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Retention of knowledge after basic life support course for professional football coaches: A prospective study

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ABSTRACT

Objectives: Teaching more people high-quality CPR through more efficient training methods can improve the rates and quality of Cardiopulmonary resuscitation (CPR) in cases of out-of-hospital cardiac arrest and help save more lives. In this study, we aimed to provide online Basic Life Support (BLS) training to football coaches who are in close contact with the risk group, and to examine the effectiveness of the training, to what extent they retained basic life support knowledge after completing the training program, and to determine the time of booster training.

Methods: Online BLS training was provided to football coaches. Pre- and post-tests were administered to measure the effectiveness of online BLS training. A retention test was administered to one group after 3 months and to one group after 6 months to evaluate the permanence of the training.

Results: Knowledge gain was significant immediately after the BLS course. There was no difference between the two groups in the post-training test results. Overall level of knowledge decreased significantly after three and six months. While there was a 5-point decrease in the retention test performed after three months, a 12-point reduction after six months.

Conclusions: There is no clear answer yet regarding the time and frequency of booster training. Rather than single training, the most effective approach will be to integrate booster content with short training videos at intervals of 3-6 months. Online BLS training videos can serve as an alternative.

Keywords: Basic cardiac life support, cardiopulmonary resuscitation, online education

Exercise-induced sudden cardiac arrest (SCA) is defined as a cardiac arrest occurring outside of a hospital setting during physical exertion, sports, or exercise, or within one hour following the cessation of such activities. SCA represents the leading cause of sudden death among competitive athletes during physical activity, with survival rates remaining low—only one in three patients survive the event [1]. Evidence indicates that bystander interventions, such as cardiopulmonary resuscitation (CPR) and the use of automated external defibrillators (AED), are strongly associated with improved survival outcomes after SCA. A systematic review of survivors following exercise-related SCA demonstrated that up to 80% of individuals had an initial shockable rhythm. Additionally, 56-93% of survivors had received bystander-administered CPR and AED applications. These findings underscore the critical role of immediate bystander in-

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tervention in maximizing survival following exercise-related SCA [2]. Given that coaches are likely to be present during such emergencies, the American Heart Association and the American College of Cardiology recommend that this group receive formal training in recognizing cardiac events, utilizing AEDs, and performing effective CPR (Class I recommendation; Level of Evidence B) [3].

The International Liaison Committee on Resuscitation, in its formula for survival in cardiac arrest, emphasized that efficient training is one of the three multipliers that will affect survival [4, 5]. Expanding access to high-quality CPR training through more efficient instructional methods can enhance both the frequency and quality of CPR performed during out-of-hospital cardiac arrest, ultimately increasing survival rates and saving more lives [6]. Therefore, it has been advocated for so long that lay-rescuer CPR training be targeted to those most likely to be at the scene of out-of-hospital cardiac arrest [7]. For this reason, ensuring that the team in charge of sports fields, and especially football fields, which are widely accepted and participated in all over the world, receive periodic training to be adequate and effective in cardiopulmonary resuscitation will be of great benefit to both the athletes and the spectators, and will reduce sudden deaths.

Studies show that survival rates of out-of-hospital cardiac arrest cases can increase two to three times if effective basic life support is provided [8]. Even if adequate training is provided, basic life support skills acquired decrease over time. Sustaining effective education is only possible with booster training. This is also recommended in the AHA 2020 guide as providing booster training [9]. Although AHA guidelines show evidence that frequent training improves CPR skills, there is no definitive information on when and how often to perform booster training after initial training. In some studies, booster training was provided for various periods between 3 to 15 months, and all of them were shown to give positive results compared to situations where no booster training was given. In another study, booster training was given to healthcare personnel every month, and it was found to be more effective than the training given at 3, 6 and 12 months. It is obvious that these trainings, which require regular participation every month, are not applicable for public rescuers. As a result of all these studies, it has been shown that it is necessary to provide at least one booster training after the initial training, whether for healthcare personnel or lay rescuers [10, 11]. FIFA has also emphasized in its emergency action plan for sudden cardiac arrest the training of potential first responders and their rehearsal at least once a year.

