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# The impact of video review in karate kumite during a Premier League competition

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**ABSTRACT**

The aim of the study was to investigate whether a) the option to make video-review appeals influences the match outcome; b) the number of video reviews differs depending on the time period during a match; and the rejected-to-approved-appeal distribution differs depending on the c) time period during the match, d) match status, and e) match category in karate kumite. Video recordings from 555 matches in a Premier League competition were analysed. Point(s) awarded after the video review(s) changed the match outcome for a total of 47 matches, which corresponded to 13.1% of the matches with video review(s). The number of appealed video reviews increased for each 30-s time period in the 3-min matches ($P < 0.001$). The rejected-to-approved-appeal distribution differed depending on the time period during the match ($P = 0.0025$) but not depending on match status and match category (both $P > 0.05$). For karateka who had fewer points than the opponent, the rejected-to-approved-appeal distribution differed between time periods ($P = 0.017$). The option for coaches to make video-review appeals for techniques that were not awarded point(s) by the judges increased the chance for a fair match outcome in elite karate kumite.

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**KEYWORDS**
Karateka; video analysis; match outcome; combat sport

## 1. Introduction

During a karate kumite match, the karateka use both upper-limb techniques ("punching") and lower-limb techniques ("kicking"), which can be directed to the head or torso; however, when the punching/kicking techniques are directed to the head, the karateka must control the execution of the technique to avoid injuring the opponent (World Karate Federation, 2019). At present, there are four seated judges, one in each corner of the mat, who award points for techniques that are executed to a point-awarding area on the opponent when the following criteria are met: good form, sporting attitude, vigorous application, awareness, good timing, and correct distance (World Karate Federation, 2019). Moreover, the rules dictate that a minimum of two judges must, by raising a hand-held flag, indicate that the technique should be awarded point(s) and that the referee on the mat must declare their decision. The karateka with the most points at the end of the 3-minute match

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is the winner. A match can also be finished before the 3-min limit if one of the karateka is leading by 8 or more points.

A previous study found that there is no significant difference in the number of executed techniques during matches between the winning and defeated karateka (14 ± 5 versus 12 ± 4, respectively) (Chaabene et al., 2014). Moreover, winning karateka were found to use techniques garnering more points than losing karateka (Laird & McLeod, 2009). Hence, successful elite karateka execute more techniques to point-awarding areas and/or can better execute the techniques in accordance with the judgement criteria than less successful karateka. It was reported that winning elite karateka produce more power in both their upper and lower limbs than their defeated counterparts (Roschel et al., 2009). The ability to produce high-speed actions influences both the striking power and efficacy of the executed technique; hence, movement speed in both upper-limb and lower-limb techniques is related to the competitive results in championships and world cups (Blazevic et al., 2006). The speed of execution of upper-limb techniques is generally lower than that of lower-limb techniques (Daniel & Razvan-Liviu, 2014); however, the execution time has been shown to be shorter for punches (0.10–0.15 s) than for kicks (0.18–0.29 s) (Chaabene et al., 2015). As a result of the shorter execution time, most techniques used by karateka during a match are upper-limb techniques (~ 70–90%) (Chaabene et al., 2014; Koropanovski et al., 2008). There are often exchanges of more than one technique, and each fighting sequence ranges from less than 1 s to 5 s (Beneke et al., 2004; Chaabene et al., 2014; Tabben et al., 2015). It has been reported that approximately 84% of the fighting sequences have a duration under 2 s (Chaabene et al., 2014), and the mean number of fighting sequences for a karateka during a match was found to be between 16 and 18 (Beneke et al., 2004; Chaabene et al., 2014).

The high-intensity fighting sequences and quick execution of the techniques (i.e. high limb-movement speeds) make it challenging for judges to decide whether a technique should be awarded points or not. The difficulty of making an accurate decision, in addition to identifying the effect of a high-speed movement, for example, can be influenced by whether several techniques are executed within a few seconds. Therefore, a challenge for judges is to process fast-paced information under time pressure (MacMahon & Mildenhall, 2012). The decision-making process of judges is initiated by their perception of the athletes' performance, and thereafter, the event is categorised using the judges' prior organised knowledge and the rules of the sport (Bless et al., 2004; Plessner & Haar, 2006). Finally, the categorisation of the event together with information retrieved from the memory is integrated into a judgement.

