

ORIGINAL RESEARCH

The level of the aggression in karate athletes with different handedness and belt grades

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Abstract

Karate athletes with different lateral talents possess different functions in terms of skills and personality characteristics in a way that handedness can be considered an advantage. Given that there is a paucity of research in the domain of personality characteristics, handedness and belt grades, the current research aims to investigate the relationship between handedness and belt grades with aggression among karate athletes. 120 male karate athletes participated. To measure handedness, we used Annette's handedness questionnaire and to measure aggression, we used Bredemeier's aggression questionnaire. The questionnaires were distributed among participants one day before the tournament. A two-way analysis of variance (ANOVA) was used to measure the effects of belt grades and handedness on the level of aggression. The results of the study indicated that there was no statistically significant difference in the average level of aggression between left-handed and right-handed karate athletes. There was also no statistically significant difference in the average level of aggression between karate athletes with different belt grades.

Keywords

Functional laterality; Handedness; Reactive aggression; Instrumental aggression; Martial arts

1. Introduction

The popularity of Karate is steadily growing due to its ability to enhance both physical prowess and personal growth. Fighting sports encompass activities characterized by high-intensity, brief-duration, and anaerobic lactic metabolic demands. The athlete's success in these sports is contingent upon several conditioning and coordinative attributes, including joint mobility, balance, coordination, and stimulus-response capabilities [1]. Handedness is the unequal distribution of hands in implementing motor skills between the two hands [2]. Polymorphism in human handedness, like the relative rarity of left-handers compared to right-handers, has persisted for thousands of years [3]. Reports indicate that only about 11% of the general population is left-handed [4]. In approximately 95% of individuals, the motor regions responsible for hand control are predominantly localized inside the left hemisphere [1]. This is why people most commonly use their right hands. Interestingly, handedness is related to the performance of specific tasks associated with the dominance of the right or left hemisphere of the brain [5]. Research has shown that handedness can influence motor skills and cognitive functioning, suggesting that it may also play a role in athletic performance. Within the realm of elite international athletes, there exists a notable overrepresentation

of left-handed individuals in various interactive sports that involve direct competition between two or more athletes, such as tennis, fencing, and boxing. However, this overrepresentation is not observed in noninteractive or individual sports such as golf or swimming [6]. The left-handers (or left-footers) appear to be more common (19.5%) in what is called fast ball sports, interactive sports, and confrontational sports such as combat sports [7]. The results of the study by Baker & Schorere (2013) showed no statistically significant relationship between laterality and winning percentage, although there was a significant difference between stances for number of fights [8]. According to Fisekcioglu (2011), there is an advantage for taekwondo athletes who use their left hand in training [9]. Cingoz *et al.* [1] (2018) discovered that female karate and taekwondo athletes who are dominant left-handed have a slight edge over their dominant right-handed counterparts. However, there was no difference in the dominance of hand preference and the likelihood of winning a medal for male athletes in karate and taekwondo [1].

Additionally, personality characteristics have been found to influence sports performance and aggression levels among athletes. Aggressiveness is interpersonal behavior intended to cause physical harm or mental distress and can have many negative and positive effects on performance [10]. Aggressive

behaviors “are sometimes out of the ethical realm of sports, and very much part of sport” [11]. The concept of aggression is not unique. When viewed as a character trait, aggressiveness may be defined as the “individual’s readiness to respond to a situation with aggression” [12]. During competitions, the referee should decide what aggressive behavior is acceptable and what is not according to standards [12]. Athletes mainly face two types of aggression called hostile aggression and instrumental aggression [11]. Hostile aggression is when the main aim is to cause harm or injury to your opponent while instrumental aggression, such as a rugby player who tackle his opponent to win the ball, is when the main objective is to achieve a goal by using aggression [13]. Inaccuracies in terminology can lead to misunderstandings about aggression in sports, particularly combat sports which are often associated with aggressive behavior [14, 15]. Therefore, it is crucial to emphasize the moral and psychological development of individuals involved in combat sports. Due to the controversial nature of these sports, it is important for those training to be fully aware of the potential risks associated with the techniques they practice. Additionally, the specific characteristics and type of combat sport can influence the level of aggressiveness exhibited by participants. Research has shown that fighters in contact sports display higher levels of aggression compared to those in non-contact sports [16, 17]. Kusnierz and Bartik compared contestants in different kinds of combat sports, they found that Brazilian ju-jitsu fighters were the most aggressive while Shotokan karate fighters had the lowest level of aggression [18].

