Effectiveness Of Structured Exercise Progrme On Delayead Onset Of Muscle Soreness In Amateur Football Players.

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ABSTRACT

Background: Delayed Onset Muscle Soreness (DOMS) is a common condition experienced by football players following intense physical activity, particularly exercises involving eccentric muscle contractions. It is characterized by muscle pain, stiffness, and reduced functional performance, which may affect training and athletic performance.
Structured exercise programs that include warm-up, stretching, strengthening, and cool-down exercises may help reduce the severity of DOMS and improve recovery. However, limited evidence exists regarding their effectiveness among amateur football players. Therefore, this study aims to determine the effectiveness of a structured exercise program in reducing delayed onset muscle soreness in amateur football players.

Methods:

A pre-experimental one-group pre-test and post-test study was conducted among 30 amateur football players aged 18–22 years to evaluate the effectiveness of a structured exercise program on delayed onset muscle soreness. Participants underwent a four-week structured exercise program consisting of jogging, dynamic stretching, eccentric strengthening, balance and agility training, and cool-down exercises. Outcome measures included the Visual Analogue Scale (VAS), Range of Motion (ROM), and Vertical Jump Test (VJT).
Assessments were performed before and after the intervention. Data were analyzed using descriptive statistics and paired t-tests, with statistical significance set at $p < 0.05$.

Results: Thirty amateur football players completed the study.The results of the study demonstrated significant improvements in all outcome measures following the 4-week structured exercise program. The mean Visual Analogue Scale (VAS) score significantly decreased from 6.80 ± 0.92 to 2.97 ± 0.72, indicating a substantial reduction in delayed onset muscle soreness. The mean Range of Motion (ROM) significantly increased from $118.60 \pm 2.75°$ to $127.07 \pm 3.10°$, reflecting improved lower-limb flexibility. Similarly, the mean Vertical Jump Test (VJT) score improved from 33.87 ± 2.58 cm to 40.37 ± 2.87 cm, demonstrating enhanced functional performance and lower-limb muscular power. Statistical analysis using the paired t-test revealed highly significant differences between pre-test and post-test values for all outcome measures ($p < 0.001$).

Conclusion: The present study concluded that the structured exercise program was effective in reducing delayed onset muscle soreness (DOMS) among amateur football players. Significant improvements were observed in pain levels, lower-limb flexibility, and functional performance following the 4-week intervention. The reduction in VAS scores, along with improvements in ROM and Vertical Jump Test performance, indicates that the structured exercise program contributed to enhanced recovery and physical function. Therefore, structured exercise programs can be recommended as an effective strategy for managing DOMS and improving athletic performance in amateur football players.

Keywords: Delayed Onset Muscle Soreness, Structured Exercise Program, Amateur Football Players, Range of Motion, Vertical Jump Test, Functional Performance
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INTRODUCTION

Football is one of the most widely played and physically demanding sports across the world. Success in football depends on a combination of technical skills, tactical awareness, muscular strength, endurance, speed, agility, balance, and coordination. During both training and competitive matches, players are required to perform repeated bouts of sprinting, jumping, kicking, tackling, accelerating, decelerating, and rapid changes in direction. These high-intensity activities impose considerable mechanical and metabolic stress on the musculoskeletal system, particularly the lower-limb muscles. Consequently, football players frequently experience muscle fatigue, reduced physical performance, and exercise-induced muscle soreness, all of which can influence their ability to train and compete effectively.
Therefore, appropriate recovery strategies play a crucial role in maintaining athletic performance and minimizing the risk of injury.[1]

One of the most common consequences of strenuous physical activity is Delayed Onset Muscle Soreness (DOMS). DOMS is a temporary condition characterized by muscle pain, tenderness, stiffness, swelling, and a reduction in functional capacity that typically develops 24 to 72 hours after intense or unfamiliar exercise. Unlike acute muscle pain that occurs during exercise, DOMS appears several hours after activity and reaches its peak intensity between 24 and 48 hours. The condition is particularly associated with activities involving eccentric muscle contractions, where muscles lengthen while simultaneously generating force. Football players frequently perform eccentric movements during sprinting, deceleration, landing from jumps, and directional changes, making them highly susceptible to the development of DOMS.[2]

