lasting from 10 to 30 seconds during game sometimes? | (Anaerobic capacity) | 3.3±1.0 | 3.0±1.0 | 3.3±0.9 |
| 11 Could you move continuously during the game? | (Aerobic capacity) | 3.1±0.9 | 2.8±0.9 | 3.8±0.7 | C > B |

Psychology

| 12 Could you enjoy playing the game? | (Interest) | 3.7±1.3 | 3.6±1.2 | 3.8±1.1 |
| 13 Could you play game with maximal effort? | (Volition) | 3.6±1.1 | 3.5±1.2 | 3.7±0.9 |
| 14 Could you play the game in a friendly way and in cooperation with friends? | (Attitude) | 3.8±1.3 | 3.9±1.2 | 3.7±1.0 |

Values are mean. ±SD.  
> ; P < 0.05

Table 3 shows the correlation coefficients between the number of ball contacts and the results of the skill and the physical fitness tests. The number of ball contacts showed stronger correlation with the results of the skill tests than with those of the physical fitness tests. In addition, the number of ball contacts showed stronger correlation with the results of the pass test than with those of the dribble test. Although there were significant correlations between the number of ball contacts and the results of the pass test in the free and the man to man games, no significant correlation was found in the pass game (Table 3 and Figure 2).

4. Discussions

4.1. Load Characteristics from the viewpoint of improvement in physical fitness during the three types of mini games

In ball games, because providing sufficient opportunity to learn techniques directly is essential for children (Takii, 2001, p.48), an increase in the number of ball contacts during the game is one goal of ball game classes. For this reason, the present study examined the number of ball contacts in the three types of mini games. Investigation revealed that the number of ball contacts in the pass game was significantly greater than in the man to man game (Table 1). This result suggests that the pass game with a restricted the number of ball contacts might be available for increasing practical opportunities to participate children in a PE class.

Since the nerve system improves rapidly during the growing phase, it is important to develop abilities to perform various movements with speed (Takamatsu, 2005, p.89). Therefore, the present study examined the ratio of the appearance of each movement speed during the game. The results showed that the ratios of movement at moderate and higher speeds (3-4, 4-5, and 5-6m / sec) were significantly greater in the man to man than in the free game (Table 1). Kagaya (2005, p.3) suggested that repetition of short-duration intensive exercise is available as a stimulus to enhance strength and speed. Ball games such as soccer are known to
be intermittent intensive exercise with intervening low-intensity exercise (Tokari and Suzuki, 1991, pp.2-3). Therefore, a man to man game with restricted rules for the defense might be available for improvement in strength and speed. However, considering that ball games consist of on-the-ball and off-the-ball movements (Takii, 1993, p.52), future studies will be needed to develop a measurement method to evaluate off-the-ball movement appropriately. On the other hand, the total movement distance was significantly greater in the man to man than in the free game, as well as at moderate and higher movement speeds (Table 1). In general, achieving a sufficient amount of activity has been shown to be important in enriching PE classes from the viewpoint of the improvement of student physical fitness (Kagaya, 2005, p.3). Based on the above findings, the man to man game might be available for enabling children to move during the game.

In order to evaluate exercise intensity for aerobic energy supply during PE classes, measurement of heart rate during classes is widely employed (Kagaya, 2005, pp.2-3; Siedentop, 1994, pp.100-103). The present study examined heart rate in the three types of mini games, and there was no significant difference among the three games (Table 1). As movements during soccer games have been reported to be complicated (Tokari and Suzuki, 1991, pp.5-7), heart rates are maintained at higher values throughout the game. Therefore, this characteristic of soccer

**Table 3** Correlation coefficient between the number of ball contacts in the three types of mini games and the results of the skill and fitness tests.

<table>
<thead>
<tr>
<th></th>
<th>Free game</th>
<th>Pass game</th>
<th>Man to Man game</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of ball contacts vs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>skill test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pass test (score)</td>
<td>0.653 *</td>
<td>0.488</td>
<td>0.726 *</td>
</tr>
<tr>
<td>Dribble test (sec)</td>
<td>-0.412</td>
<td>-0.226</td>
<td>-0.353</td>
</tr>
<tr>
<td>The number of ball contacts vs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fitness test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50m sprint (sec)</td>
<td>-0.224</td>
<td>-0.249</td>
<td>-0.194</td>
</tr>
<tr>
<td>250m sprint (25m × 10 set, rest time of set:30sec) with a change of direction (sec)</td>
<td>-0.073</td>
<td>0.127</td>
<td>0.173</td>
</tr>
<tr>
<td>20m shuttle run (time)</td>
<td>0.112</td>
<td>0.348</td>
<td>0.226</td>
</tr>
</tbody>
</table>

* ; P < 0.05

**Figure 2** Relationships between the result of pass test and the number of ball contacts in three types of mini games.
games may be responsible for the higher heart rates shown in the present study. Furthermore, there was no significant difference in RPE among the three games (Table 1).

