




# Prevention of anterior cruciate ligament injuries in female soccer: Effectiveness and adherence to the FIFA 11+ protocol

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## ABSTRACT

The main objective of this study was to evaluate the effectiveness of prevention protocols and rehabilitation strategies, particularly through the implementation of the FIFA 11+ program. Throughout the process, a detailed analysis of each athlete's physical condition was conducted, considering both previous injuries and potential muscular or joint weaknesses. This personalized approach allowed for the identification of specific prevention needs and the adoption of targeted interventions, aiming to reduce the risk of new injuries, especially in the most vulnerable joints, such as the knee and ankle. The study did not solely focus on the application of prevention protocols but also involved continuous comparison with historical data from previous seasons. This comparison enabled an objective assessment of the effectiveness of the adopted programs by measuring their impact not only in terms of injury reduction but also in the overall improvement of the athletes' physical performance and health.

**Keywords:** Sport medicine, FIFA11, Prevention, Anterior cruciate ligament.

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## INTRODUCTION

The FIFA 11+ protocol is an injury prevention program developed by FIFA, primarily targeting football players of all ages and skill levels. It is designed to reduce the risk of injuries, particularly ligament injuries and muscle strains. Numerous scientific studies demonstrate that physical exercise represents one of the most effective forms of prevention for various diseases. In particular, football, being a team sport, proves to be an ideal activity for promoting socialization and improving physical fitness. Through the regular implementation of the FIFA 11+ program, it is possible to make football, both at the amateur and professional levels, a safer physical activity. It has been shown that the frequency of non-contact injuries can be significantly reduced through proper physical preparation. For this reason, FIFA and its Medical Assessment and Research Centre (F-MARC) have developed a specific injury prevention program called 11+. Clinical studies have demonstrated that the consistent adoption of the 11+ protocol can reduce the incidence of injuries by 30% to 50%. Based on these findings, FIFA has decided to promote this program globally within its federations. To this end, training programs have been developed for coaches, fitness trainers, referees, and technical staff to educate them on the principles and operational methods of the 11+ injury prevention program. Playing football requires a range of skills and abilities, including endurance, agility, speed, and both technical and tactical understanding of the game. These aspects are developed and enhanced during training sessions; however, football also carries a significant risk of injury. Therefore, an ideal training session should include specific exercises aimed at reducing the risk of injuries. The "11+" is an injury prevention program created by a group of international experts, based on practical experience accumulated through various prevention programs targeting amateur players aged 14 years and older.

It is a comprehensive package to be integrated at the beginning of training activities and should replace the conventional pre-training warm-up. A scientific study has shown that youth football teams that regularly use the "11+" as a warm-up practice have a significantly lower risk of injuries compared to those adopting a traditional warm-up routine.

Teams that adhered to the FIFA 11+ protocol at least twice per week experienced 37% fewer injuries during training and 29% fewer injuries during matches. Severe injuries decreased by nearly 50%.

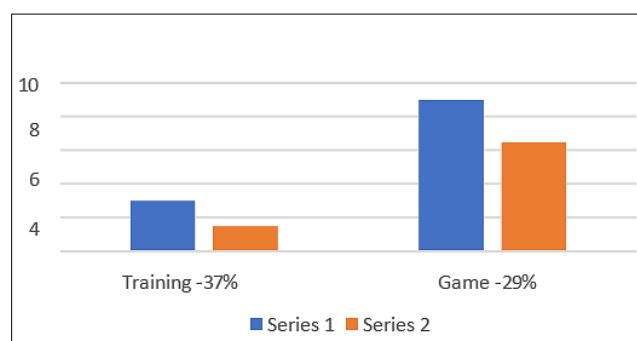


Figure 1. Injury in 1000 hours of activity.

## MATERIAL AND METHODS

The FIFA 11+ protocol, originally developed to reduce injuries in men's football, has never been thoroughly studied in relation to the prevention of anterior cruciate ligament (ACL) injuries in women's football, despite these injuries being particularly common among female players. This was a key motivation for the research.