Online education has become an integral part of the field of healthcare and medical education, especially as technology continues to advance. The retention of information learned in training can directly impact the performance of life-saving techniques and skills in real-life emergencies. Therefore, assessing knowledge retention after online basic life support training is crucial to ensure the effectiveness and quality of training in this critical area [12]. In this study, we aimed to provide online BLS training to football coaches who are in close contact with the risk group, and to examine the effectiveness of the training, to what extent they retained basic life support knowledge after completing the training program, and to determine the effect of booster training.

METHODS

The study received approval from the Balıkesir Atatürk City Hospital Scientific Research Ethics Committee (Decision no: 2023/1/10 and date: 06.04.2023) was carried out in compliance with the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participating football coaches before their enrollment in the study. Additionally, each coach provided informed consent following regulations under the Personal Data Protection Authority before responding to the questionnaire. The study was conducted between May and October 2023.

Our study was conducted in six parts:

Part 1, a pre-test was administered to assess the baseline knowledge of all coaches regarding BLS.
Part 2, the BLS course was given online to all coaches.
Part 3, the same assessment (post-test) was administered immediately following the completion of the course to evaluate the improvement in knowledge.
Part 4, the coaches were randomly assigned into two groups (Group 1 and Group 2) using simple randomization.

Part 5, the retention test was performed in group 1 after three months to evaluate the permanence of the information. (16 people did not attend the exam).
Part 6, the retention test was performed in group 2 after six months to evaluate the long-term retention of the information.

Description of Courses and Exams

The course was designed as an online training program tailored for professional football coaches and was conducted by a team of three emergency medicine specialists certified to provide BLS training. This training is a mandatory requirement for obtaining the Union of European Football Associations coaching certificate. Football coaches completed the course by accessing pre-recorded instructional videos over 7 days. The online format allowed participants to complete the training at their convenience, whether at home, work, or any location with internet access. The course was accessible from any internet-enabled device. To ensure active participation, a pop-up notification appeared on the screen every 5 minutes during the video sessions. Participants were required to click on the alert within 10 seconds; failure to do so resulted in the video being restarted from the beginning. Similarly, if the video was fast-forwarded, the session was marked as incomplete and had to be replayed in its entirety. Additionally, no option to increase the playback speed of the videos was provided.

This course, modeled after the American Heart Association's (AHA) BLS course, aimed to equip participants with the necessary skills to promptly recognize various life-threatening emergencies and provide effective interventions. The key topics covered in the course included: (1) High-quality CPR for adults, children, and infants; (2) AHA Chain of Survival with a focus on BLS components; (3) Early use of an automated external defibrillator (AED); (4) Effective ventilation using a barrier device; (5) The role of teamwork in multi-rescuer resuscitation and the importance of effective team performance during CPR; (6) Management of foreign body airway obstruction (choking) in adults and infants; and (7) Approach to life-threatening trauma, particularly head and spinal injuries.

This comprehensive training aimed to enhance participants' competencies in delivering timely and effective life support during emergencies.

The exams were administered by the same team of emergency medicine specialists. The exam content was aligned with the AHA's BLS guidelines and consisted of 40 multiple-choice questions, each with four options. Participants could score a maximum of 100 points, with no penalties for incorrect answers. To ensure fairness, the order of questions and answer options was randomized for each participant. However, the evaluation was conducted on a question-by-question basis. The exam was only accessible via a computer and required the use of a camera for monitoring to prevent cheating. Participants were granted a single login session, and the system did not permit simultaneous logins from different locations using the same credentials. If a login attempt was made from another location, the system automatically terminated the session. Upon accessing the exam system, participants' computers were monitored to detect whether other websites or applications were opened. Eye-tracking technology was employed through the camera to monitor where participants looked on the screen, for how long, and how frequently. This provided insights into their gaze patterns, focus areas, and potential distractions. Additionally, the entire examination process was recorded via video to maintain the integrity of the evaluation.

Sample

The sample size was determined using G*Power® software (v.3.1.9.4). Based on an estimated effect size (d) of 0.5, an alpha level (α) of 0.05, and a power of 0.95, the minimum required sample size for the t-test was calculated to be 220 participants. The final study sample included 242 volunteer football coaches who completed the online BLS training within the designated time frame. A total of 226 volunteers participated in the entire study. Of those included in the study, 211 were male and 15 were female. The median age was 36 years. 195 football coaches had not received any previous BLS training. 13 of them had a high school degree, 204 had a bachelor's degree and 9 had a master's degree. Of these, 211 had previously performed basic life support. The coaches had not attended any other formal BLS or AED courses during the 2 tests.