In the questionnaires about the three games, a significant difference was found only in one question on the aspect of techniques; namely, “Could you get the ball frequently?” (Table 2). This result suggests that the technique for getting the ball might be a skill which is easy to recognize when compared to other skills such as kicking, controlling, and dribbling the ball. On the other hand, there was a significant difference in the aspect of physical fitness; “Could you move continuously during game?” showing a significantly higher amount of activity in the man to man than in the free game (Table 2). This result might reflect a specific demand on the defense movement with marking the ball holder during the man to man game. In questions on the aspect of psychology, interest, volition and attitude showed relatively high values with no significant difference among the three games (Table 2). With regard to the preparation of PE class teaching materials, although the pedagogically valuable learning content is found and materialized, it will not function as a teaching material unless it evokes student motivation (Takahashi, 1994, pp.26-34). Consequently, since the present three games conducted with modified rules showed considerably high scores in the questions on interest, volition and attitude, they might be utilized without decreasing student motivation.

4.2. Factors affecting the number of ball contacts during games

Although the ball game is one of the most popular PE class exercises for students, there are actually many students who cannot participate in games (Siedentop, 1994, pp.7-8; Yoshinaga, et al., 2000). It is also reported that the students who have enough ball contact opportunities are students who are good at sports, and that some students are turned away from games (Kawashiro, 1994, p.42). Therefore, to clarify the factors affecting the number of ball contacts during a game, the present study examined the relationship between the number of ball contacts during mini games and the results of the skill and physical fitness tests. As a result, the correlation coefficient between the number of ball contacts and the results of the skill test was higher than those of the physical fitness test. Furthermore, the number of ball contacts showed a stronger correlation with the results of the pass test than with those of the dribble test (Table 3). These results suggest that the number of ball contacts is affected by basic technique, especially passing ability. However, it was also noteworthy that a significant positive correlation between the number of ball contacts and the results of the pass test was observed in the free and the man to man games, but a similar correlation was not found in the pass game (Figure 2). These results might be due to the possibility that even though students with better skills cannot contact the ball frequently because the number of ball contacts is restricted to three times or fewer in one play. In general, games with a decreased number of players have been used to enable all students to participate more (Kobayashi, 1999, p.14). However, the present results indicate that it is possible even for students of different technical levels to have equal opportunities for participating in games by changing the rules. Considering that a certain achievement is demanded within the limited time of PE class, preparing effective teaching materials to improve individual technique is an essential approach in soccer including higher techniques.

4.3. Ideal approaches for improvement of physical fitness in ball game class

Under the current Japanese school physical education curriculum, gymnastic exercise is conducted as exercise for improvement in body constitution (Karadatsukuri undo, in Japanese), consisting of exercise for improvement in physical fitness (Tairyokuwotakameru undo, in Japanese) and exercise for body awareness (Karadahogushi undo, in Japanese). However, it has been pointed out that it is difficult to enable students to improve their physical fitness and perform “Karadahogushi” in a limited number of “Karadatsukuri undo” classes, and that it is impossible to enhance abilities for improvement in physical fitness according to individual physical fitness levels or students’ daily lives (MEXT, 1999b). Therefore, there is a necessity to prepare learning content for improvement in physical fitness even in sport and dance. As ball games occupy a large part of the current PE curriculum, greater learning effects can be expected if, in ball game classes, physical fitness specific to the respective sport is acquired.
without altering the characteristics of the game. Based on these ideas, we focused on the mini games in soccer and examined the effects of differences in rules on load characteristics from the viewpoint of physical fitness. The present results indicate that load characteristics from the viewpoint of improvement in physical fitness differ greatly by changing game rules.

Table 4 shows the load characteristics from the viewpoint of improvement in physical fitness and psychology of the three types of mini games.

<table>
<thead>
<tr>
<th></th>
<th>Free game</th>
<th>Pass game</th>
<th>Man to Man game</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Objective evaluation</td>
<td>Subjective evaluation</td>
<td>Objective evaluation</td>
</tr>
<tr>
<td>Technique (or Coordination)</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Physical fitness</td>
<td>△</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Anaerobic power</td>
<td>△</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Aerobic endurance</td>
<td>△</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Psychology</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Interest</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Volition</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Attitude</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Mark(○, △) shows higher evaluation in order.

