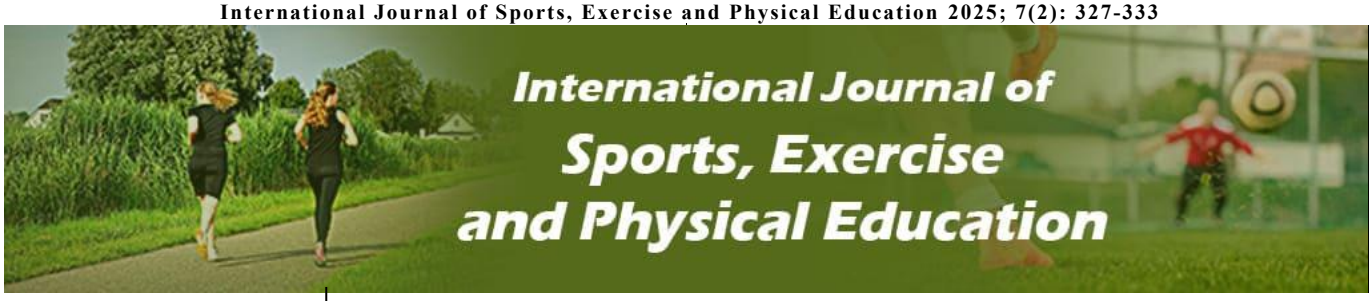

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The effectiveness of a preventive program in terms of the level of interleukin in the blood from sports injuries in football players

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Abstract
The study aimed to design a preventive program from sports injuries and identify its effect on the concentration of interleukin (IL-6) and interleukin (IL-10) in the blood. and using the experimental method, it was applied to a sample of the players of the Naft Misan Football Club for the sports season 2023/2024, and their number is (25) players from the research community, and their number is (20) players, they were randomly divided into two equal groups. and then the pre-measurement was applied by measuring the concentration ratio of interleukin-6 and interleukin-10 in the blood before and after exertion, then the components of the preventive program were applied using manual massage and cold-water diving to the experimental group, while the control group was satisfied with the usual negative rest. then the telemetry was performed in exactly the same way, and the researchers concluded that there is a positive effect of applying the proposed program to the physiological variables under research, and the combination of manual massage hospitalization with immersion in cold water has helped speed up the recovery time by taking advantage of the effect of both preventive methods together. and they recommended Researchers apply the proposed preventive program using manual massage and then immersion in cold water as an essential element in the training process in the pre-competition stage because of its positive impact on hospitalization and prevention of injuries in this critical period. with the need to apply physical tests and conduct them periodically during the periods of the training season to identify the players' physical capabilities of its importance in modifying physical loads and preventing injuries.

Keywords: Preventive program, interleukin, blood, sports injuries

Introduction
Injury rates differ across sports, contingent upon the sport's inherent characteristics and the presence of injury prevention measures during training or competition (Mugele *et al*., 2018) [21]. Achieving peak athletic performance is a primary objective of scientifically grounded sports training, as performance levels hinge on meticulous planning of the training process to enhance technical proficiency and attain the highest standards (Huang & Yongquan, 2025) [11]. A critical aspect of contemporary training, particularly at advanced levels, is the elevated intensity of training loads (McLaren *et al*., 2018) [20]. While this increase in loads yields advantages that enhance performance and productivity among athletes, it also presents drawbacks, adversely affecting certain bodily systems (Maestroni *et al*., 2020) [17]. Furthermore, sports training physiologists have yet to ascertain the maximum physiological potential of athletes, thereby amplifying the aspirations of both players and coaches (Al Behadili & Kasim, 2022; Dovgan, 2023) [1, 9]. Muscle fatigue stemming from intricate issues related to both the nervous and muscular systems can be attributed to several factors, including the accumulation of lactic acid due to anaerobic muscle activity and fatigue resulting from glycogen depletion, particularly in slow-twitch muscle fibres (Constantin-Teodosiu & Constantin, 2021) [7]. This occurs despite the support of liver-derived glucose and fatty acids, which facilitate the production of ketones in the bloodstream, contributing to muscle fatigue (Valenzuela *et al*., 2021) [33]. In instances of glycogen deficiency, the active muscles generate specific cytokines. Interleukin-6 (IL-6) significantly elevates in plasma and functions as a hormone that enhances lipolysis; its production rate is closely correlated with exercise duration, indicating that elevated IL-6 levels contribute to muscle exhaustion

(Nash *et al*., 2023) [22]. Intense athletic training elevates the inflammatory cytokines interleukin-10 beta (IL-10) and interleukin-6 (IL-6), a rise counterbalanced by increased levels of cytokine inhibitors such as interleukin-1 receptor antagonist (IL-1Ra), interleukin-10 (IL-10), and tumour necrosis factor alpha (TNF-α), which inhibits interleukin-6 (IL-6) (Małkowska & Sawczuk, 2023) [18]. Rhibi *et al*. (2022) [29] observed that high physical load intensity in sports training and intense competitions resulted in a significant elevation of interleukin plasma levels, as well as a more pronounced increase in the concentration of natural killer (NK) cells and (CD+) cells, which are critical factors in muscle damage.