Martial arts are “systems that blend the physical components of combat with strategy, philosophy, tradition or other features, thereby distinguishing them from pure physical reaction” [19]. Specifically, the Japanese word “karate” means empty-handed and punches, kicks and defensive techniques without using any weapons is essential in karate [20, 21]. Contrary to common belief, Karate is not an attack sport but a defense sport and harming others is prohibited. Lafuente *et al.*’s [22] study (2021) revealed that there was no relationship between martial arts and combat sports and anger and aggression levels. Guilbert (2006) reported that athletes who practice basketball, karate, or shooting usually show more physical violence and aggression because of the nature of their sport [23]. Moore *et al.* [24] (2020) pointed out that there is support for martial arts training as an efficacious sports-based mental health intervention for improving well-being and reducing symptoms associated with internalizing mental health.

Specifically, the relationship between sports aggressiveness and handedness has been studied previously. Dinsdale *et al.* [25] (2011) found that male aggression was higher in individuals whose one hand is more dominant than those who can use both hands (mixed handers), while no difference was seen in females. This finding highlights the importance of considering sex as a factor when investigating relationships between cerebral handedness and personality characteristics [25]. The results of the study of Dane and Şekertekin (2005) showed more sports aggressiveness among left-handed Turkish football players than right-handed. It appears that lower tolerance and persistence may be associated with better athletic performance in left-handed athletes. Therefore, considering

the issues mentioned above and the little background on the relationship between handedness and increasing combat levels with the level of sports aggressiveness, this study aimed to investigate the level of aggression in karate athletes with different handedness and belt grades [26].

2. Materials and methods

2.1 Participants

In this cross-sectional design study, we investigated the level of aggression in karate athletes with different handedness and belt grades. Using G*Power (version 3.1.9.6, for Windows, Heinrich Heine University, Dusseldorf, Germany), an a priori calculation of optimal sample size was calculated based on parameters taken from the pilot study. When using criteria such as main effect and interactions, a desired power of 0.95, and an alpha level set to 0.05, it was estimated that a sample size of 120 participants would be needed to reach an effect size of 0.4 from the required 2 (level of aggression: instrumental and reactive aggression) \times 5 (rates handedness: always right, usually right, non-difference, usually left and always left) ANOVA [27]. This was estimated to induce a meaningful detectable effect size (ES) of 0.4 according to the primary outcome measure [27]. Accordingly, 120 national Shotokan style kumite karate athletes (21.10 ± 4.53 years; range 16–31 years; 5.38 ± 4.09 years of experience) distributed in different belt grades: advanced belts ($n = 71$; 59.2%), and black belts ($n = 49$; 40.8%) participated in this study. The inclusion criteria for participation in this study were as follows: (i) have more than 2 years of experience in sports practice, (ii) being older than 16 years old and (iii) being part of the Islamic Republic of Iran Karate Federation (IKF).

2.2 Measures

2.2.1 Handedness

Annette’s Handedness Questionnaire (AHQ) was used to assess handedness. This questionnaire has 12 questions about the hand used in different activities to determine Participants’ Handedness. The items included: writing, throwing, using a racket, striking a match, using scissors, threading a needle, sweeping, shoveling, dealing cards, hammering, using a toothbrush and unscrewing the lid of a jar. Each question on a 5-point Likert scale were included in the survey. The individuals were asked if they preferred using their right or left hand for each task, and the grading was based on their response. The options of the right-hand preference always, the right-hand preference most of the time, and the lack of a preference for hand use were indicated by the scores of +2, +1 and 0 correspondingly. Additionally, the ratings of -2 and -1 indicated that the left hand was preferred in every situation and in the majority of cases, respectively. For left- and right-handedness, the overall range of values ranged from -24 to +24, respectively. Those who completed the test with a score of +9 or above, -9 to +8, and -9 or lower were classified as right-handed people, people without a preference, and left-handed people, respectively. To ensure the validity of the study, Annette’s Handedness Questionnaire (AHQ) was employed to assess the participants’ handedness patterns. The