Table 4 Characteristics from the viewpoint of improvement in technique, physical fitness and psychology of the three types of mini games.

Mark(○, △) shows higher evaluation in order.

Table 4 shows the load characteristics from the viewpoint of improvement in physical fitness in the three types of mini games in accordance with the outcome of the present study. The free game enables students to play games with no loss of interest, volition and attitude, but students might play games without a particular purpose. The pass game would be the most effective in developing techniques (or coordination) of ball contact, especially kicking. Although the man to man game includes comparatively fewer opportunities for ball contact, students’ energy-related physical fitness components improved. Based on results indicating which types of children contact the ball frequently, the pass game might be teaching material that provides all participants with the opportunity for proportioned ball contact (Table 3 and Figure 2).

It is important to prepare various teaching material according to learning task, and to incorporate it into units on the teaching field. Although the present study focused on rules in games and examined the load characteristics of mini games from the viewpoint of improvement in physical fitness, further research examining other conditions (e.g., changed rules, court area, number of the players, play time, and so on) will be necessary in order to prepare teaching material appropriate to the learning tasks. In addition, enhancement of practical learning ability associated with improvement in physical fitness is a valuable learning aim for school PE (Takamatsu, 1994, p.18). Moreover, enhancement of ability for planning – doing – evaluating teaching material and units according to the aim of improvement in physical fitness is an important task, not only through “Karadatsukuri undou” but also through sport and dance.

There are several limitations to the interpretation of the present results. The primary limitation is that we utilized games focusing specifically on fundamental techniques. On the actual teaching field, various games focusing on other techniques and tactics are conducted. Therefore, it is necessary to prepare games focusing on other techniques and tactics, and to examine load characteristics from the viewpoint of improvement in physical fitness. In addition, because soccer is an interpersonal game,
load characteristics of the game are partially affected by other participants. Further research including the above task will be needed. Although PE classes using ball games have been generally regarded as exercise for satisfying desire (Yokkyuzyusoku no undo, in Japanese) until now (Takahashi, 2005, p.15), it is of value that the present study indicates a way to prepare teaching material that improves physical fitness and contributes to the enhancement of soccer skills.

5. Summary

This study focused on mini games commonly used as teaching material in soccer classes, and examined the effects of rule changes on load characteristics from the viewpoint of the improvement in physical fitness. Eighteen male junior high school students participated in the present study. They played in three types of mini 4 vs 4 games: a free game, a pass game and a man to man game. The number of ball contacts, the ratio of appearance time of each movement speed (0-1, 1-2, 2-3, 3-4, 4-5, 5-6m / sec), the total movement distance, heart rate and RPE during the game were measured. Questionnaires were conducted after all games. Skill tests (pass and dribble tests) and physical fitness tests (50m sprint, 250m sprint with a change of direction (25m × 10 sets with 30 sec rest), and 20m shuttle run) were also performed.

The main results were as follows:
1. The number of ball contacts during the game was significantly greater in the pass than in the man to man game.
2. The ratio of movement at lower speeds (1-2m / sec) was significantly greater in the free than in the man to man game, whereas those at moderate and higher speeds (3-4, 4-5 and 5-6 m / sec) were significantly greater in the man to man than in the free game.
3. Total movement distance was significantly greater in the man to man than in the free game. However, there was no significant difference in heart rate and the RPE among the three games.
4. The results of questionnaire showed partial significant differences in technique and fitness aspects among the three games, whereas no significant difference was observed in the psychological aspect.
5. In the free and man to man games, a significant correlation was observed between the number of ball contacts during the game and the results of the pass test, whereas no significant difference was observed in the pass game.

These results suggest that the load characteristics of the soccer game from the viewpoint of improvement in physical fitness differ greatly by changing the rules of the mini games. In addition, the pass game might be available for providing increased opportunity for unskilled children to participate in the games.

References

Japanese)
Shingakushushidoyoryou niokeru chuugakkou taiiku no jugyou (ge). Taishukan : Tokyo. (in Japanese)

Name: Ryosuke Tsuda
Affiliation: Graduate School of Comprehensive Human Sciences, University of Tsukuba
Address: 1-1-1 Tennodai, Tsukuba, Ibaraki 305-8574 Japan

Brief Biographical History:
2001- Master's Program in Health and Physical Education, University of Tsukuba
2003- Graduate School of Comprehensive Human Sciences, University of Tsukuba

Main Works:

Membership in Learned Societies:
• Japan Society of Physical Education, Health and Sport Sciences
• Japan Society for the Pedagogy of Physical Education
• Japanese Society of Sport Education