It has been reported that the perceptual-cognitive tasks a judge faces sometimes exceed the limits of the human information processing system (MacMahon et al., 2007). To facilitate decision making, researchers have proposed that information gaps are filled by the processing system (MacMahon & Mildenhall, 2012). In line with this proposition, expert judges in sports have been found to develop effective anticipatory strategies that improve their decision making (MacMahon & Ste-Marie, 2002). The tasks and demands of judges in sports are vastly different depending on the characteristics of the sport; therefore, judges are classified into three main categories (i.e. interactors, reactors, and monitors) based on interactions with the athletes in the performance space and the number of cues or athletes monitored (MacMahon & Plessner, 2008).

To make an accurate decision according to the rules of the sport, the judge has to perceive the event accurately so that the appropriate information is processed (Plessner & Haar, 2006).

Previously, it was found that the error rate of experienced judges in gymnastics, who are classified as monitors according the model by MacMahon and Plessner (2008), was influenced by the viewing position (Plessner & Schallies, 2005); judges' error rate increased when their position deviated from the frontal view. Karate kumite judges are also categorised as monitors because of their low interaction with the karateka and high number of cues. Karate judges are faced with the same problem as gymnastics judges regarding the assessment of the execution of fast events. To support more accurate decision making in karate kumite, the number of judges has increased from three to four, and their seated position around the mat has changed from the sides to the corners during the last decade (World Karate Federation, 2009, 2015). However, despite the use of four seated judges with fixed positions in each corner of the mat, a karateka's execution of a technique can theoretically be hidden by one of the karateka or the referee or at least viewed from a non-optimal position for one or some of the judges.

Most likely as a consequence of the high intensity of a karate kumite match and the related problems concerning judges' decision making, the option to appeal a decision made by the judges and request a video review of a technique that was not awarded points was included in the World Karate Federation's (WKF's) competition rules in 2015 (World Karate Federation, 2015). The request to appeal a decision, by pushing a joy stick button, is initiated by the coach of the karateka who is considered disadvantaged; a buzzer will sound, and the video review card displayed on the scoreboard will start flashing (World Karate Federation, 2019). Thereafter, the coach must specify to the coach supervisor which technique and corresponding decision he or she wants to appeal. In Premier League matches, the video judges have access to recordings from two video cameras (positioned on opposite sides of the mat) in elimination round matches, whereas bronze and gold matches in these tournaments are monitored by four video cameras (positioned in each corner of the mat) (World Karate Federation, 2019). If the technique is awarded point(s) after the video review, the coach is allowed to appeal another decision during the match (if necessary). However, if the appeal is rejected by the video-review judges, the coach is not allowed to make another appeal in the specific match or subsequent elimination-round matches for the karateka. If the karateka qualifies for the semi-finals or medal matches, the coach regains the option of making a video-review appeal.

The introduction of the video-review system has transformed karate into a more tactical sport where the coaches can play an important role in the match outcome. To our knowledge, no previous study has investigated the impact of video review in karate kumite during a Premier League competition. The aim of the current study was to investigate whether a) the option to make video-review appeals influences the match outcome; b) the number of video reviews differs depending on the time period during a match; and the rejected-to-approved-appeal distribution differs depending on the c) time period during the match, d) match status, and e) match category in karate kumite.

## 2. Materials and methods

### *2.1. Study design*

To investigate the impact of video review in karate kumite, an observational analysis of Premier League competition matches at the Paris Open in 2019 was conducted. The videos were analysed by two observers who completed an analysis protocol for each

match. The observations were focused on the outcome of the video review(s) during each match. Video recordings of all analysed matches were available on a public domain. The study was approved by the Research Ethics Committee at Dalarna University in Falun, Sweden.