The primary aim of the study was to compare the results obtained by the women's team during the current season with those from the previous season, in order to analyse the effectiveness of implementing the FIFA 11+ protocol in injury prevention, with a specific focus on anterior cruciate ligament (ACL) injuries. The ACL is one of the most vulnerable structures in football, particularly for female athletes; thus, the objective was to determine whether the use of this protocol could significantly reduce the incidence of such injuries or, conversely, whether there were any complications or worsening outcomes compared to previous years. To conduct a thorough analysis, the study was structured in several phases, each aimed at exploring and understanding the group of athletes more comprehensively.

### **Phase one: Analysis of demographic characteristics and injury history**

In this preliminary phase, key parameters of the players were examined, including year of birth, weight, height, body mass index (BMI), playing position, and previous injuries. These data not only provide a comprehensive overview of the physical profile but are also essential for better understanding potential predisposing factors for injuries, such as ACL tears. For example, greater height, higher BMI, or specific playing positions (such as goalkeepers or central defenders) may be risk factors for certain types of injuries.

The analysis of past injuries, including fractures, muscle strains, and previous ACL injuries, was crucial for identifying potential comorbidities or predisposing factors that could influence the effectiveness of the FIFA 11+ protocol. The examination of both quantitative and qualitative data will allow us to determine whether the implementation of the protocol has led to significant improvements in reducing injuries or whether there is still room for optimization and refinement. In this way, the study outlines a comprehensive framework that not only aids in the prevention of future injuries but also contributes to building a safer and more resilient physical profile for female football players.

Table 1. Athletes.

	Year	Weight (Kg)	Height (cm)	BMI	Role	Past injuries
Athlete 1	2008	59.5	163	22.4	Central	/
Athlete 2	2007	55.4	164	20.4	Defender	/
Athlete 3	2004	50.9	164	18.9	External	/
Athlete 4	2009	51.0	160	19.9	Defender	/
Athlete 5	2008	52.4	153	22.4	Fullback	Left ACL injury left meniscus microfracture
Athlete 6	2007	52.7	158	21.1	External	/
Athlete 7	2007	59.6	164	22.2	Defender	Tendon injury patellar
Athlete 8	2009	47.5	158	22.1	Central	Quarter Fracture right toe
Athlete 9	2009	62.0	159	24.4	Central	Bone oedema right malleolus
Athlete 10	2006	61.5	163	23.0	Defender	Hematoma from left knee contusion
Athlete 11	2009	76.5	160	29.9	Forward	Microfracture ankle malleolus left
Athlete 12	2008	72.7	157	29.5	Defender	Stretching M. Obliques
Athlete 13	2008	55.8	156	22.9	Central	Stretching m. adductors and fracture of the left ankle malleolus
Athlete 14	2006	62.3	161	23.9	Goalkeeper	Ligament injury Peroneal talus
Athlete 15	2008	54.5	157	22.1	Central	/
Athlete 16	2009	99.3	167	35.6	Goalkeeper	Injury leg. Peroneal talus and stretch m. Sartorio
Athlete 17	2008	55.7	164	20.7	Forward	Right ACL injury and fracture of the right malleolus
Athlete 18	2009	59.8	166	21.7	Goalkeeper	/

The age of the athletes ranges from 2004 to 2009, with a distribution of roles including defenders, central players, wingers, and goalkeepers.

The average BMI ranges from normal to overweight, with higher values observed among goalkeepers.

In terms of previous injuries, some players have experienced significant lesions such as anterior cruciate ligament (ACL) ruptures, fractures, and muscle injuries, while others have reported no injuries.

These preliminary data highlighted the need to focus not only on athletes who had sustained major injuries but also on those with minor muscular issues, in order to prevent the worsening of these conditions.

Special attention was given to players who had previously suffered ACL injuries, with the aim of preventing recurrence, which is often caused by muscular insufficiencies or premature return to sports activities without adequate strengthening.

To address this, specific muscle strengthening and functional rehabilitation protocols were implemented, focusing on improving knee stability, proprioception, and neuromuscular coordination, which are critical aspects for preventing further injuries.

At the same time, considerable attention was also given to other athletes presenting signs of muscular weakness, particularly in the thigh region.

This is because a lack of strength or imbalance between the flexor and extensor muscles of the thigh can predispose individuals to injuries such as strains, sprains, or even more severe lesions.

For these athletes, it was essential to constantly monitor potential muscular imbalances and motor difficulties, integrating specific exercises aimed at improving muscle strength, flexibility, and endurance.

