Determinants for Duration of Drink Breaks in J-League in 2021: Special References for COVID-19 Temporary Amendment

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[Received December 22, 2021; Accepted July 6, 2022]

The purpose of the present investigation was to clarify the inter-match variability and the determinants of drink break (DB) duration and its contribution to the extra-time added to the end of official matches of the Japan Professional Football League (J-League). The investigation analyzed official matches of the first division of the J-League (J1-League) in 2021. Of the total season, a final sample of 60 matches with complete videos was analyzed; thereafter, the DB durations and the additional time were obtained in the first and second halves, respectively. The results indicated that the horizontal position for restart location contributes 15.3% of the variation in DB duration, and the restart play and the number of substitutions were also selected as significant predictors for the duration of DBs ($p < 0.001$). The DB duration was not significantly associated with the goals scored, environmental factors, or additional time. The present investigation suggested that the time for the out-of-play associated with the DB was over 1 min, and the DB duration depended on the distance from the bench side to the location of the restarting. Regarding the inter-match variability of the DB duration, the environmental and human-dependent factors remain unclear.

Keywords: soccer, football, extra-time, corona virus, infection

[Football Science Vol.19, 85-89, 2022]

1. Introduction

The COVID-19 pandemic has several impacts on soccer (Rampinini et al., 2021). In addition to an irregular match schedule, several temporary complications have developed. In order to protect players, a temporary amendment was introduced, stating that competition should be played in a condensed period and under different weather conditions, as this may have an impact on player welfare (IFAB, 2020; J-League, 2021a). The International Football Association Board (IFAB) approved temporary amendments, including an amendment to the number of allowed substitutes. Furthermore, from the viewpoint of infection control against COVID-19, players are prohibited from sharing water bottles during the match. As a result, players are worried about dehydration during matching. Therefore, from the 2020 season, it has been a general rule to set a drink break (DB) once in the first half and once in the second half. Furthermore, the objective of DBs is different from cooling breaks; therefore, the allowance of DBs is independent of the wet bulb globe temperature (J-League, 2021a).

The DB duration was set to 1 min or less according to the IFAB law (IFAB, 2020) and contributes to the additional time in each half. The timing of a break depends on the referee's discretion but should be as close to the middle of each half as possible. The referee chooses the desirable moment for the break in each half with two breaks across 90 minutes. In order to maintain the principle of the law, players should

aim to only drink water during 1 min DBs without purposeful physical cooling or tactical coaching. As the implementation of DBs in official matches began in 2020, no prior scientific evidence has explored the actual DB duration and its determinants. Although the DB rule was not continued in the 2022 season of the Japan Professional Football League (J-League), it cannot be guaranteed that there will be no novel pandemic infectious disease in the future that will affect sports such as football. Moreover, regardless of whether the rule was implemented to prevent the risk of infection from diseases such as COVID-19, it should not be abandoned, as there is no social situation in which it is truly desirable for athletes to share bottles. Therefore, clarifying the actual situation regarding DBs will be useful to ensure player safety in the future of football. Furthermore, the findings derived from this particular 2021 season will provide an interesting long-term perspective reference for the J-League.

The purpose of the present investigation was to clarify the inter-match variability and the determinants of DB duration and its contribution to the extra-time added to the end of official matches of the J-League.

2. Methods

The data sample was obtained from 100 matches of the first division of the J-League (J1-League) from the start of the 2021 season. The official full match video service (DAZN) was used for analysis, and it was confirmed that the match time displayed on the screen of the broadcast program was less than 1 second compared to the time measured by a standard stopwatch; therefore, the data was obtained in 1-second intervals. The first 100 matches of the 2021 season were automatically selected, and were not selected by investigators. Of a total of 100 sample matches, 40 matches were excluded because in 39 of them, the plays before and after the interruption were not captured in the video frame, and the remaining one match did not have any DB. Therefore, the present investigation sampled 60 matches of the J1-League from the 26th of February to 17th of April. DB duration was defined as the duration of out-of-play time associated with the DB from the time that the referee interrupted the game (referee blow whistle) to the restart of the game. The number of substitutions after DB, location, and the restart play were also recorded. The field was divided into horizontal and vertical location guidelines based on the tactical bench and penalty area (PA) as follows: width behind the PA, width of the PA, vertical width of the PA, and the vertical width of the left PA (**Figure 1**). The restart play was classified as a free-kick, kick-off, slowing, or goal-kick, and there were no corner kicks as the restart play after the DB. All analyses were performed by two or more independent researchers with soccer experience to ensure reproducibility of the measurements.

Additional information, including match score, weather, temperature, humidity, and referee, was obtained from the J-League official site (J-League, 2021b). The final sample covered all 20 teams of the J1-League in 2021 (3 to 8 matches/team) at all 20 home stadiums and was judged by 20 different referees (2 to 5 matches/referee). The weather conditions were as follows: 45 sunny days, 8 cloudy days, and 7 rainy days, and temperature and humidity were 15.6±3.9 (7.4–22.3) ºC and 44.8±19.8 (20%–90%), respectively.