### 2.2. Procedures

The Premier League competition at the Paris Open in 2019 consisted of 645 matches (including participants of both sexes and all weight categories). The video recordings of 558 of the 645 matches were available on a public website (www.youtube.com). The 87 unavailable matches were not included in the study, and they were all from the elimination rounds. In three of the matches, information for at least one of the predetermined variables could not be observed; hence, 555 matches were included in the study. For each match, the following variables were assessed: 1) the match time when the appeal for video review was requested, 2) the actual score when the appeal for video review was requested, 3) the karateka whose coach requested the appeal, 4) the outcome of the video review, 5) the number of video reviews in the match, and 6) the final score of the match. In addition to variables 1–6, the karateka's sex, weight category (five for each sex), and match category (elimination-round match or medal match) were noted.

Two observers, who had previously been karateka and coaches at a national level, performed the analyses. The number of matches was divided equally between them. To evaluate the inter-observer reliability, each observer analysed the same 20 matches noting the predetermined six variables. To assess the intra-observer reliability, one of observers analysed all his matches twice. Cohen's kappa (κ) was used to calculate the inter-observer and intra-observer reliability for each variable. All κ values were larger than 0.85, indicating almost perfect conformity (Landis & Koch, 1977).

### 2.3. Statistical analysis

To determine the impact of video reviews in karate kumite, chi-square ($\chi^2$) tests for independence and goodness of fit were used. To fulfil the criteria for the $\chi^2$ tests, in which at least 80% of the expected frequencies must be five or higher, the 3-min matches were divided into six 30-s periods. Effect sizes were calculated to enable more informative inferences from the results. The phi coefficient ($\varphi$) and Cramer's $V$ were used for the $\chi^2$ tests with degrees of freedom equal to 1 or greater than 1, respectively. The substantial effects for $\varphi$ were divided into more fine-graded magnitudes as follows: $0.10 \leq \varphi < 0.30$ corresponded to a small effect size, $0.30 \leq \varphi < 0.50$ corresponded to a medium effect size, and $\varphi \geq 0.50$ corresponded to a large effect size (Cohen, 1988). The substantial effects for $V$ for 2 degrees of freedom were divided into more fine-graded magnitudes as follows: $0.07 \leq V < 0.21$ corresponded to a small effect size, $0.21 \leq V < 0.35$ corresponded to a medium effect size, and $V \geq 0.35$ corresponded to a large effect size (Cohen, 1988). The magnitudes corresponding to 5 degrees of freedom were as follows: $0.04 \leq V < 0.13$ corresponded to a small effect size, $0.13 \leq V < 0.22$ corresponded to a medium effect size, and $V \geq 0.22$ corresponded to a large effect size (Cohen, 1988). A random sample of 150 video reviews was used to determine the time for a video review (i.e. the time span from when the appeal was made to when the match restarted after the video-review decision

was made), and the result is presented as the mean and standard deviation. For all statistical analyses, the results were assumed to be significant at an alpha level of 0.05. The statistical analyses were conducted using IBM SPSS Statistics software, version 25 (IBM Corporation, Armonk, NY, USA).

## 3. Results

A total of 283 matches with male karateka and 272 matches with female karate were analysed. The number of matches in each match category was as follows: 528 elimination-round matches, 19 bronze-medal matches, and 8 gold-medal matches. During 195 of the matches, no video-review appeals were requested. For the remaining 360 matches, a total of 527 video-review appeals were performed. The distribution of the number of matches with 1, 2, 3, 4, 5, and 6 video reviews was 231, 101, 21, 5, 1, and 1, respectively. A total of 365 appeals were rejected (69.3%), and 162 appeals were approved (30.7%). The time for a video review was 43 ± 20 s on average and ranged from 16 s to 133 s.

Point(s) awarded after the video review(s) changed the match outcome for a total of 47 matches, which corresponded to 13.1% of the matches with video review(s) and 8.5% of all analysed matches.

The number of appealed video reviews increased with each 30-s time period (0–30 s = 35; 31–60 s = 67; 61–90 s = 78; 91–120 s = 93; 121–150 s = 111; and 151–180 s = 143). The $\chi^2$ test showed that there was a significant difference between the distribution of video reviews and an expected even distribution ($\chi^2$(df = 5, N = 527) = 78.9; $P < 0.001$), with a medium effect size ($V = 0.17$) (Figure 1).