Although DOMS is considered a normal physiological response to exercise, it can have important consequences for athletes. Muscle soreness often leads to discomfort during movement and may negatively affect an individual's willingness to participate in subsequent training sessions. Research has shown that DOMS can reduce muscle strength, impair flexibility, alter proprioception, and decrease neuromuscular control. These changes may compromise athletic performance and increase susceptibility to injury. For football players, even a small decline in physical function may affect sprint speed, kicking efficiency, jumping performance, balance, and agility, ultimately influencing overall sporting performance.[3]

The pathogenesis of DOMS is complex and remains an area of active investigation. Earlier theories suggested that lactic acid accumulation was responsible for post-exercise soreness; however, current evidence does not support this explanation. Contemporary research indicates that DOMS results primarily from microscopic damage to muscle fibers and connective tissues caused by eccentric exercise. This structural disruption initiates a series of inflammatory responses within the affected muscles. The release of inflammatory mediators stimulates pain receptors, resulting in soreness and tenderness. In addition, muscle swelling and localized inflammation contribute to stiffness and reduced range of motion. These physiological changes collectively lead to the symptoms commonly experienced during DOMS.[4]

Researchers have also identified an adaptive phenomenon known as the "repeated-bout effect." This phenomenon refers to the observation that muscles become more resistant to damage following repeated exposure to eccentric exercise. After an initial episode of muscle soreness, subsequent bouts of similar exercise often produce less muscle damage and reduced soreness. This protective adaptation is believed to occur through neural, mechanical, and cellular mechanisms that improve the muscle's ability to tolerate eccentric loading. Understanding these adaptive responses has contributed to the development of exercise-based strategies aimed at reducing the severity of DOMS and improving recovery.[5]The negative effects of DOMS extend beyond pain perception. Muscle soreness may alter normal movement patterns and affect an athlete's ability to perform sport-specific

tasks efficiently. Studies have demonstrated that DOMS can reduce force production, impair balance, decrease flexibility, and limit joint range of motion. In football players, these impairments may affect performance during activities such as sprinting, cutting, jumping, tackling, and ball control. Furthermore, persistent soreness may disrupt training schedules and reduce training quality, potentially affecting long-term athletic development and performance outcomes.[6]

To minimize the impact of DOMS, various preventive and therapeutic interventions have been proposed. Commonly investigated approaches include stretching, massage therapy, cryotherapy, thermotherapy, compression garments, nutritional supplementation, active recovery techniques, and physiotherapy interventions. While some studies have reported beneficial effects, the overall evidence remains inconsistent. Systematic reviews and meta-analyses have suggested that no single intervention can completely eliminate DOMS, although several methods may contribute to symptom reduction and improved recovery.[7,8]

Among the available approaches, structured exercise programs have gained increasing attention because they address multiple factors associated with muscle recovery. A structured exercise program typically includes warm-up activities,
dynamic stretching, eccentric strengthening exercises, balance training, agility drills, and cool-down exercises. These components may improve circulation, enhance flexibility, increase muscular endurance, and promote neuromuscular adaptation. Regular participation in such programs may also facilitate the repeated-bout effect, thereby reducing the severity of muscle damage and soreness following subsequent exercise sessions. Consequently, structured exercise programs have the potential to serve as both preventive and rehabilitative strategies for managing DOMS.[8]

The importance of structured exercise interventions is particularly relevant for amateur football players. Unlike professional athletes, amateur players often have limited access to specialized medical support, recovery facilities, and individualized training programs.
Inadequate recovery practices may increase their susceptibility to DOMS and its associated performance limitations. Therefore, identifying practical, affordable, and evidence-based interventions is essential to support recovery and enhance performance in this population. Despite extensive research on the mechanisms and management of DOMS, limited studies have specifically evaluated the effectiveness of structured exercise programs among amateur football players. Given the physical demands of football and the potential consequences of prolonged muscle soreness, further research is warranted in this area. Therefore, the present study was undertaken to investigate the effectiveness of a structured exercise program on delayed onset muscle soreness in amateur football players. The findings of this study may provide valuable evidence for physiotherapists, sports trainers, coaches, and athletes seeking effective strategies to reduce muscle soreness, promote recovery, and optimize athletic performance.[9,10]

Participants

The study was conducted after obtaining informed consent from all participants. Amateur football players aged between 18 and 22 years who regularly participated in football training and experienced delayed onset muscle soreness (DOMS) following training or match activities were eligible to participate in the study. Participants were required to provide written informed consent prior to enrollment.