Data are expressed as means with standard deviations. The difference in DB duration among the >3 categories was analyzed by one-way ANOVA. Differences among the groups at the same time point were analyzed using Scheffe's multiple comparison procedure when significant interactions were observed. The contribution to DB duration was analyzed by stepwise regression analysis. The significant correlation was analyzed using Pearson's correlation coefficient (r). Statistical significance was set at $p < 0.05$. All statistical analyses were performed using the SPSS software program, ver. 26.0 (IBM Corp., Armonk NY, USA).

3. Results

The DB duration was 102±19 s and ranged from 52 to 196 s. The DB duration differed significantly by the vertical position for restart location, horizontal position for restart location, and restart play ($p < 0.05$, **Table 1**). The DB duration was not significantly associated with weather, temperature, humidity, or number of goals. Similarly, the DB duration did not differ significantly between the first and second halves. Stepwise regression analysis revealed that the horizontal position for restart location contributed 15.3% of the variation for the DB duration, and the restart play and number of substitutions were

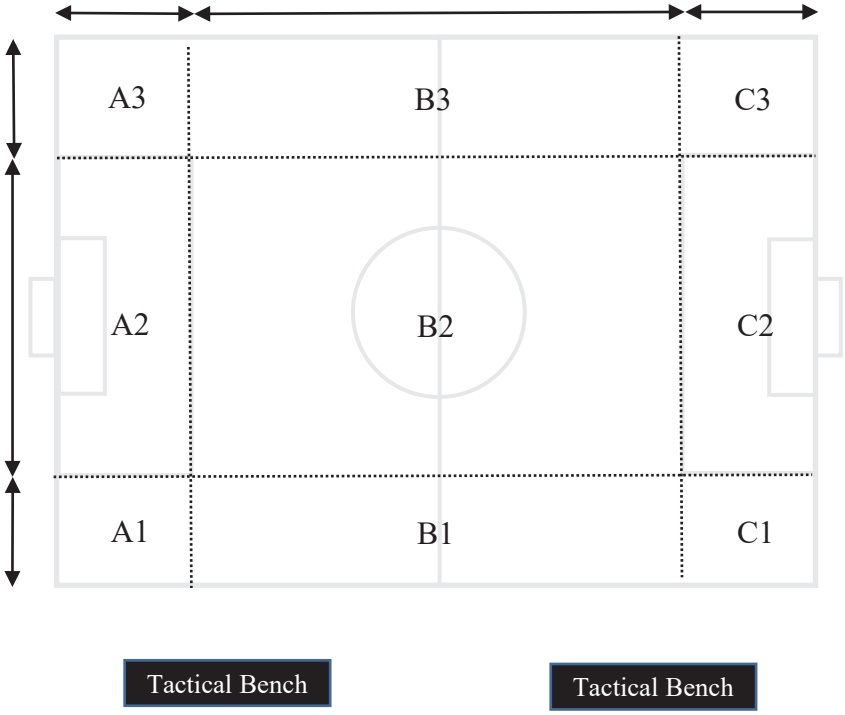

Figure 1 Nine classifications of ground for restart locations after drink break

The ground was divided horizontally (1, 2, and 3) and laterally (A, B and C) based on the penalty area and the tactical bench.

Table 1 Duration of drink breaks by restart location, restart play, substitutions, weather, and first half/second half in J1-League 2021

Variables	Categories				*P value*
	a	b	c	d	Category difference
Half	First 101.1±19.1 sec	Second 103.15±19.1 sec			P = 0.557
Horizontal location*	Behind PA 120.2±18 sec	Inside of PA 102±17.2 sec	Front of PA 93.4±18.1 sec		*P < 0.001* *a < b, a < c*
Vertical location*	Right PA 101.4±13.2 sec	Between PA 99.5±18.9 sec	Left PA 113.1±23.3 sec		*P = 0.016* *b < c*
Play of restart	Free-kick 92.5±17.1 sec	Kick-off 92.7±14.6 sec	Slowing 105.2±19.8 sec	Goal-kick 108±18.2 sec	*P < 0.001* *a < c, b < c, b < d*
Weather	Sunny 102.2±19.3 sec	Cloudy 104.5±10.5 sec	Rainy 99.1±24.9 sec		P = 0.740
Substitution	No 99.2±16.6 sec	Yes 111.1±23.1 sec			*P = 0.002* *a < b*

The data are expressed by mean with standard deviation (mean±SD).
PA: Penalty area, * The location relative to the PA indicates the direction with respect to the tactical bench. "Behind PA", "Inside of PA", and "Front of PA" are corresponding to #3, #2, and #1 of the horizontal categories, respectively (Figure 1). "Right PA", "Between PA", and "Left PA" are corresponding to #C, #B, and #A of the lateral categories, respectively (Figure 1).

also selected as significant predictors for the duration of DBs ($p < 0.001$, **Table 2**). These results of the stepwise analyses did not change, even if environmental factors (temperature and humidity) were removed from the independent variables. The relative DB duration to the additional time (243±113 seconds) was 54.9±35.1% and ranged from 16% to 176%. There was no significant relationship between the DB duration and additional time.