There was a significant difference in the rejected-to-approved-appeal distribution between the time periods during the match ($\chi^2$(df = 5, N = 527) = 18.4; $P = 0.0025$), with a medium effect size ($V = 0.19$) (Figure 2). The proportions of approved video reviews in relation to the total number of video reviews in each time period were 0–30 s = 25.7%; 31–60 s = 46.3%; 61–90 s = 32.1%; 91–120 s = 38.7%; 121–150 s = 28.8%; and 151–180 s = 20.3%.

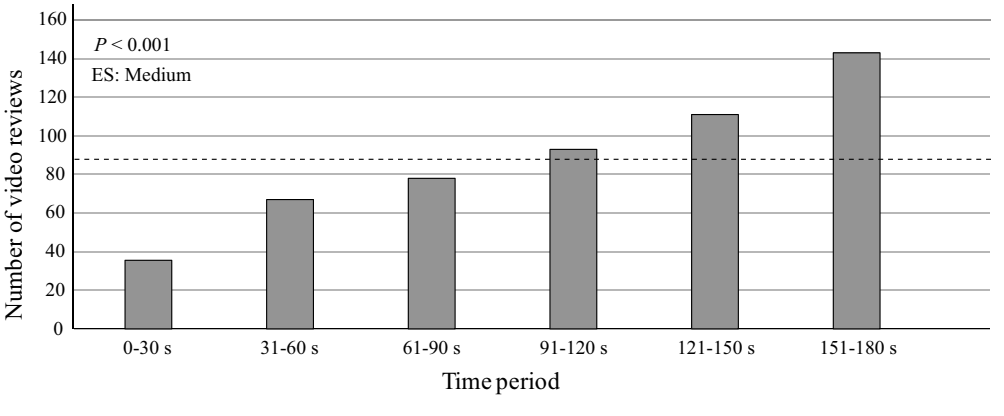


**Figure 1.** The number of appealed video reviews per time period.
Note: The dashed line represents an assumed even distribution of video reviews; ES, effect size.

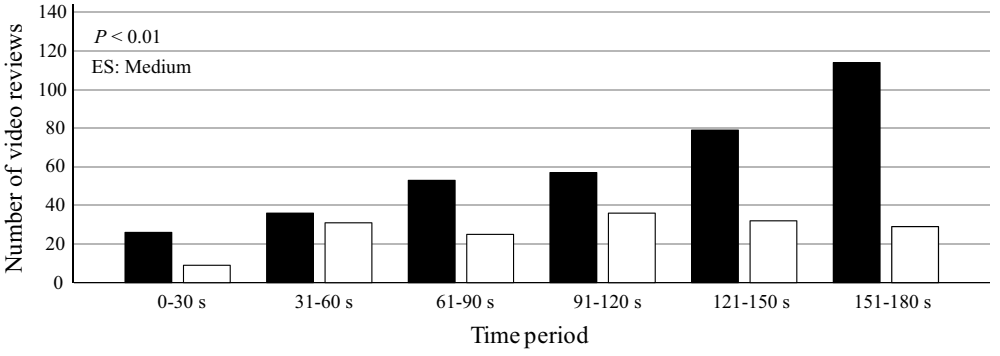


**Figure 2.** The number of rejected and approved video reviews per time period.
Note: Black bars, rejected video reviews; white bars, approved video reviews; ES, effect size.

No difference in the rejected-to-approved-appeal distribution was found for the different match statuses ($\chi^2$(df = 2, N = 527) = 2.4; $P$ = 0.31), with a very small effect size ($V$ = 0.067) (Figure 3). The proportion of approved video reviews was 34.2% for the karateka who were leading in points, 25.2% for tied matches, and 31.9% for the karateka who had fewer points than their opponent. However, there was a significant difference between the number of appealed video reviews for the karateka who were leading in points and for the karateka who had fewer points than the opponent (79 vs. 329) ($\chi^2$(df = 1, N = 408) = 153.2; $P$ < 0.001), with a large effect size ($\varphi$ = 0.61).