Including Criteria

1. To be a professional football coach

2. Giving consent for the study
3. Having received BLS training within the specified time and fully participating in all tests.

The study design is presented in Fig. 1.

Measuring Instrument

The first section of the study collected demographic information, including age, gender, educational background, prior participation in any BLS course, and previous experience in a situation requiring BLS.

The second section consisted of a validated BLS knowledge assessment containing 40 multiple-choice questions administered before the training, immediately after the training, and 3-6 months post-training. Each question had five answer options, with only one correct answer. Each correct response was worth 2.5 points, allowing participants to achieve a maximum score of 100 points. The test was administered before and immediately after training. In Part 5, the test was administered again with the same questions three months later for group 1, and in Part 6, six months

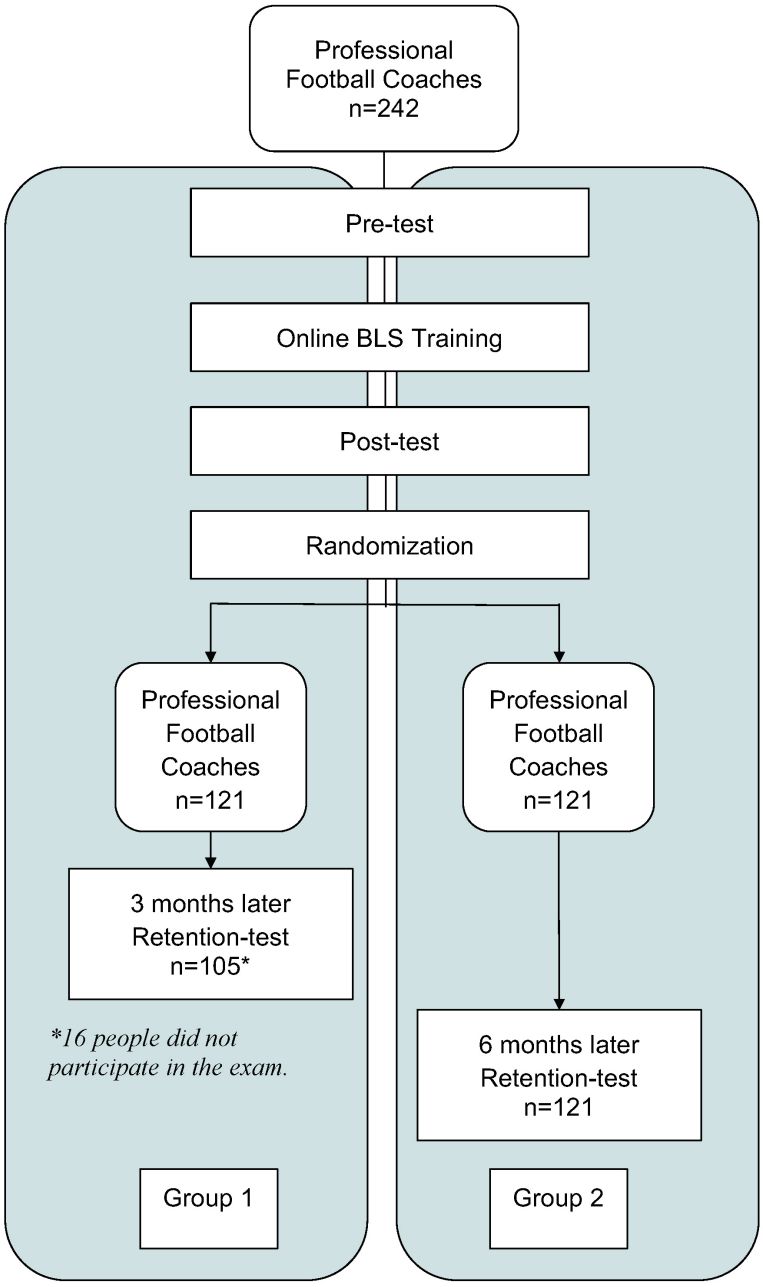

Fig. 1. Flow chart.

later for group 2. Informed consent (within the scope of PDPL) was obtained from each coach before answering the questions in each study.