AHQ is a widely recognized and validated instrument for assessing handedness in various research contexts and has been extensively used to determine the dominant hand preference in individuals across different populations. While the AHQ has not been specifically validated for Shotokan-style Karate athletes, its reliability and validity have been established in general handedness research. Since all the questions of this questionnaire are used to measure a characteristic (handedness), the reliability of the questionnaire has also been assessed by the internal stability method. Therefore, we believe that the AHQ is a suitable tool for assessing handedness patterns in the karate athlete population in our study. The relative Cronbach's alpha coefficient reliability of Annette's Handedness questionnaire was 0.97 [28].

2.2.2 Sports aggressiveness

Bredemeier Athletic Aggression Inventory (BAAGI)—Short form Questionnaire was used to assess Sports aggressiveness. This scale shows a combination of existing defined instrumental aggression and reactive aggression. The short form, BAAGI-S, consists of 30 questions that summarize items into 15 hostile phrases and 15 instrumental expressions. This short form, including those with the highest operating loading, offers anger, hostility and frustration elements. The answers were evaluated on a 4-point Likert scale: strong agreement, agreement, disagreement, or strong disagreement. Therefore, higher scores show higher levels of aggression for each subscale [29]. While the BAAGI has not been specifically validated for Shotokan-Style Karate athletes, it is important to note that the instrument has been widely employed in the assessment of aggression in various sporting contexts. The BAAGI has demonstrated favorable psychometric properties, including reliability and validity, in previous studies examining aggression in different athletic populations. The internal consistency of the test was examined by Cronbach's alpha for instrumental aggression was $\alpha = 0.86$ and test reactive aggression was $\alpha = 0.90$ [29].

2.2.3 Procedures

Nonprobability consecutive sampling was applied in the analyses. Karate athlete participants were recruited by distributing an invitation through the administrative channels of the Islamic Republic of IKF *via* social media (Instagram, version 98.0.0.34). The questionnaires were distributed among the athletes the day before the start of the competition at a hotel. In a short introductory section prior to the different questionnaires the principal investigators explained the objectives of the survey and the athletes completed the questionnaires in a self-reported manner. The data were collected on 18 July 2019. Before starting the survey, it was reiterated that it would be completely anonymous and the identity of the participants could not be traced. Two questionnaires were used for this purpose: Annette Hand Questionnaire [28, 30] and Bredemeier Athletic Aggression Inventory (BAAGI)—Short form [29].

2.2.4 Statistical analysis

All data were analyzed with SPSS software (version 27, SPSS Inc, Chicago, IL, USA). Sociodemographic data is expressed as mean \pm standard deviation. In order to test the differences

in sport aggressiveness among various sub-groups of participants, including those with different belt grades in karate and varying levels of handedness, we employed appropriate statistical procedures. A two-way analysis of variance (ANOVA) was performed to explore the influence of handedness on sport aggressiveness, with handedness serving as the independent variable and instrumental and reactive aggression scores as the dependent variables, to investigate the main effects of both belt grades and handedness, as well as any potential interaction effects on instrumental and reactive aggression. All statistical tests employed a significance level of $p < 0.05$. Effect sizes were interpreted using established thresholds for small ($d = 0.2$ be considered), medium (0.5), and large effects (in the sense of Cohen's $d \geq 0.8$). To ensure the internal consistency of the tests used to measure sport aggressiveness, Cronbach's alpha was calculated based on Loughhead (2000) scale, with a minimum threshold of 0.88 considered indicative of satisfactory homogeneity among the scale items.

3. Results

The frequency and percentage of handedness and belt grades participants are reported in Table 1.

TABLE 1. Frequency and percentage of karate athletes according to handedness and belt grades.

Handedness	Frequency (%)
High right-handedness	17 (14.17)
Right-handed	84 (70.00)
Mixed handedness	5 (4.17)
Left-handed	6 (5.00)
High left-handedness	8 (6.66)
Belt grades	
Advanced belts	71 (59.20)
Brown	14 (11.70)
Purple	11 (9.20)
Blue	17 (14.20)
Green	10 (8.30)
Orange	9 (7.50)
Yellow	10 (8.30)
Black belts	49 (40.80)

High: to achieve score of 24/–24 from Annette's Handedness Questionnaire (AHQ).