4. Discussion

The present investigation analyzed the actual situation and determinants of the DBs in 60 official matches of the J1-League in 2021. As a result, the investigation first showed that the DB duration was over 1 min and depended on the restart location, restart play, and substitutions. Additionally, the DB accounts for more than half of the additional time, and the main cause of the inter-match variation in the DB duration was the location of the restart. The findings of the present investigation suggest that the DB duration might be longer than that permissible by official match laws, and that it is associated with the location of the restart in the J1-League in 2021.

The results of the present investigation suggest a large impact of DB duration on the additional time. Since the DB was temporarily established in 2020, the present investigation shows that the DB duration has accounted for 54.9±35.1% of the additional time. In a J-League study of 15 matches in 2001, the additional time was concluded to be only 99 to 184 seconds per half (Kobayashi, 2001). Furthermore, in the aforementioned study, one instance of the out-of-play time lasted only 17.2 s, and the out-of-play duration longer than 30 s accounted for 12% of the additional time (Kobayashi, 2001). Although the additional time was increased by including the DB in the 2021 season (243±113 s), the overall additional time (109 s), excluding the DB duration, was not inconsistent with the previous finding. These results also suggest that sporadic breaks depending on each player would not be traditionally excluded from the actual playing time during the soccer match. However, the players could drink freely prior to the 2020 season. Therefore, it is reasonable to consider that the DB may specifically affect the additional time rather than the actual playing time. Furthermore, with regard to the determinants of DB duration, the results of the present investigation were also supported by previous findings where substitutions were one of the main contributors to additional time (Butler and Butler, 2017; Kobayashi, 2001). Based on these findings, the DB contributes to increases in the additional time, and referees may be encouraged to pay special attention to the locations of the interrupting for DBs in order to avoid excessive additional time.

The present investigation did not find any significant effects of environmental factors on DB duration. Unexpectedly, DB duration was not significantly associated with weather or temperature. The explanation for these results is that the present investigation sampled the match data from February to April, and the estimated maximum temperature and humidity during this period likely fail to achieve the recommended levels for a cooling break

Table 2 Multiple stepwise regression analyses for contribution of duration of drink breaks in J1-League 2021

Dependent variable	Step	Modelled variable	Adjusted R^2 (P value)	SEE	F value
Duration of drinks break	*1*	Lateral position for restart location	0.146 (<0.001)	17.64	21.21
	2	Lateral position for restart location Restart play	0.243 (<0.001)	16.62	19.90
	3	Lateral position for restart location Restart play Substitutions	0.264 (<0.001)	16.38	15.09

Calculated Variables: The analysis employed 9 variables: Lateral position for restart location, the restart play, the number of substitutes, the weather, the match scores, fist half/second half
SEE: Standard error of estimation.

(J-League, 2021a). Although the IFAB and J-League apparently separate the DB and cooling break (IFAB, 2020; J-League, 2021a), the DB duration would be expanded in the summer season due to the players' increased thirst.

There are several limitations to the present investigation. First, as the sample for this investigation was obtained in the spring season at the beginning of the league match, the study result cannot be applied for the DB in a hot environment. Furthermore, the present investigation examined only 60 matches, which is approximately 16% of the total yearly matches (380 matches). Although DB is inconsistent with the cooling break, DBs may be extended in hot environment. Second, the present investigation found that the DB duration exceeded the additional time in 11 cases, and the largest ratio to the additional time was 176%. In 10 cases, the ratio exceeded 110%, and the official additional time on the electronic board was 1 min. Third, the reason for the inconsistency between the obtained DB duration and IFBA laws (<1 min) is unclear. As the timing of the DB depends on each referee, the referee's decision making can help rectify these inconsistencies. In one specific case, the actual match ending time was prior to 46 min regardless of the 1 min of the additional time on the electronic board, resulting in a relative DB of 176%. Although these results are unexpected and occasionally unreasonable, it can be speculated that there are several reasons for the inconsistencies with the additional times. For instance, unlike during futsal and basketball matches, the time course during a soccer match is measured by a referee, who has the discretion to take appropriate action within the framework of the Laws of the Game (IFAB). Therefore, the players and team officials could pay special respect to the principle of the DB, as not only referees but also players and coaching staff contributed to the duration of the DB as well as its inconsistency with the additional time.

In summary, the present investigation first examined the determinants of DB duration in the official matches of the J1-League. As a result, the investigation found that the DB duration exceeded 1 min on average and was partially dependent on the ground location of the restart and the number of substitutions. The DB duration accounts for half or more of the additional time. These original findings of the present investigation suggest a significant impact of DB duration on additional time. Regarding the inter-match variability of the DB duration, the environmental and human-dependent factors remain unclear.

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