Practical Skill Test

No practical skill assessment was performed for the coaches.

Statistical Analysis

Statistical analyses were conducted using SPSS version 23 (SPSS Inc, Chicago, IL, USA). The normality of the data distribution was assessed through both visual methods (histograms) and analytical tests (Kolmogorov-Smirnov). Descriptive statistics were presented as mean and standard deviation for normally distributed variables and as median, interquartile range (IQR), minimum, and maximum values for non-normally distributed variables. Data for Group 1 and Group 2 do not conform to normal distribution. Pairwise comparisons for Group 1 and Group 2 were calculated using the chi-square test and Mann Whitney-u test. Repeated measurements were examined using the Friedman test. Wilcoxon test was applied to find the difference between the groups. Type-1 error level was determined as 5% for statistical significance.

RESULTS

Baseline Characteristics

For baseline characteristics, refer to Table 1. The median age of participants in Group 1 was 36 years (IQR: 26-51), while the median age in Group 2 was 36 years (IQR: 28-52). Group 1 consisted of 96 males and 9 females, whereas Group 2 included 115 males and 6 females. In terms of educational background, 5 coaches in Group 1 and 4 coaches in Group 2 had completed a master's degree.

Theoretical Test Results

It was determined that the test results of the 1st group were higher before the training (Pre-test: Group 1=63.6±5.2; Group 2=55.2±4.9; P<0.001). As expected, knowledge gain was significant immediately after the BLS course (Pre-test > Post-test increase P<0.001 for both groups). However, there was no difference between the two groups in the post-training test results (Post-test: Group 1=80.8±5.8; Group 2=81.6±4.7; P=0.091). While there was a 5-point decrease in the retention test performed after three months (78, IQR: 73-78; P<0.001), there was a 12-point decrease in the test performed after six months

Table 1. Baseline characteristics

		Group 1 (3-Months)	Group 2 (6-Months)	P value*
Age (years), Median (IQR)		36 (26-51)	36 (28-52)	0.799
Gender, n (%)	**Female**	9 (8.6)	6 (5)	0.277
	Male	96 (91.4)	115 (95)	
Educational level, n (%)	**High school**	8 (7.6)	5 (4.1)	0.441
	College	92 (87.6)	112 (92.6)	
	Master Degree	5 (4.8)	4 (3.3)	
Those who have previously been in an emergency situation where BLS was required, n (%)	**Yes**	93 (88.6)	118 (97.5)	
	No	12 (11.4)	3 (2.5)	
	1 time	77 (73.3)	110 (90.9)	
	2 times	5 (4.8)	3 (2.5)	
	3 times	7 (6.7)	1 (0.8)	
	4 times	4 (3.8)	4 (3.3)	

IQR=Interquartile range
*Mann Whitney U

Table 2. Theoretical test results

	Group 1 (3-months)	Group 2 (6-months)	p value*
Pre-test			
Mean±SD	63.6±5.2[a]	55.2±4.9[d]	**<0.001**
Median (IQR)	63 (63-68)	55 (55-60)	a>d
Min-Max	28-70	15-60	
Post-test			
Mean±SD	80.8±5.8[b]	81.6±4.7[e]	0.091
Median (IQR)	83 (78-83)	80 (80-85)	
Min-Max	35-88	50-90	
Retention-test			
Mean±SD	76.8±5.4[c]	68.3±6.3[f]	**<0.001**
Median (IQR)	78 (73-78)	68 (65-70)	c>f
Min-Max	33-83	40-85	
P value**	**<0.001**	**<0.001**	
	b>a	e>d	
	b>c	e>f	
	c>a	f>d	

SD=Standard deviation, IQR=Interquartile range, Min=Minimum, Max=Maximum
*Mann Whitney U, **Friedman Test