***Phase two: Analysis of the distribution of weekly training sessions, working closely with the athletic trainer and the coach***

Training sessions were held three times a week, each lasting two hours, and included various exercises targeted at specific objectives depending on the focus of the day.

1) On Tuesdays, exercises aimed at increasing muscle strength:  
Use of high hurdles with the objective of performing straddle jumps, followed by a rapid sprint. Use of low obstacles to perform straight-leg jumps with legs apart, followed by a final sprint aimed at increasing calf muscle strength. Direction change exercises using cones to improve agility.

2) Thursday: Exercises focused on endurance:  
Fartlek training: This is a training method that combines running at varying intensities, alternating phases of high intensity with active recovery periods. This type of training is particularly effective for improving both aerobic and anaerobic endurance, as well as enhancing the ability to recover quickly between sprints and high-intensity actions typical of football (soccer).

3) Friday: Exercises targeting speed and coordination:  
Shuttle runs: This training activity aims to improve speed, agility, and the ability to change direction rapidly. Shuttle runs involve running back and forth between two or more points spaced at regular intervals. This exercise trains both the aerobic and anaerobic systems while also developing muscular endurance and coordination. Ball possession drills: This methodology is used to improve players' technical, tactical, and cognitive abilities, particularly regarding ball control, game management, and decision-making under

pressure. This drill aims to develop the ability to maintain ball possession for extended periods, involving quick movements, precise passing, and continuous space-seeking.

### **Phase three: Introduction of the FIFA 11+ protocol as an integral part of the warm-up during training sessions**

Its innovation lies in the structured combination of exercises that replace traditional warm-ups and are based on scientific evidence to reduce common football-related injuries, such as anterior cruciate ligament (ACL) injuries, muscle strains, and sprains.

The program lasts 20 minutes and must be performed at least twice a week during training sessions. On match days, it is recommended to perform only the running sections (parts 1 and 3 of the protocol), avoiding more intense exercises to prevent athlete fatigue. The quality of exercise execution is crucial: athletes must be continuously monitored to correct any errors and ensure proper technique.

## **RESULTS**

The introduction of the FIFA 11+ protocol led to a significant reduction in overall injuries compared to the previous year, when the athletes did not follow a specific injury prevention program. This was particularly evident when compared to the "control group" (the athletes from the previous season). During this year, the "intervention group" recorded a significantly lower number of injuries, especially those related to muscle overload or fatigue, which are commonly seen in young female football players. The FIFA 11+ protocol proved effective in improving physical endurance and reducing risks associated with repetitive efforts. One of the most significant outcomes of the protocol was the complete absence of anterior cruciate ligament (ACL) injuries in the intervention group. In the control group from the previous year, two athletes had sustained ACL injuries, a severe injury that can seriously impact an athlete's sports career. This year, thanks to the adoption of the FIFA 11+ program, none of the players sustained ACL injuries, demonstrating that the protocol is a powerful preventive tool, especially for severe joint injuries that require long recovery times. Another key aspect was the improvement in the physical performance of the athletes, attributed to the consistent implementation of the FIFA 11+ program. The players showed enhanced endurance, agility, and muscle coordination, which are critical not only for injury prevention but also for optimizing on-field performance. The athletic preparation resulting from the application of the protocol allowed the athletes to engage in training and matches with reduced risk of overload and an overall improvement in motor skills. It is important to highlight the outcome for the two athletes who had sustained ACL injuries the previous year.

Thanks to the implementation of the FIFA 11+ protocol and a targeted rehabilitation program, both were able to fully recover and actively participate in the season without experiencing re-injury or further related damage. This not only demonstrated the program's effectiveness in preventing new injuries but also its role in promoting recovery and muscle strengthening.

Figure 2 clearly illustrates the benefits of adopting the FIFA 11+ protocol within the Pescara women's football team.

- General injuries: The intervention group showed a significant reduction compared to the control group.
- ACL injuries: No ACL injuries occurred this year in the intervention group, while the control group experienced 2 cases.
- Physical performance: Athletes in the intervention group demonstrated improvement compared to the control group.

- Recovery of athletes with ACL injuries: Two athletes from the intervention group, who had sustained ACL injuries the previous year, fully recovered and did not experience any recurrences.

