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A COMPARATIVE ANALYSIS OF JUGGLING SKILL BETWEEN *SEPAK RAGA* AND *BULU AYAM*

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ABSTRACT

The uses of *sepak takraw's* ball for daily training for children might cause injury, while contact between the foot and ball due to hard and heavy structure. This study aims to examine the differences of kinematic juggling between *sepak raga* and *bulu ayam*. Eight participants within the age 13.63 (±0.52) years old were asked to perform 20 trials of *sepak sila* and *sepak kuda* juggling using *raga* ball and *bulu ayam*. Digital Motion Analysis software was used to analyze the kinematics parameters. One-way repeated measure ANOVA was implemented to examine the differences between the *sepak raga* and *bulu ayam*. The finding shows that there are no significant differences of kinematic juggling between *sepak raga* and *bulu ayam* in *sepak sila* juggling skills as well as *sepak kuda* juggling skills ($p > 0.05$). The young athlete could choose either *raga* ball or *bulu ayam* for skill acquisition depending on their comfort.

Keywords: juggling skill; *sepak kuda*; *sepak sila*; kinematics parameters; traditional game.

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1. INTRODUCTION

Sepak takraw is played by a team of three players namely *tekong*, feeder and spiker. Each player plays a different role at a particular position. *Tekong* is responsible for taken services, feeder feeds the ball to *tekong* while spiker is in charge of spiking the ball. The fascinating *sepak takraw* sport is known to have originated from Southeast Asia. *Sepak takraw* sport has been discovered in the 15th century that was also known as *sepak raga* [1]. However, some unconfirmed reports claimed that the sport originated from Thailand but there is insufficient evidence to draw a conclusion. *Sepak takraw* experienced evolution from traditional games to modern sport. *Sepak raga* and *bulu ayam* are Malaysian traditional games and have been the precursors of the present *sepak takraw* games. Fig. 1 and 2 show the picture of *raga* ball and *bulu ayam* respectively. The *raga* ball (Fig. 1) is similar to *sepak takraw* but is made up of different material, whereas *bulu ayam* ball (Fig. 2) is made up of feathers and a layer of rubber. The nature of these two games in Malaysian traditional game perspective is passing the ball between two players until the ball drops down. The fundamental skill of *sepak takraw* and these two traditional games are the same but to date, there is no scientific evidence available to prove that the fundamental skill based on the kinematic analysis are similar between *sepak raga* and *bulu ayam*. Nevertheless, a study conducted in Iran revealed that Iran traditional games can improve children fundamental motor skill of Iranian children [2].

Fig.1. *Sepak raga*

Fig.2. *Bulu ayam*

Few studies have been conducted in *sepak takraw* skills. However, to our knowledge, there is no any available literature on *sepak raga* and *bulu ayam*, although *sepak raga* and *bulu ayam* have the similar fundamental skill of *sepak takraw* juggling skill. The previous study conducted on *sepak takraw* was to determine the effectiveness of two type of service skill; *kuda* service and *sila* service and the result shows that *kuda* service has higher speed than *sila* service [3]. The same service skill has also been investigated in visual perception. The findings revealed that the anticipation of the expert *sepak takraw* player is more accurate than novice and the expert in kuda and sila service, and anticipation on *sila* service is better than *kuda* service among the expert as well as anticipating the final location of the ball for *sila* service compare to *kuda* service [4]. In addition, other studies conducted investigation on sepak takraw skills, have focused on the anthropometric parameter of the game [5]. Similarly, previous study had been conducted look at the physiological responses [6] and talent identification in *sepak takraw* [7] based on the biomechanical point of view. Besides, reusing traditional games in the concept of deliberate play not only can keep the heritage of the country but might also attract the children to play *sepak takraw*. Juggling skill was an interactive skill and the movement was a ballistic movement that required performing quickly and repeatedly [8]. The study seems to be alike but the previous study had been done on soccer juggling skill and specifically investigating the human body stability during soccer juggling.