The participants were recruited from local football clubs, training academies, and sports training facilities and were actively involved in football-related activities such as sprinting, jumping, kicking, tackling, and agility drills as part of their regular training routine.
The exclusion criteria included a history of lower-limb fractures, recent

musculoskeletal injuries, previous lower-limb surgery, congenital or acquired lower-limb deformities, neurological or vascular disorders affecting lower-limb function, and any acute lower-limb injury within the three months preceding the study. Participants undergoing treatment for chronic pain or any medical condition that could influence physical performance or recovery were also excluded from the study.
This ensured the selection of a homogeneous group of amateur football players suitable for evaluating the effectiveness of the structured exercise program on delayed onset muscle soreness.

Procedure

After obtaining ethical approval, amateur football players were screened according to the inclusion and exclusion criteria. The purpose, procedure, benefits, and potential risks of the study were explained to all participants, and written informed consent was obtained prior to participation. Eligible participants experiencing delayed onset muscle soreness (DOMS) following football training or match activities were enrolled in the study. Baseline assessment was conducted before the intervention using the Visual Analogue Scale (VAS) to assess muscle soreness, Range of Motion (ROM) using a universal goniometer to evaluate lower-limb flexibility, and the Vertical Jump Test (VJT) to assess functional performance and lower-limb muscular power.

All participants underwent a supervised 4-week structured exercise program, consisting of three sessions per week. The exercise protocol included light jogging, dynamic stretching exercises, eccentric strengthening exercises targeting the lower-limb muscles, balance and agility training, and cool-down exercises with static stretching. The intensity and progression of the exercises were gradually increased throughout the intervention period according to participant tolerance and performance.

Following completion of the 4-week intervention, post-intervention assessments were performed using the same outcome measures. Pre-test and post-test values were then compared to determine the effectiveness of the structured exercise program in reducing delayed onset muscle soreness and improving flexibility and functional performance among amateur football players.Ethical approval and participation consent

The ethical approval for undertaking the suggested studies has been obtained from the Institutional Committee of Ethics of Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, India, dated January 22, 2026. Every participant provided their informed permission in writing after being given the assurances of confidentiality and the freedom to discontinue participation at any moment.

Outcome Measures

Pre-test and post-test assessments were conducted to evaluate the effectiveness of the structured exercise program on delayed onset muscle soreness (DOMS) among amateur football players. Muscle soreness was assessed using the Visual Analogue Scale (VAS), a reliable and widely accepted tool for measuring pain intensity. Participants rated their level of muscle soreness before and after the intervention. A reduction in VAS scores indicated a decrease in the severity of DOMS following the exercise program

Lower-limb flexibility and functional performance were assessed using Range of Motion (ROM) and the Vertical Jump Test (VJT), respectively. ROM was measured using a universal goniometer to determine flexibility and joint mobility, while the Vertical Jump Test was used to evaluate lower-limb muscular power and functional performance. Improvements in ROM and VJT scores following the intervention indicated enhanced flexibility, reduced muscle stiffness, and improved athletic performance. Together, reductions in VAS scores and improvements in ROM and VJT measurements were considered

indicators of the effectiveness of the structured exercise program.

Statistical Analysis

Statistical methods were used to analyze the data collected during the study. Demographic characteristics of the participants, including age, gender, height, weight, and body mass index (BMI), were summarized using descriptive statistics. Continuous variables were expressed as mean and standard deviation (Mean ± SD).
The pre-test and post-test scores of the Visual Analogue Scale (VAS), Range of Motion (ROM), and Vertical Jump Test (VJT) were compared to evaluate the effectiveness of the structured exercise program on delayed onset muscle soreness (DOMS) among amateur football players. As the study followed a one-group pre-test and post-test design, a two-tailed paired t-test was used to analyze the differences between baseline and post-intervention values. Statistical analysis was performed using SPSS version 25, and a p-value of less than 0.05 ($p < 0.05$) was considered statistically significant.

Result:

The present study included 30 amateur football players experiencing delayed onset muscle soreness (DOMS). All participants fulfilled the inclusion criteria and completed the 4-week structured exercise program without dropout. Pre-test and post-test assessments were recorded for all participants and included in the final statistical analysis.

Table 1: Age Distribution of Participants (n = 30)

Age Group (Years)	Frequency (n)	Percentage (%)
18-19	12	40.0%
20-21	13	43.3%
22	5	16.7%
Total	30	100%

Interpretation:
The majority of participants (43.3%) belonged to the 20–21 years age group, followed by 40.0% in the 18–19 years age group and 16.7% in the 22-year age group. This indicates that the study population primarily consisted of young amateur football players.