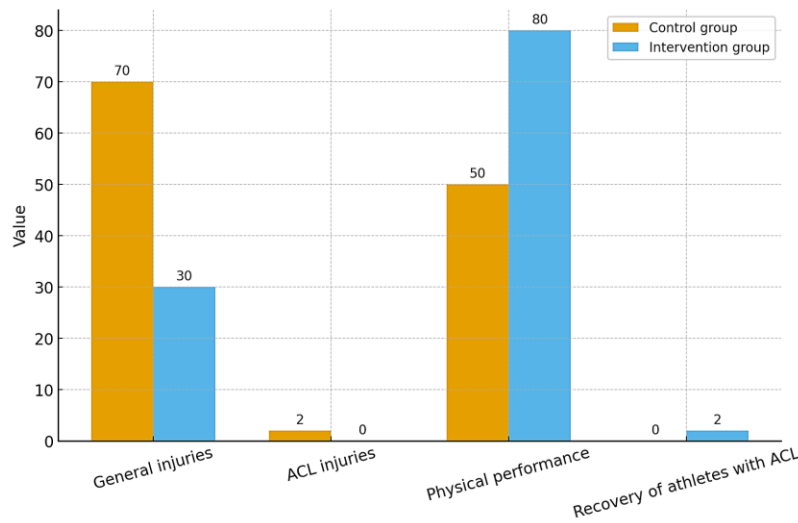


Figure 2. Comparison between the control group and the intervention group regarding the use of the FIFA 11+ protocol.

The study demonstrated a high effectiveness of the FIFA 11+ protocol for injury prevention, despite the sample being composed of female, non-professional football players with an average age lower than that of other studies.

## DISCUSSION

The athletes involved, belonging to the Under-17 youth category, showed significant improvements both in injury reduction and physical recovery, demonstrating that the prevention program can be equally effective in a younger and less experienced population. To further investigate the impact of the FIFA 11+ protocol and determine whether there were similarities or differences with other studies in the literature, I decided to compare my results with a study titled "*Efficacy of the FIFA 11+ Injury Prevention Program in Male College Football Players*", conducted on male university teams (NCAA Division I and II). The main objective was to understand whether the effectiveness of the protocol was limited to specific groups or if it could be generalized to different populations, such as young female athletes compared to male collegiate athletes.

The comparison with this male population provided an additional perspective on the protocol's effectiveness in different contexts.

In the referenced study, the control group (without the use of the FIFA 11+ protocol) recorded a total of 665 injuries with an incidence rate of 15.04 injuries per 1000 athletic exposures and an average of 13.20 days lost due to injuries. In contrast, the group implementing the FIFA 11+ protocol showed a significant 46.1% reduction in general injuries, with 285 total injuries and an incidence rate reduced to 8.09 injuries per 1000 athletic exposures. The average time lost due to injuries also decreased by 28.6%, with an average of 10.08 recovery days. This allowed for a deeper understanding of the cross-sectional effectiveness of the FIFA 11+ protocol, demonstrating how it can be adapted and successfully used across various athletic populations, regardless of gender, age, or experience level. At the conclusion of this analysis, a table was developed to

provide a clear representation of the comparison between the female football team and a male team, both evaluated before and after the introduction of the FIFA 11+ protocol. The table allows for a detailed highlighting of the differences between the two groups across various key parameters: the total number of injuries, specific anterior cruciate ligament (ACL) injuries, changes in physical performance, and recovery time following injuries. Additionally, it shows how the incidence of these events changed in the absence of the protocol compared to when it was adopted. Therefore, the table serves as a summary tool to emphasize the advantages derived from the use of the FIFA 11+ protocol compared to its absence.

The differences in key parameters (number of injuries, ACL injuries, physical performance, and recovery time) are clearly outlined, providing a clear and visually immediate overview of the positive impact the protocol had on both study ed populations, female and male, despite differences in gender, age, and competition level. The comparison between the two groups highlights the differences in gender, age, and competition level, but also underscores how the FIFA 11+ protocol is versatile and adaptable to different types of athletes, regardless of these differences. In the youth female team, which is characterized by a higher vulnerability to ACL injuries, the benefits of the protocol were evident, with a significant reduction in severe injuries during the season. At the same time, in the male collegiate group, an improvement in general physical conditions was observed, with a reduction in both ACL injuries and other common football injuries, such as muscle strains and minor fractures. This type of comparative analysis further strengthens the idea that FIFA 11+ is a versatile and effective tool for injury prevention, adaptable to different athlete groups. Both in the female youth and male collegiate settings, the benefits were significant, suggesting that the systematic adoption of the protocol not only reduces injury incidence but also improves overall athletic conditions and shortens recovery times.