For the karateka who were leading in points, no difference in the rejected-to-approved -appeal distribution was found for the different time periods ($\chi^2$(df = 2, N = 79) = 3.3; $P$ = 0.19), with a medium effect size ($V$ = 0.21) (Figure 4(a)). For the tie matches, no difference in the rejected-to-approved-appeal distribution was found for the different time periods ($\chi^2$(df = 2, N = 119) = 4.9; $P$ = 0.085), with a medium effect size ($V$ = 0.20) (Figure 4(b)). For the karateka who had fewer points than their opponent, a significant difference in the rejected-to-approved-appeal distribution was found for the different

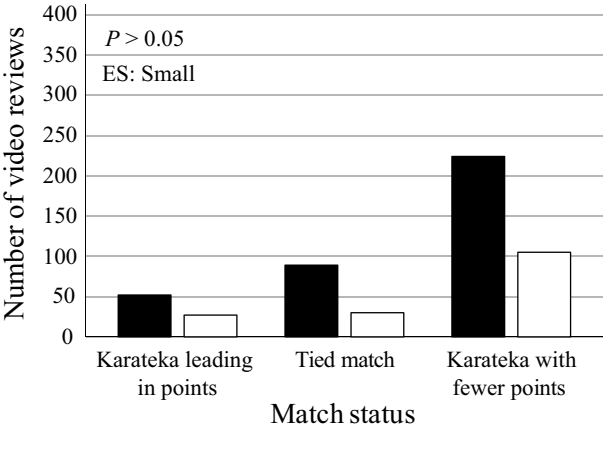


**Figure 3.** The distribution of rejected to approved appeals for the different match statuses.
Note: Black bars, rejected video reviews; white bars, approved video reviews; ES, effect size.

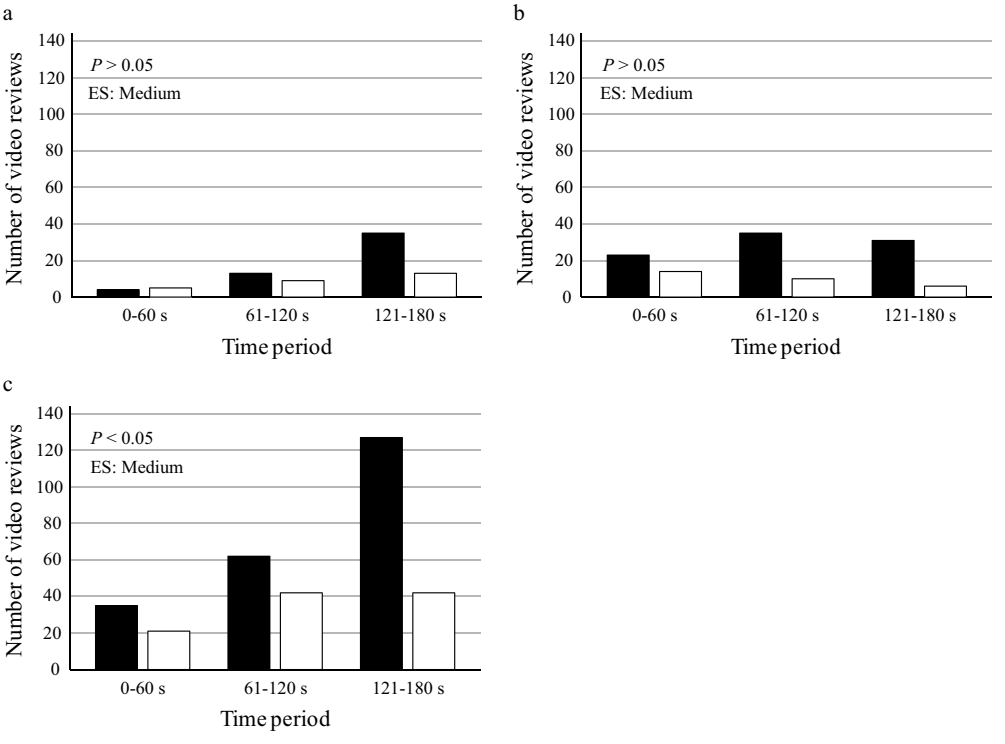


**Figure 4.** The distribution of rejected to approved appeals for the different time periods based on the standing of the match.
Note: Black bars, rejected video reviews; white bars, approved video reviews; ES, effect size.

time periods ($\chi^2$(df = 2, N = 329) = 8.1; $P$ = 0.017), with a medium effect size ($V$ = 0.16) (Figure 4(c)).