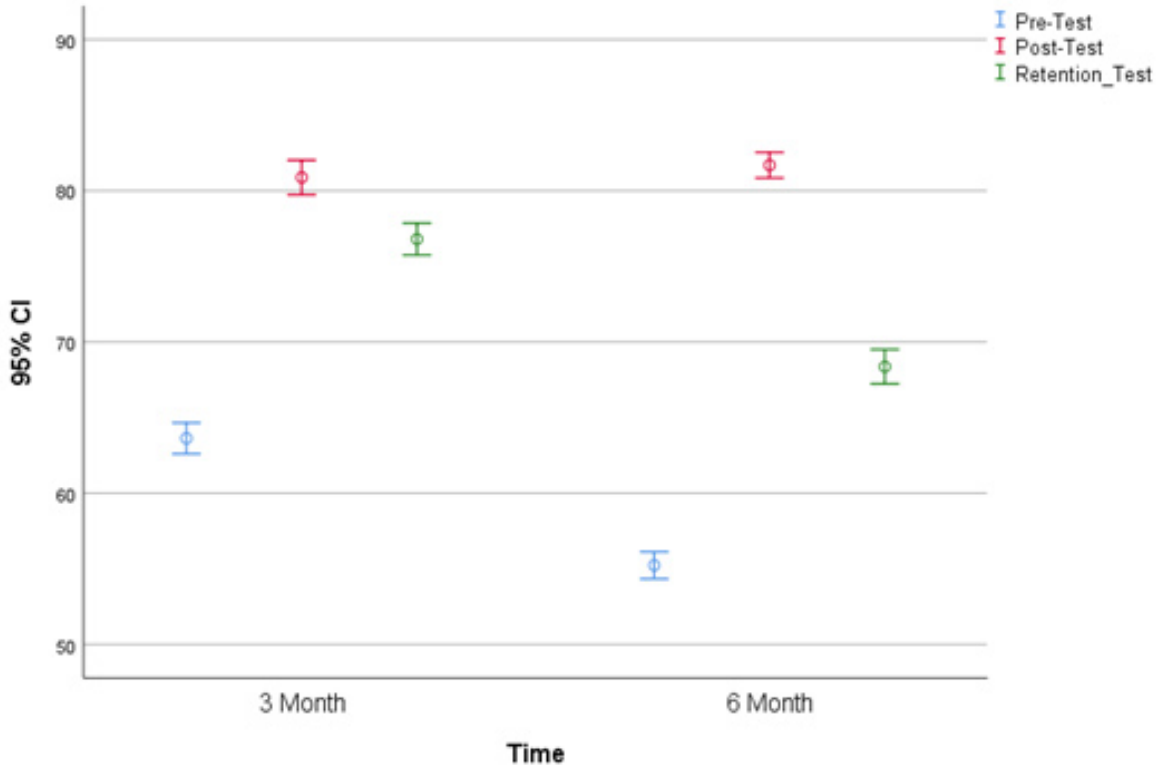

Fig. 2. Theoretical test results.

(68, IQR: 65-70; P<0.001). The between-group comparison of retention test scores demonstrated that the six-month group had significantly lower scores than the three-month group (P<0.001). Additionally, retention test scores at both three and six months remained significantly higher than the pre-test baseline levels (Group 1: P<0.001; Group 2: P<0.001). The comparative results for Theoretical Test are shown in Fig. 2. and Table 2.

DISCUSSION

Online basic life support training is increasingly accepted in medical education and emergency response fields today. Resuscitation guides also say that online courses can be used as resources in basic life support training. This method offers a powerful option, especially for individuals who find it difficult to study in a traditional classroom setting due to time constraints and physical limitations. In our study, pre-course and post-course tests were conducted to evaluate the effectiveness of the online basic life support training program. The data obtained shows that the post-course test results are significantly higher than the pre-course test results (P<0.001). This finding, as expected, in line with the literature, shows that online basic life support training can be effectively implemented and used as an alternative to traditional training methods [13, 14].

It is vitally important that BLS qualifications are maintained over the long term. Even if a satisfactory level of theoretical learning is achieved after a course or training, the permanence of life support skills tends to decrease over time. Maintaining BLS information, like most training, requires regular reminder training. Online education can make this easier. Unfortunately, sufficient evidence is not currently available in the literature to recommend optimal intervals or methods for BLS booster training, although numerous studies are showing that skills decline within the 3 -12-month time frame after initial BLS training [15-17]. Although it is important to measure the effectiveness of online basic life support training, examining the permanence of knowledge through evaluations made immediately afterward is at least as important as post-training evaluation. Our study is also compatible with the results of previous studies in the literature where similar permanence tests were applied. Our main finding that stands out is that BLS information decreases over time starting from the third month and when it approaches the sixth month, nearly half of the newly acquired information is lost.