Rescaling sports equipment has become a phenomenon in the sports today [9]. The purpose of

rescaling is to increase the performance and speed up skill acquisitions among young athlete. Usually, sports equipment are made up for adult and not suitable for a young athlete especially children who are in developmental phase. Too large and too heavy equipment might lead the children to be vulnerable to injuries. In *sepak takraw*, several skills must be acquired and mastered to become a good *sepak takraw* player. These skills are service, spiking and juggling. However, to possess all these skills, the player has to master some fundamental skills first. Previous researchers stated that mastering in basic skill before learning the other complex skill is essential [10]. There are two basic juggling skills in *sepak takraw*, *sepak sila* and *sepak kuda*. Both of these skills are usually used to save the ball during competition.

The suitable age for learning basic sports skill is between 13 to 15 years old. Based on late specialization model [11], during this range of age, athlete tend to be critical and sensitive towards physical and skill mastering. Similarly, earlier study reported that transfer of learning may occur in six levels [12]. Each level indicates different concepts and situation. However, researchers conclude that this research is more on creative transfer that use development of new ideas by using prior knowledge as fundamental to all learning.

The resemblance of juggling skill between *sepak takraw* and *sepak raga* and *bulu ayam* attract the researchers to investigate the kinematic analysis of *sepak raga* and *bulu ayam*. Thus, the purpose of this study was to investigate the differences of juggling kinematic between *sepak raga* and *bulu ayam*.

2. METHODOLOGY

This study is a quantitative study that utilized ex-post facto design. Data collections were undertaken at *sepak takraw* court. The kinematics' parameters we used in this study are juggling period, foot period at impact, foot displacement at impact, foot velocity at impact and foot acceleration at impact. They were asked to perform two types of juggling skill *sepak sila* and *sepak kuda* by using two different balls. They were asked to perform juggling using *raga* ball and *bulu ayam*. They performed left and right foot juggling alternately. All participants performed 20 trials of juggling. Each trial was performed with four contacts with the ball.

2.1. Setting

The study was conducted at the *Tunku Mahkota Ismail* Sports School Johor Malaysia in the year 2015. The layout of data collection shows in Fig. 2.

2.2. Participants

Eight *sepak takraw* youth players aged 13 to 14 years old were recruited in this study. They were all dominant in the right leg and played in the categories of the age under 15. The entire participants were free from any injury. The objective of the study was explained to the participants and consent forms were signed by the participants.

2.3. Instrumentation

Shank lengths were measured to the nearest 0.5cm by using Rosscraftanthrotape. This measurement transferred into Digiman software (Fig. 3) for calibration. Video camera (Sony Handycam, 50Hz) was used to record the juggling performances. The video recorded was then transferred into digital motion analysis software (DigiMan) for video digitizing (figure). The video has been initially reformatted to avi format before digitizing.