There was no difference in the rejected-to-approved-appeal distribution between the elimination-round matches and medal matches ($\chi^2$(df = 1, N = 527) = 0.4; $P$ = 0.54), with a very small effect size ($\varphi$ = 0.027) (Figure 5).

## 4. Discussion

The results of this study demonstrate that approximately one-third of the video-review appeals were approved. In more than 8% of the analysed matches, the video review(s) influenced the match outcome, resulting in another winner of the match. The number of appealed video reviews increased gradually throughout the match; however, the ratio of rejected to approved appeals decreased for each new time period. It was also found that the coaches appealed for a video review more often when their karateka had fewer points than the opponent, and this option was used more frequently towards the end of the matches. Furthermore, there was no difference in the rejected-to-approved-appeal distribution between the elimination-round matches and medal matches.

Previously, a research study investigated tennis players' possibility of challenging a decision made by judges (Kovalchik et al., 2017), and the study identified the location

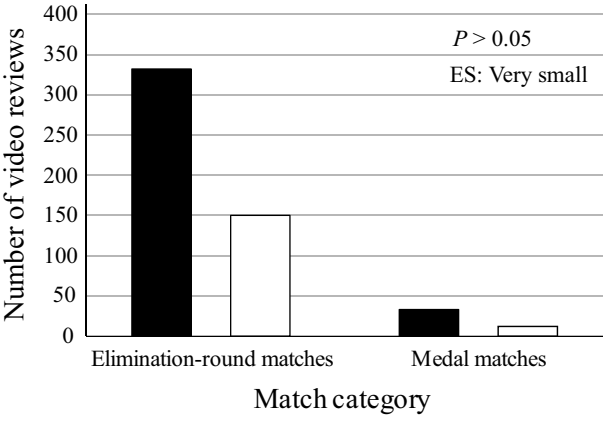


**Figure 5.** The distribution of rejected to approved appeals for the different match categories.
Note: Black bars, rejected video reviews; white bars, approved video reviews; ES, effect size.

of the ball and player as the most important factors for successful challenges. However, the present study is the first to investigate the impact of video reviews in karate kumite, and the results show that the introduction of the option to make video-review appeals in karate kumite has a major impact on the match outcome. In fact, more than 1 out of 12 matches resulted in another winner of the match as a consequence of approved video-review appeals. Notably, 3 out of 10 appeals were approved, which demonstrates that the rate of incorrect decisions made by judges was relatively high. There are several possible explanations for these results. In karate kumite, the time a karateka takes to perform a technique is sometimes as short as 0.1 s (Chaabene et al., 2015), and the speed of movement is often higher than 8 and 12 $m \cdot s^{-1}$ for upper-limb and lower-limb techniques, respectively (Daniel & Razvan-Liviu, 2014).

These high-speed actions place high demands on judges' visual perception, which may partly explain why judges fail to notice techniques that should be awarded points. Another factor that can help explain judges' difficulty in making a correct decision is a karateka's attempt to deceive the referee and judges; a previous study reported that some karateka try to find the most effective means of influencing the referees' decision (Kanazawa, 2013). Judges are certainly aware of karateka's attempts to create an advantage over the competitor, and it is probably more difficult to influence the decisions of experienced judges. Officiating experience, as well as previous motor experience (as an athlete) and visual experience (as a spectator), has been found to be related to officiating performance in sports such as handball, ice hockey, trampolining, and soccer (Pizzera & Raab, 2012). In line with these findings, the validity of decision making was greater for national standard referees in karate kumite than for regional standard judges (Fidalgo, 2013). The introduction of video reviews in karate kumite makes it possible for video review supervisors to observe fighting sequences in slow motion, which reduces the problem related to high-speed actions to some extent. In soccer, it was found that decision-making accuracy was higher in slow motion than in real time (Spitz et al., 2017). However, another study reported that foul-play situations in soccer were penalised more severely in slow motion than in real time (Spitz et al., 2018). In karate kumite, the judges have to consider whether the "vigorous application" criterion is met for a performed technique, and this is challenging to determine when reviewing a slow-motion