Right-handed: to achieve score between 9 and 24 from AHQ.

Mixed handedness: to achieve score –9 to 9 from AHQ.

Left-handed: to achieve score between –9 and –24 from AHQ.

Advanced belts: to have belts grades Brown kyu, Purple kyu, Blue kyu, Green kyu, Orange kyu, Yellow kyu.

Black belts: to have black belts (dan).

We conducted a two-way ANOVA to examine the effects of belt grades and handedness on the level of aggression. We found no statistically significant difference in average instrumental aggression by handedness ($F(1) = 0.354$, $p = 0.841$) and by belt grades ($F(2) = 0.249$, $p = 0.619$). Also, no

significant interaction effect was observed between belt grades and handedness ($F(3) = 0.259, p = 0.903$), indicating that the relationship between belt grades and instrumental aggression did not differ based on handedness + kg (Fig. 1, Table 2).

Moreover, there was no statistically significant difference in average Reactive aggression by handedness ($F(1) = 1.228, p = 0.303$) and by belt grades ($F(2) = 0.027, p = 0.871$). Also, no significant interaction effect was observed between belt grades and handedness ($F(3) = 1.410, p = 0.235$), indicating that the relationship between belt grades and Reactive aggression did not differ based on handedness (Fig. 2, Table 3).

4. Discussion

This study aimed to investigate the aggression levels among karate athletes, taking into consideration their handedness and belt grades. The hypothesis proposed that left-handed karate athletes would display higher aggression levels compared to right-handed athletes, and that athletes with higher belt grades would exhibit higher aggression levels than those with lower belt grades. However, the findings of this study did not support the hypothesis. Specifically, there was no statistically significant distinction in the average aggression levels between left-handed and right-handed karate athletes. Similarly, there was no statistically significant difference in average aggression levels among karate athletes with varying belt grades. These findings suggest that handedness is not a significant predictor of aggression in karate athletes. However, it is important to note that this study was conducted with a relatively small sample size from left-handed (a total of 120 volunteer participants male which consists of 101 karate, are right-handed, 5 are mixed-handed and 14 of them are left-handed).

4.1 Handedness and aggression

Since the research subject we have conducted regarding athletic aggression and handedness in karate athletes has no precedent in the literature, the discussion focuses on scientific studies on athletes from different branches and hand preferences. Martial arts and combat sports are regarded as activities that are perceived as having educational value owing to the possibility of aggression release in socially controlled conditions and of learning to control its expression. On the other hand, they may also intensify aggressive tendencies and make them easier to vent in everyday life by shaping specific personality attributes (bravery, determination) along with increased physical possibilities of harming other people [31]. These results are in incongruent with the findings of Dane and Şekertekin [26], which showed that left-handed athletes have a higher rate of aggression and right-handed have a higher rate of benevolence and kindness. It is generally expected that left-handed people, who use the right hemisphere, have more dominant emotions. The result of all the research ultimately points to the fact that the right hemisphere dominates the diagnosis of emotions in others, both pleasant and unpleasant feelings. In another study, Kari *et al.* [2] (2012) found that reactive aggression in right-handed male athletes was more than in left-handed males and instrumental aggression was more in right-handed female athletes than left-handed female athletes, contrary to

this study's findings. Perhaps the reason for this conflict can be related to the great variety of factors affecting the incidence of aggression in sports, such as the impact of the type of competition in different sports fields, especially contact fields and specific disciplines that are more exciting and sensitive because of the nature of the game such as football or basketball or tournaments at different skill levels [2]. When comparing right- and left-handed individuals on executive functioning designed to involve the right hemisphere, Beratis *et al.* [32] (2013) showed that left-handed people had a greater engagement with the right hemisphere, which facilitated performance on tasks requiring specific forms of cognition and mental flexibility.

4.2 Belt grades and aggression

The influence of belt grades on aggression levels among karate athletes warrants consideration. Belt grades reflect an athlete's skill level and experience in karate, which may influence their confidence, self-esteem, and competitiveness. It is plausible that individuals with higher belt grades possess greater emotional control and discipline, leading to lower levels of aggression.