Table 2. Comparison between the two studies.

<b>Pescara women's football team</b>		<b>Men's College Teams (NCAA Division I e II)</b>	
Control group (previous year without FIFA 11+)	Intervention Group (this year with FIFA 11+)	Control Group (without FIFA 11+)	Intervention Team (with FIFA 11+)
General Injuries: More injuries than the intervention group.	General Injuries: Significant reduction in injuries compared to the control group.	General Injuries: 665 accidents with an incidence rate of 15.04 accidents per 1000 athletic exhibitions.	General Injuries: 285 accidents, a reduction of 46.1% compared to the control group.
ACL injuries: 2 cases of anterior cruciate ligament (ACL) injuries	ACL injuries: No cases of ACL injuries.	ACL injuries: Not specified, but included in the total number of injuries.	ACL injuries: Not specified.
Physical performance: Lower level than the intervention group	Physical performance: Improved physical performance. Two athletes with ACL injuries the previous year recovered without recurrence.	Physical performance: It has not been measured explicitly. Time lost due to injuries: 13.20 days on average lost due to injuries.	Physical performance: Not specifically measured, but injury reduction suggests better physical condition.
	Retrieval: Improvement, particularly for athletes with ACL injuries.		Recovery: 28.6% reduction (average of 10.08 days lost)

Before the introduction of the FIFA 11+ program, both groups exhibited a high incidence of general injuries, with significant cases of ACL injuries, which represent one of the major career risks for an athlete. The pre-FIFA 11+ comparison highlighted similar issues: high injury frequency, prolonged recovery times, and a

negative impact on athletic performance. In both teams, the absence of a structured prevention program left ample room for the occurrence of overload injuries, trauma, and, in particular, ACL injuries. With the introduction of the FIFA 11+ protocol, both the female Pescara Calcio team and the male university team showed significant improvement. The overall reduction in injuries, particularly ACL injuries, was noteworthy. In the female team, the absence of new ACL injuries throughout the season represents an exceptional result, while in the male university team, there was a 46.1% reduction in general injuries, with a substantial decrease in time lost due to recovery from injuries. This data demonstrates the effectiveness of the protocol not only in preventing injuries but also in facilitating faster recovery and a better return to athletic activities. In the case of the youth female team, the introduction of FIFA 11+ resulted in a notable reduction in injuries, especially concerning ACL injuries. In fact, no ACL injuries were reported in the intervention group, compared to two cases in the control group from the previous year. Physical performance of the athletes also improved significantly, particularly among those who had sustained ACL injuries in previous years, with full recovery and no recurrence. Similarly, in the male team, the adoption of the FIFA 11+ protocol led to a 46.1% reduction in general injuries, and although no specific data was provided on ACL injuries, the overall decrease in injuries suggests a positive impact on this population as well. Furthermore, the average time lost due to injuries decreased by 28.6%, indicating faster recovery times for the athletes.

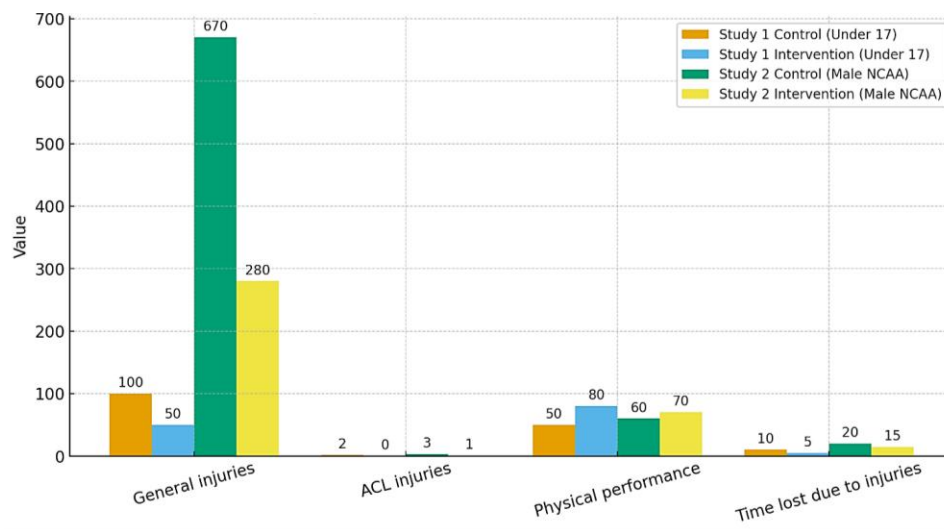


Figure 3. Comparison of studies: control vs. intervention.