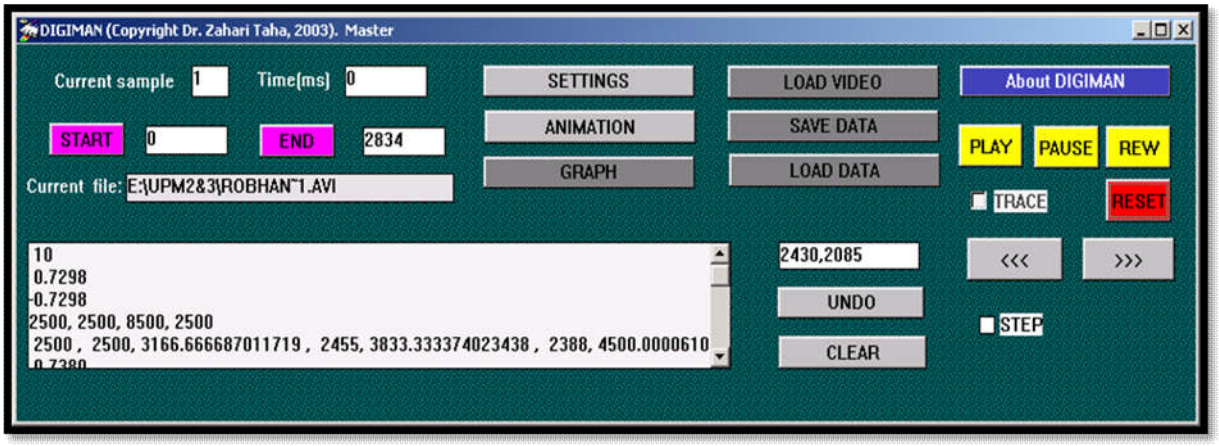


Fig.3. DigiMan interface

2.4. Data Collection

Digital camera video was used to record the performances of the juggling skill. We used Digital Motion Analysis software (DigiMan) to digitize the video recorded. Only the third contacts of juggling were selected to digitize in the study because during the third cycle of juggling, the participants are assumed to reach the juggling stable phase. For calibration, participant's shank lengths were recorded. The arrangement of video recording is shown in Fig. 4.

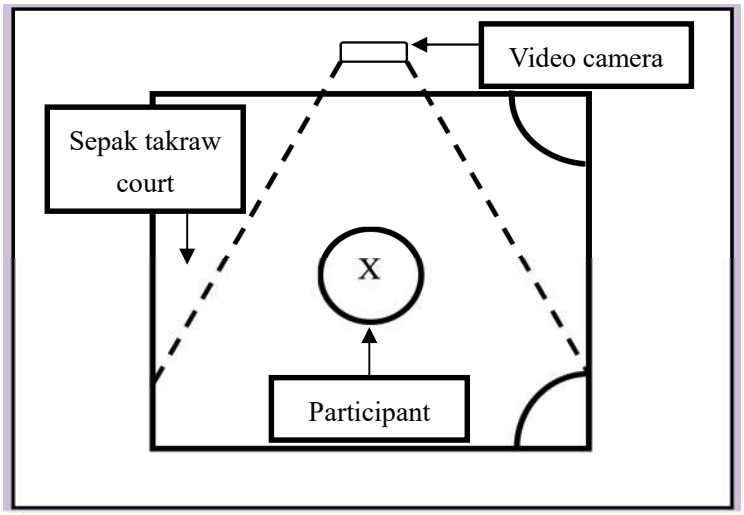


Fig.4. Data collection layout

2.5. Data analysis

One-way repeated measure ANOVA was employed to compare the kinematics effects between *sepak raga* and *bulu ayam*. Mauchly test of sphericity was used to determine whether the sphericity could be assumed. Therefore, if the p-value is greater than 0.05, sphericity has to be assumed. If the p-value is less than 0.05, sphericity cannot be assumed. Thus, correction for violations was applied. Greenhouse-Geisser was selected because the epsilon is lesser than 0.75. Similarly, Huynh-Feldt was also selected as the epsilon is greater than 0.75. In the result section, we explained the results with the parameters selected in this study. In order to visualize the consistency of juggling performance, we used scatter graph to see the dynamic patent.

3. RESULTS AND DISCUSSION

Table 1 shows the descriptive statistics of *sepak sila* and *sepak kuda* juggling skills with the kinematic parameters. The mean and standard deviation of juggling period, foot period at impact, foot displacement, foot velocity at impact and foot acceleration at impact are disclosed.