Table 2: BMI Distribution of Participants (n = 30)

BMI Category	Frequency (n)	Percentage (%)
Underweight (<18.5 kg/m²)	2	6.7%
Normal (18.5–24.9 kg/m²)	23	76.7%
Overweight (25.0–29.9 kg/m²)	5	16.7%

Obese (≥30 kg/m²)	0	0.0%
Total	30	100%

Interpretation:
The majority of participants (76.7%) had BMI values within the normal range. A total of 16.7% of participants were classified as overweight, while 6.7% were underweight. No participants were classified as obese. These findings indicate that most participants had an appropriate body composition for football participation.

Table 3: Gender Distribution of Participants (n = 30)

Gender	Frequency (n)	Percentage (%)
Male	24	80.0%
Female	6	20.0%
Total	30	100%

Interpretation:
The study included 24 male participants (80.0%) and 6 female participants (20.0%). The majority of participants were male amateur football players.

Table 4: Visual Analogue Scale (VAS) Analysis

Outcome Measure	Pre (Mean ± SD)	Post (Mean ± SD)	Mean Difference	t-value	p-value
VAS	6.80 ± 0.92	2.97 ± 0.72	3.83	35.46	<0.001

Interpretation:
VAS scores showed a highly significant reduction following the structured exercise program. The mean score decreased from 6.80 ± 0.92 before intervention to 2.97 ± 0.72 after intervention. This reduction indicates a substantial decrease in delayed onset muscle soreness among amateur football players. Statistical analysis demonstrated a highly significant difference between pre-test and post-test values ($p < 0.001$).

Table 5: Range of Motion (ROM) Analysis

Outcome Measure	Pre (Mean ± SD)	Post (Mean ± SD)	Mean Difference	t-value	p-value
ROM	118.60 ± 2.75	127.07 ± 3.10	8.47	91.39	<0.001

Interpretation:
Range of Motion showed a highly significant improvement after intervention. The mean ROM increased from 118.60 ± 2.75° to 127.07 ± 3.10°. The increase of 8.47° reflects improved lower-limb flexibility and reduced muscular stiffness following participation in the structured exercise program. The improvement was statistically significant ($p < 0.001$).

Table 6: Vertical Jump Test Analysis

Outcome Measure	Pre (Mean ± SD)	Post (Mean ± SD)	Mean Difference	t-value	p-value
Vertical Jump Test	33.87 ± 2.58 cm	40.37 ± 2.87 cm	6.50 cm	70.01	<0.001

Interpretation:
Vertical Jump Test scores showed a highly significant improvement following the intervention. The mean score increased from 33.87 ± 2.58 cm to 40.37 ± 2.87 cm. This improvement indicates enhanced lower-limb muscular power, neuromuscular performance, and functional ability among amateur football players. Statistical analysis demonstrated a highly significant difference between pre-test and post-test values ($p < 0.001$).

Final Interpretation for Results Section

The overall findings of the present study demonstrated significant improvement across all outcome measures following the 4-week structured exercise program. The average Visual Analogue Scale score decreased by 3.83 points (from 6.80 ± 0.92 to 2.97 ± 0.72), indicating a substantial reduction in delayed onset muscle soreness. The average Range of Motion increased by 8.47° (from 118.60 ± 2.75° to 127.07 ± 3.10°), demonstrating improved lower-limb flexibility. The average Vertical Jump Test score increased by 6.50 cm (from 33.87 ± 2.58 cm to 40.37 ± 2.87 cm), indicating enhanced muscular power and functional performance.
The results of statistical analysis demonstrated highly statistically significant differences between all three outcome measures ($p < 0.001$). Based upon these findings, it is concluded that the structured exercise program was effective in reducing delayed onset muscle soreness, improving lower-limb flexibility, and enhancing functional performance among amateur football players.

Discussion

The present study was conducted to evaluate the effectiveness of a structured exercise program on delayed onset muscle soreness (DOMS) among amateur football players. The findings demonstrated significant improvements in all outcome measures following the 4-week intervention. A significant reduction in muscle soreness was observed, accompanied by improvements in lower-limb flexibility and functional performance. These findings suggest that a structured exercise program can be an effective strategy for managing DOMS and enhancing physical performance in amateur football players.[11]