The results showed no significant relationship between belt grades and aggression in karateka athletes. These results are incongruent with the findings of Frigout *et al.* [33] (2020). The researchers demonstrated that notable disparities in observed levels of aggressiveness were solely evident among individuals who were new to karate or had limited experience in practicing it. Conversely, no discernible variations in aggressiveness were observed between individuals who practiced karate in a prison setting versus those who practiced it in a club setting, specifically among individuals who had attained a high level of karate practice (*i.e.*, black belt) [33]. Likewise, this finding is inconsistent with those of Daniels and Thornton [34] as well as those of Nosanchouk [35], who have shown a negative relationship between aggression and duration of sport training. The likely cause may be more participants have black and brown belts than other belts in our work.

One major limitation of the current study is that we used cross-sectional data with regard to karateka athletes' aggressiveness. Future research can benefit from longitudinal data when measuring aggressiveness. In this study, we also recruited only male participants. The inclusion of female athletes in future research can shed light on gender differences when measuring aggressiveness and handedness. Our sample is non-probabilistic, future research can shed light on probability sampling when measuring applied in the analyses. In addition to handedness and belt grade, there are a number of other factors that may be associated with aggression in karate athletes. These factors include personality traits, such as anger and hostility; childhood experiences, such as exposure to violence, and drug or alcohol use; as well as the impact of the type of competition in different sports fields, specific disciplines that are more exciting and sensitive because of the nature of the game, and tournaments at different skill levels. Future research should examine the role of these factors in aggression in karate athletes.

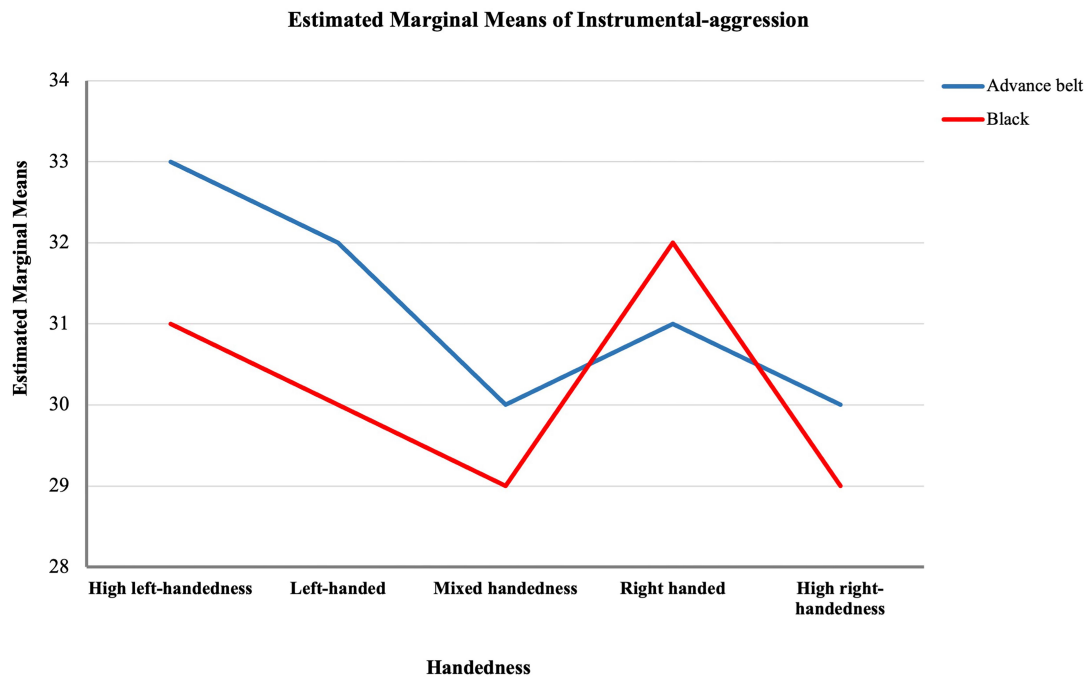


FIGURE 1. Summary of ANOVA results on the relationship between belt grades and instrumental aggression based on the handedness.