Table 1. The descriptive statistics of kinematic parameters by juggling skills

Parameters		*Sepak Sila*				*Sepak Kuda*			
		Right Foot		**Left Foot**		**Right Foot**		**Left Foot**	
		Raga	***Bulu Ayam***	***Raga***	***Bulu Ayam***	***Raga***	***Bulu Ayam***	***Raga***	***Bulu Ayam***
Juggling period (s)	M	0.85	0.78	0.80	0.74	0.78	0.81	0.78	0.80
	SD	0.08	0.07	0.08	0.06	0.10	0.08	0.09	0.09
Foot period at impact (s)	M	0.48	0.44	0.46	0.42	0.46	0.46	0.44	0.46
	SD	0.05	0.04	0.06	0.04	0.07	0.06	0.06	0.06
Foot displacement at impact (m)	M	0.51	0.60	0.51	0.58	0.27	0.41	0.33	0.41
	SD	0.05	0.06	0.06	0.06	0.10	0.14	0.12	0.14
Foot velocity at impact (ms^{-1})	M	0.20	0.389	0.17	0.21	0.06	0.33	0.15	0.32
	SD	0.58	0.849	0.60	0.73	0.44	0.59	0.50	0.60
Foot acceleration at impact (ms^{-2})	M	-27.70	-41.97	-26.39	-38.66	-18.58	-26.87	-20.34	-26.71
	SD	6.26	10.95	6.44	8.88	6.94	8.52	7.982	8.90

3.1. Juggling Period

A repeated measures ANOVA showed that for the *sepak sila* right foot, the difference in parameter juggling period between *sepak raga* (M = 0.85, SD = 0.08) and *bulu ayam* (M = 0.78, SD = 0.07) were statistically not significant, F (7.23, 101.16) = 0.74, p = 0.646, η^2 = 0.05. For *sepak sila* left foot also, there were statistically no significant difference between *sepak raga* (M = 0.80, SD = 0.08) and *bulu ayam* (M = 0.74, SD = 0.06), F (6.324, 88.535) = 1.294, p = 0.266, η^2 = 0.95. For *sepak kuda*, *sepak kuda* right foot, result shows that there is no significant difference between *sepak raga* and *bulu ayam*, F (5.474, 76.633) = 0.425, p = 0.845 as well as *sepak kuda* left foot, F (6.584, 92.176) = 1.528, p = 0.172).

3.2. Foot Period at Impact

Differ to juggling period, foot period at impact recorded right after the foot starts juggling

until the foot touches the ball. Analysis of foot period between *sepak raga* and *bulu ayam* for all of four variables; *sepak sila* for right and left foot and *sepak kuda* for right and left foot, shows no significant difference; $F(14,196) = 0.453$, $p = 0.955$, $F(5.819,81.461) = 1.013$ $p = 0.422$, $F(14,196) = 0.360$, $p = 0.984$, $F(14,196) = 1.288$, $p = 0.217$ respectively.

3.3. Foot Displacement at Impact

The height of the foot during juggling plays its role. Juggling displacement indicates how height the foot was left for juggling. To maintain the consistency of juggling, the performer has to raise foot at optimal height every time he performs. Foot displacement at impact means the height reach where the foot and ball contact. Result shows that *sepak raga* and *bulu ayam* juggling performance were statistically no significant difference for each parameter, *sepak sila* right and left foot, *sepak kuda* right and left foot; $F(6.913,96.777) = 0.893$, $p = 0.514$, $F(14,196) = 0.784$, $p = 0.686$, $F(6.411,89.754) = 1.241$, $p = 0.292$ and $F(5.810,81.337) = 0.956$, $p = 0.458$ respectively.

3.4. Foot Velocity at Impact

Velocity is associated with length and duration. The previous result for foot period at impact and foot displacement at impact shows no significant different between *sepak raga* and *bulu ayam*. However, differ with velocity at impact, three variables, *sepak sila* right and left foot and *sepak kuda* right foot shows no significant differences; $F(7.372,103.214) = 0.737$, $p = 0.730$, $F(5.569,77.963) = 1.502$, $p = 0.193$ and $F(5.860,82.045) = 0.381$, $p = 0.886$ respectively except *sepak kuda* left foot, $F(14,196) = 2.003$, $p < 0.05$.