The figure intuitively illustrates the differences in results obtained before and after the implementation of the FIFA 11+ protocol, allowing for a clearer understanding of the program's impact on key parameters such as injury frequency and physical performance.

This visualization enables a deeper understanding not only of the similarities and differences between the two studies but also provides a clearer view of the effectiveness of the FIFA 11+ protocol in injury prevention and improving the physical condition of athletes, regardless of gender or competition level. Both studies confirm the effectiveness of the FIFA 11+ program in reducing injuries, although they focus on different populations (female vs. male). In the youth female team, the absence of ACL injuries and the recovery of athletes who had sustained such injuries in the previous year represent particularly significant outcomes, while the male university study shows a global reduction in injuries. The comparison was useful in highlighting the differences in the protocol's effectiveness between athletes of different genders, confirming the program's efficacy in reducing injuries in both populations.



## CONCLUSIONS

The implementation of the FIFA 11+ protocol as a preventive measure against anterior cruciate ligament (ACL) injuries in the Pescara Calcio Under 17 female team proved to be an extremely effective and beneficial intervention. The primary aim of this study was to evaluate whether the integration of this warm-up program, combined with specific exercises, could reduce the incidence of injuries, particularly ACL injuries, compared to previous seasons. Throughout the entire season, although some muscle strains were reported during certain matches, no ACL injuries occurred. This result is particularly significant, as ACL injuries are among the most feared for an athlete, not only because of the physical impact they cause but also due to the psychological consequences and the long recovery period they require. The complete absence of ACL injuries in a highly competitive context such as the Under 17 level suggests that the FIFA 11+ protocol played a key role in ensuring the necessary joint stability and protecting the athletes from potential severe injuries. Additionally, another important aspect revealed by the analysis was the general physical improvement observed even among athletes who had previously sustained ACL injuries. This data highlights not only the effectiveness of the protocol in preventing new injuries but also its contribution to fostering a solid recovery and reducing recurrences among players previously injured.

The progressive and specific exercises proposed by FIFA 11+ enabled the athletes to strengthen their physical capabilities, improving their endurance and preparing their bodies for intense efforts and the unpredictability of the game. The study thus underscores the crucial importance of injury prevention in sports, demonstrating that the adoption of structured protocols like FIFA 11+ is not only advisable but essential for ensuring the long-term health of athletes. Constant supervision and attention to the correct execution of exercises played a decisive role in the results obtained, significantly reducing the risk of injury and enhancing the overall performance of the team. To support these conclusions, the results obtained were compared with another scientific study in the literature that examined the application of the FIFA 11+ protocol in a sample of male athletes (NCAA Division I and II). This comparison further reinforced the effectiveness of FIFA 11+, demonstrating how the protocol, in both female youth soccer and male soccer, can significantly reduce the risk of injuries and the time lost for recovery. Although the studied populations differ in terms of gender, age, and competition level, the effectiveness of the protocol emerges as a common point between the two groups, highlighting the universal value of prevention through targeted exercises.

In conclusion, the adoption of the FIFA 11+ protocol in the female team resulted in tangible and positive outcomes. It not only succeeded in preventing ACL injuries but also contributed to the overall improvement of the athletes' physical condition, including those who had previously sustained injuries. This comparison with male athletes further confirms the validity of the program, emphasizing how its systematic application not only reduces the incidence of injuries but also improves athletic performance, thanks to enhanced functional strength, joint stability, and the physical response capacity to game stimuli. To achieve lasting results, it will be essential to continue implementing the FIFA 11+ protocol regularly, alongside careful and ongoing supervision to ensure proper execution and maximize the benefits of the program.

## AUTHOR CONTRIBUTIONS

All authors contributed to the study conception and design. All authors read and approved the final manuscript.

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## DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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