TABLE 2. Results of two-way ANOVA to examine the effects of belt grades and handedness on instrumental aggression.

Source	Type III Sum of Squares	<i>df</i>	Mean Square	<i>F</i>	Sig.	Partial Eta Squared	Observed Power ^a
Handedness	64.058	4	16.014	0.354	0.841	0.013	0.128
Grade Belts	11.266	1	11.266	0.249	0.619	0.002	0.078
Handedness × Grade Belts	46.944	4	11.736	0.259	0.903	0.009	0.105

^a: *R Squared* = 0.023 (*Adjusted R Squared* = -0.057).

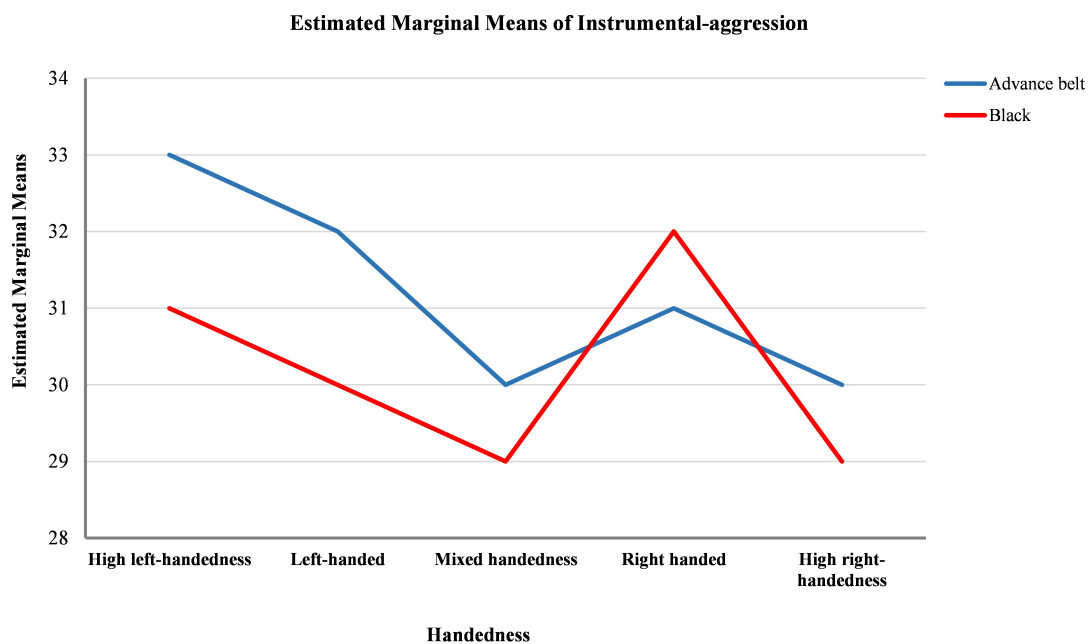


FIGURE 2. Summary of ANOVA results on the relationship between belt grades and Reactive aggression based on the handedness.

TABLE 3. Results of two-way ANOVA to examine the effects of belt grades and handedness on Reactive aggression.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power ^a
Handedness	271.227	4	67.807	1.228	0.303	0.043	0.374
Grade Belts	1.465	1	1.465	0.027	0.871	0.000	0.053
Handedness × Grade Belts	311.402	4	77.850	1.410	0.235	0.049	0.426

^a: Computed using $\alpha = 0.05$.

5. Conclusions

In summary, it can be said that there was no statistically significant difference in the average level of aggression between left-handed and right-handed karate athletes. There was also no statistically significant difference in the average level of aggression between karate athletes with different belt grades. Further research is needed to explore the underlying mechanisms and potential moderating factors involved in this relationship, ultimately enhancing our understanding of the complex interplay between handedness, belt grades and aggression among karate athletes.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

AUTHOR CONTRIBUTIONS

YA, MN, GRMR, MG, FHY, BY, MG and LPA—designed the research study; performed the research; analyzed the data; wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The procedures followed were approved by the Bioethics Committee of Kharazmi University (code: IR.KHU.KRC.1000. A. 100) and based on the principles of the Declaration of Helsinki. Athletes or their parents/guardians signed a written consent form.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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