video. The difficulty in determining the magnitude of the impact force in video replays has resulted in a change in the scoring criteria in taekwondo, where force upon impact is no longer required to obtain points (Moenig, 2017). Despite these addressed movement speed and video-related concerns, the results in the current study show that coaches' option to make video-review appeals has increased fairness in karate kumite.

Another novel finding was that the distribution of rejected to approved appeals differed depending on the time period during the match, where the ratio increased throughout the match. In addition, for each new 30-s time period, the total number of appeals increased. Moreover, there was a significant difference in the distribution of the number of appealed video reviews between karateka who were leading in points and karateka with fewer points than their opponents. Together, these findings indicate that coaches are more willing to sacrifice their option to appeal for a video review during the later stages of the match or when their karateka have fewer points than their opponents to increase their chance of winning. Based on the results, coaches' motive to appeal may be to gain points to try to change the match outcome and/or gain time for their karateka to recover.

The mean video-review duration was 43 s, which is relatively long compared to the durations of breaks, which are decided by the referee; breaks had a mean duration of 9–11 s (Beneke et al., 2004; Tabben et al., 2015). The metabolic rate of the participants in karate kumite is high (Beneke et al., 2004), so the potential for exhausted karateka to obtain more time to recover by making a "tactical" appeal during the match can increase their chance of winning. This unintended use of video review as a tactic to recover has been proposed in tennis, where it is indicated that players use challenges to delay the game after longer rallies (Kovalchik et al., 2017). Another tactical aspect of the video-review break is that coaches are allowed to provide tactical feedback to their karateka, which is otherwise not allowed during the match according to the rules (World Karate Federation, 2019).

The results showed that there was no difference in the rejected-to-approved-appeal distribution between the elimination-round matches and medal matches; thus, the video-review outcome is not dependent on the number of available video cameras and their positions. However, it is fair to assume that the difference in the karatekas' performance capacities is larger in the elimination-round matches than in the medal matches. Therefore, in future studies in which both elimination-round matches and medal matches in karate kumite are recorded, ordinary video camera positions (i.e. 6 video cameras) should be used. Thereafter, video review supervisors can investigate key sequences with access to recordings from either two or four video cameras.

The relatively high percentage of matches (8%) where the outcome of the video review resulted in another winner of the match emphasises the importance of having a skilful coach in charge of the video-review appeals. A practical application could therefore be the practical training of coaches to further improve their skilfulness in judging whether a technique should be awarded points or not. This ability to appeal for a video review in the right situation can potentially be the deciding factor for a match outcome.

## 5. Conclusions

The results in the current study show that the option for coaches to make video-review appeals for techniques that were not awarded point(s) by judges has increased the chances for fair match outcomes in elite karate kumite. Coaches use their option to appeal more

frequently towards the end of matches and when their karateka has fewer points than the opponent. Thus, coaches' motive is to gain points to try to change the match outcome and/or gain time for their karateka to recover. Hence, the approved video-review appeals are a deciding factor for match outcomes, emphasising the importance for a karateka having a skilful coach who appeals for video reviews in the right situations.

A limitation of the current study was that only a single Premier League competition was chosen for data sampling. This could affect the generalisability of the results, so it is recommended that future studies include several competitions when investigating the impact of video review in karate kumite. Furthermore, it would also be of great interest in future studies to investigate a) whether the outcome of video reviews has changed from the introduction of coaches' option to request a video review to date, b) how many techniques that were not awarded points by the judges but should have been given points by video judges, and c) whether there is a relationship between the approved-to-rejected-appeals ratio and level of expertise of coaches.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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