The results showed a significant decrease in Visual Analogue Scale (VAS) scores following the intervention, indicating a reduction in the severity of delayed onset muscle soreness. DOMS commonly develops after intense or unaccustomed exercise, particularly activitiesinvolving eccentric muscle contractions. The reduction in soreness observed in the present study may be attributed to the combined effects of dynamic stretching, eccentric strengthening exercises, and progressive training adaptation. Regular exposure to controlled exercise may improve muscular tolerance to eccentric loading and contribute to the repeated-bout effect, thereby reducing the perception of muscle soreness. These findings are consistent with the observations of Cheung et al. and Sayers and Dannecker, who reported that exercise-based recovery strategies may help reduce the severity of DOMS and promote faster recovery.[12]

A significant improvement in Range of Motion (ROM) was also observed after completion of the structured exercise program. Muscle soreness is often associated with increased stiffness and reduced flexibility, which can limit joint mobility and athletic performance. The improvement in ROM seen in this study may be related to the inclusion of dynamic stretching and progressive strengthening exercises, which help maintain muscle extensibility and reduce muscle tightness. Improved flexibility is important for football players because it facilitates efficient movement patterns and reduces the risk of movement restrictions during training and competition. Similar findings have been reported in previous studies, which demonstrated that exercise-based interventions can positively influence flexibility and reduce the functional limitations associated with DOMS.[13]

The findings of the Vertical Jump Test demonstrated a significant improvement in functional performance following the intervention. Functional performance is often impaired during periods of muscle soreness because of reduced force production, altered neuromuscular control, and decreased muscular efficiency. The increase in vertical jump height observed in this study suggests enhanced lower-limb muscular power and improved neuromuscular function. The structured exercise program may have contributed to these improvements by promoting muscular adaptation, improving motor control, and enhancing the ability of the lower-limb muscles to generate force. These findings support previous research indicating that appropriate exercise interventions can help restore performance and reduce the negative impact of DOMS on athletic activities.[14]

Football players are frequently exposed to repetitive high-intensity activities such as sprinting, jumping, cutting, and rapid changes in direction, all of which increase the likelihood of developing DOMS. Effective recovery strategies are therefore essential to maintain performance and prevent interruptions in training. The results of the present study indicate that a structured exercise program can serve as a practical and cost-effective intervention for amateur football players. Unlike passive recovery methods, structured exercise promotes active adaptation and may provide long-term benefits by improving flexibility, muscular strength, and functional performance while simultaneously reducing soreness.[15]

The overall findings of the study support the use of structured exercise programs as part of sports rehabilitation and recovery protocols. The significant improvements observed in pain, flexibility, and functional performance suggest that such programs may help

athletes recover more effectively from exercise-induced muscle soreness. These findings are particularly relevant for amateur football players, who may have limited access to specialized recovery resources but can easily incorporate structured exercise into their regular training routines.

Although the study demonstrated positive outcomes, certain limitations should be considered. The study included a relatively small sample size and utilized a one-group pre-test and post-test design without a control group. Therefore, the findings should be interpreted with caution. Future studies with larger sample sizes, randomized controlled designs, and longer follow-up periods are recommended to further investigate the effectiveness of structured exercise programs on delayed onset muscle soreness in different athletic populations.

Overall, the findings of the present study indicate that a structured exercise program is effective in reducing delayed onset muscle soreness and improving lower-limb flexibility and functional performance among amateur football players. The results support the integration of structured exercise interventions into training and rehabilitation programs to enhance recovery and optimize athletic performance.[18]

Conclusion

The findings of the present study demonstrated that a 4-week structured exercise program was effective in reducing delayed onset muscle soreness (DOMS) among amateur football players. Significant improvements were observed in all outcome measures following the intervention. The reduction in Visual Analogue Scale (VAS) scores indicated decreased muscle soreness, while improvements in Range of Motion (ROM) and Vertical Jump Test (VJT) scores reflected enhanced lower-limb flexibility, muscular power, and functional performance. These findings suggest that structured exercise can play an important role in promoting recovery and minimizing the negative effects of exercise-induced muscle soreness.

The positive outcomes observed in this study may be attributed to the combined effects of dynamic stretching, eccentric strengthening, balance and agility training, and cool-down exercises included in the structured exercise program. These components likely improved muscular adaptation, reduced stiffness, enhanced neuromuscular function, and supported recovery following strenuous physical activity. Therefore, a structured exercise program can be considered a practical, safe, and effective intervention for managing DOMS and improving athletic performance among amateur football players.

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Ethical Approval

Ethical approval for the present study was obtained from the Institutional Ethics Committee of Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, India, dated January 21, 2026.

Conflicts of Interest

We claim that there are no conflicts of interest in the content of this study.

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