In our study, the theoretical knowledge level decreased from a success level of 83% in the post-training evaluation to a success level of 78% after 3 months, while this loss rate was much higher at 6 months. In a study conducted with medical students on compression-related issues, it was determined that the knowledge level dropped by almost half after 3 months, and there was also a serious decrease in general competence in self-assessment [18]. It is known that frequent BLS training increases the rescuer's self-confidence, the desire to perform CPR when needed, and general resuscitation performance. Therefore, it is seen that reinforcement training is seriously important in terms of increasing not only the knowledge level but also the person's self-confidence.

It has been reported that the chance of survival decreases by approximately 10% for every minute CPR is not initiated [19]. It should not be forgotten that time is one of the most critical factors for effective CPR. In our study, it was determined that 93% of the coaches had been in an environment requiring BLS intervention at least once before. This shows how important and appropriate the target audience chosen for education is. Although FIFA has emphasized the training of potential first responders in its emergency action plan for sudden cardiac arrest and their rehearsal at least once a year, our study has shown that even in as little as three months, the level of knowledge decreases [20]. Considering that professional medical teams are not always present on the fields, it is clear that football coaches, who are most likely to be near the athletes, will play the main role in BLS. For this reason, after the first BLS course for football coaches, we recommend booster training with the help of educational short videos in 3-6-month periods.

Although rare, sudden cardiac death in young athletes who represent a healthy human model is a traumatic event that has a great impact on society. When a prominent athlete suddenly collapses and either dies during a game or requires immediate BLS intervention, it resonates as a global tragedy. Such incidents underscore the significant impact of sudden athlete deaths, extending beyond the sports community to af-

fect the general public. Despite clear recommendations from athletic organizations and medical societies worldwide, there are still unfortunate instances where CPR is not initiated at the scene, and tragically, these situations have a 100% mortality rate. [21]. However, it is now known to everyone that BLS training increases bystander CPR rates, which is of extraordinary importance in terms of survival [22]. High-quality CPR with rapid defibrillation is the focus of resuscitation in adult and pediatric cardiac arrest cases. Although it is known that cardiac arrest in most athletes is caused by a shockable rhythm, an AED was used in only 31% of these cases [2]. Although shockable rhythms are in the majority, the fact that AED use is at such a low level of 31% shows that booster training, especially regarding AED use, is mandatory. The results of our study support that these training can be given online with short training videos at 3-6 month intervals without losing their effectiveness, and when combined with the information in the literature, we think that these training can play a critical role in increasing the survival chances of athletes.

Systematic dissemination of training will be a very important step towards protecting athlete and public health by increasing the quality of responses to emergencies on football fields, especially as football coaches who cannot receive training in a traditional classroom environment due to difficult working conditions and time constraints receive basic life support training online. As far as we found in the literature review, our study is the first study in which the permanence of football coaches' basic life support theoretical knowledge was evaluated after online training and 3-6 months later and tested.

Limitations

In our study, no practical training or practical exam was conducted. Football coaches' confidence levels and satisfaction with the training they received before and after the course were not measured.

CONCLUSION

Although we found in our study that BLS knowledge decreased three months after training, there is no clear answer yet regarding the time and frequency of booster training. Rather than being content with a single training, it is clear that the most effective approach will be the integration of booster content with the help of short training videos at intervals of 3-6 months after the first course. For groups who cannot attend continuous traditional training, online BLS and especially AED training videos can serve as an alternative. We also support the slogan of the FIFA health committee, 'No AED, No Match, No Training', and we would like to point out that booster education is equally important to keep the survival rate at 80%.

Ethical Statement

The study received approval from the Balıkesir Atatürk City Hospital Scientific Research Ethics Committee (Decision no: 2023/1/10 and date: 06.04.2023) was carried out in compliance with the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participating football coaches before their enrollment in the study.

Authors' Contribution

Study Conception: MY, AOK; Study Design: TŞ, AOK, BK; Supervision: TŞ, AOK; Funding: N/A; Materials: MY, AOK; Data Collection and/or Processing: BK, TŞ; Statistical Analysis and/or Data Interpretation: AOK, MY; Literature Review: MY, TŞ, BK; Manuscript Preparation: MY, AOK; and Critical Review: BK, MY.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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