3.5. Foot Acceleration at Impact

The last parameter tested in this study was foot acceleration at impact. All the variables also show no significant difference between *sepak raga* and *bulu ayam*; *Sepak sila* right foot acceleration at impact with the value $F(6.286,88.006) = 1.339$, $p = 0.247$; *Sepak sila* left foot acceleration at impact with the value $F(14,196) = 1.254$, $p = 0.240$; *Sepak kuda* right foot acceleration at impact with the value $F(6.778,94.893) = 1.00$, $p = 0.435$ and *sepak kuda* left foot acceleration at impact with the value $F(14,196) = 1.671$, $p = 0.64$.

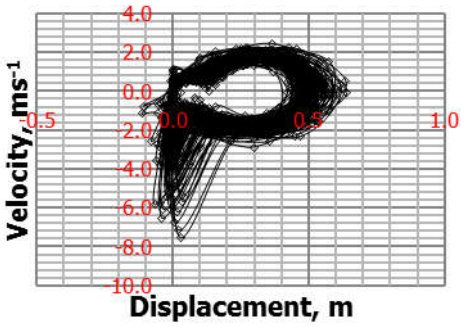
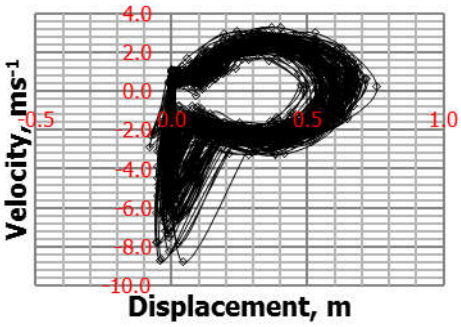
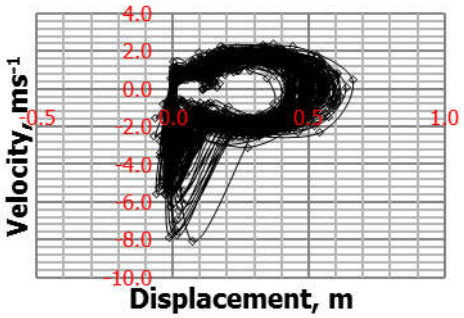
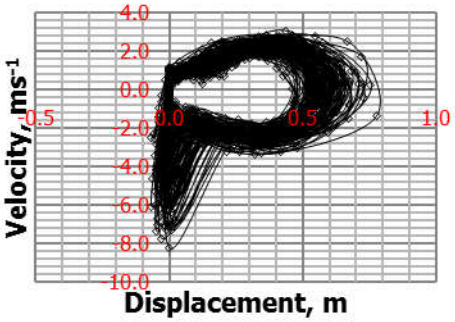
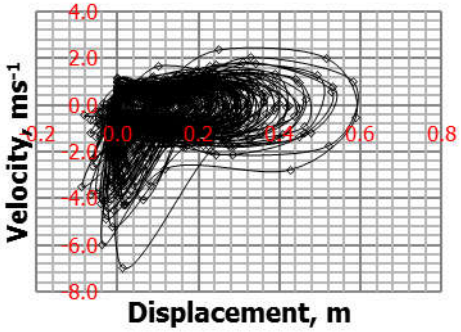
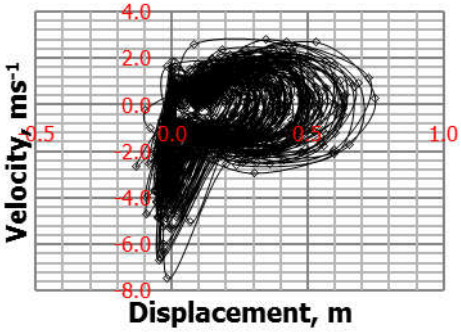
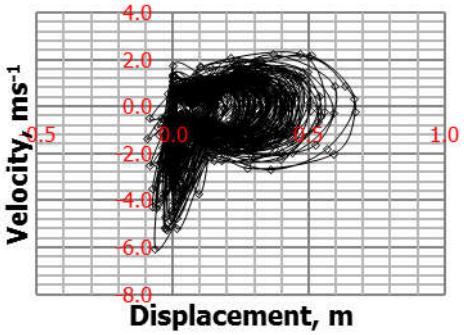
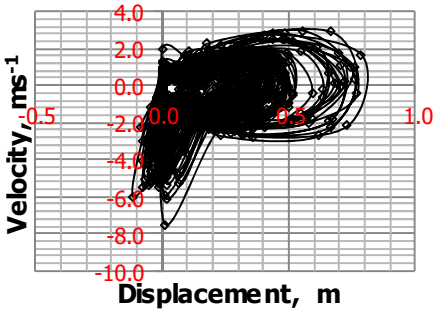
		Sepak Raga	***Bulu Ayam***
Sepak sila	Right		
	Left		
Sepak kuda	Right		
	Left		

Fig.5. Foot velocity versus foot displacement graph of consistency

The purpose of this study was to investigate the differences of juggling kinematic between *sepak raga* and *bulu ayam*. The finding shows that there are no significant differences of kinematic juggling between *sepak raga* and *bulu ayam* for *sepak sila* juggling skills as well as *sepak kuda* juggling skills. However, the result of *sepak kuda* (left foot) for foot velocity at impact, p value shows a significant difference between *sepak raga* and *bulu ayam*. As we have mentioned earlier, all the participants are dominant in right foot. Probably, for them to perform inconsistently by using left foot could be as a result of height. Therefore, the participants might rarely be practicing their left foot.

Mastering sport specific skill might take a long period to practice. In any sports participation, young athlete or children must undergo deliberate play training process to encourage them to keep playing and preventing overuse syndrome that might lead to injuries [13].

In this study, the result shows that there is no significant difference in term of kinematic parameters between sep*ak raga* and *bulu ayam* within these two juggling skills, *sepak sila* and *sepak kuda*. Two types of balls were used in this study to compare the kinematics parameters in sepa*k sila* and *sepak kuda* juggling skill. From the structure of the balls, *bulu ayam* ball is lighter and softer while the structure of *sepak raga* itself is harder and heavier. The use of *sepak raga* ball for children might cause overuse injuries because juggling skill involves ballistic movement that need to perform repeatedly. However, even though the structure of the two balls show different shape and character, the result of this study have statistically proved that their kinematics pattern does not differ from each other when both are used for juggling.

Juggling height may be influenced by foot acceleration and as a result, may increase the negative value of acceleration during juggling. Thus, the passive stability obtained. This indicates that the more the foot juggles, the higher the value of negative acceleration. However, the result between previous study and current study might have differences regarding interpretation since the variables used in both studies were different. Nevertheless, the result obtained in this study is technically comparable with previous findings. The other parameter utilized in this study was also adapted from the previous study on juggling skills [14].

Fig. 5 presents illustration between space and time. The pattern drawn in the graph specifies the consistency of juggling performance. The graph supported the statistical finding mentioned above. From the graph, it can be seen that there are no significant differences between *sepak raga* and *bulu ayam* in term of kinematical analysis.

4. CONCLUSION

Skill acquisition in all sports especially fundamental motor skill is vital. Skills must develop before achieve maturity. Therefore, the best period for mastering in fundamental skill is during development stage. Appropriate and suitable sport equipment for children to train in the concept of deliberate play may enhance their skill development. Hence, using *bulu ayam* to improve juggling skill in *sepak takraw* is recommended due to its softness and lightness.

5. PRACTICAL IMPLICATION

Children are encouraged to use *bulu ayam* ball for juggling skill acquisition in *sepak takraw* until they are mature enough to perform juggling by using real *takraw* ball. The objective is to prevent any injuries impact that might result from repeated juggling training. Coaches should also ensure children's comfort and safety during their training program.

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