Search problem

Excessive training occurs when a player engages in physical activity above their capabilities, resulting in elevated tiredness levels, and leading to a state of stress and physical, psychological, and functional weariness (Fiala *et al*., 2025) [10]. The training process transforms into a detrimental reversal process affecting the lower level (Smith, 2003) [31]. The athlete may be susceptible to physical injuries or a dysfunction in the internal organs of the body. Consequently, the inability to maintain activity reveals that 75% of injuries were muscle contusions, lacerations, and tears of muscles and tendons, while 15% pertained to fractures and tears of ligaments and cartilage. A lack of physical conditioning is a primary cause of these injuries, exacerbated by increased training-induced muscle fatigue. Cabral-Santos *et al*. (2019) [5] identified interleukin-10 (IL-10) as a cytokine produced by muscles that functions as a hormone in active muscles. It is regarded as one of the interleukins most influenced by physical performance and applied physical stress. IL-10 serves as a potent inhibitor of cytokine production and secretion in monocyte-derived macrophages, thereby mitigating the intensity and severity of inflammation resulting from physical exertion during training and competitive sports (Callegari, Rocha & Oliveira, 2023) [6]. An increase in IL-10 levels signifies the restoration of healing and the alleviation of muscle fatigue. Torres-Ronda *et al*. (2022) [32] said that the competitive dynamics in certain sports differ based on the timing of the events and the characteristics of performance in football. Their variation is contingent upon the lines, playing centres, and responsibilities linked to the strategies and methodologies used, with performance fluctuations arising from the dynamics of the match's progression (Woods *et al*., 2020) [35]. This imposes a physiological strain on the muscular system, highlighting the significance of the nervous system's efficiency in processing information from sensory organs and the rapidity of neural processes in executing precise and appropriate responses to fulfil the physical, skill-based, and tactical motor tasks necessitated by varying gameplay scenarios (Qi *et al*., 2024) [28]. This necessitates the systematic training and preparation of athletes to engage effectively in each event, which involves eliminating indicators of muscle fatigue from prior matches or competitions and ensuring adequate recovery for subsequent performances (Kellmann *et al*., 2018) [13]. Intense contests or workouts may result in harm to some tissues and muscle fibres, manifesting as spasms, aches, and soreness in the muscles, which may last for 1 to 2 days, particularly after vigorous or consecutive events (Al Behadili & Kasim, 2022; Wentao, 2024) [2, 34]. In a brief timeframe, these injuries may result in temporary damage to tendons and muscles, accompanied by spasms, oedema, inflammation, and injury to some connective tissue fibres (Norris, 2018) [24]. Based on their personal experience as football players, the researchers noted the prevalent incidence of injuries among players, including tendon infections and recurrent muscle strain, attributed to training loads and frequent tournament participation, resulting in sustained stress exposure. Sports injuries may first seem minor but might subsequently deteriorate, posing significant risks and hindering athletes' ability to resume training with the same efficacy. This motivated the researchers to investigate the impact of a preventative program on sports injuries concerning the concentration of interleukin protein in the blood, given its function in the onset of muscular inflammation. To discover innovative methods for preventing and mitigating injuries, it is essential that sports safety measures and injury prevention strategies align with the physical, psychological, mental, and skill preparation of athletes. This alignment enables them to confront challenges in the most secure and efficient manner. Furthermore, by leveraging the growing body of scientifically significant information derived from models, theories, and scientific hypotheses pertaining to physical, biological, behavioural, and cognitive dimensions, we can dynamically influence both the healing process from injuries and their prevention.

Importance of research

This work is a major scientific endeavour aimed at formulating practical solutions for coaches to address performance decline and sports injuries that may arise from stress, which substantially affects overall technical performance. This is achieved by mitigating the risk of injuries associated with elevated training loads, which are challenging to assess through conventional methods. This can be regulated using standardised laboratory measurements that analyse the levels of interleukin-6 (IL-6) and interleukin-10 (IL-10) proteins as critical indicators of inflammatory responses resulting from the effects of training loads during training and competitions. Following the suggested preventative approach, a concerted effort is made to shield the players from experiencing extreme stress due to excessive demands. Mitigation and avoidance of damage exposure of diverse forms and severities via the utilisation of infallible measures and objective evaluations to diminish the chance of injury occurrence.

Research objective

This research aims to design a preventive program to reduce sports injuries and identify its effect on the level of concentration of interleukin protein (6-1) and interleukin-10 (110) in the blood of football players.

Research hypotheses

The suggested preventative program positively influences the study variables, as shown by:

1. Statistically significant variations were seen between the pre-measurement and post-measurement levels of interleukin-6 and interleukin-10 protein concentrations in the blood of the experimental group, favouring telemetry.
2. Statistically significant differences were observed between the dimensional measures of the experimental group and the control group for the concentration levels

of interleukin-6 and interleukin-10 proteins in the blood, favouring the experimental group.

Methodology

Research Methodology

The researchers used the experimental method by designing the control and experimental groups using the method of pre-dimensional measurements appropriate to the nature of the research.

Research sample

The research sample was drawn from the original research community for the 2023/2024 sports season, comprising football players from the Iraqi Premier League. This study specifically focusses on the first team players of Naft Misan Football Club, to talling 25 individuals, all of whom undergo standardised training, with ages ranging from 19 to 35 years.

Data collection tools

In collecting data, the researchers relied on:

1. Reference survey of references, research and specialized scientific studies.
2. Sectionsfor Personal Interviews:

a) Personal interviews with some professors of sports injuries, sports physiology and football.
b) Personal interviews with football coaches and team physiotherapists.

Devices and tools used in research:

1. An electronic measuring device to measure weight and height with ultrasonic.
2. Medical bag equipped with laboratory tubes with all blood drawing tools and sterilization tools for blood analysis (IL-10), (IL-6) concentration level.

Preventive program

The researchers examined numerous books and scientific references, both Arab and foreign, as well as relevant scientific studies pertaining to the research topic. Consequently, the researcher formulated an initial concept of the program in the form of a questionnaire, which was disseminated to experts in football training, physical therapy, sports rehabilitation, and sports injuries. Based on their feedback, necessary modifications were implemented to the proposed program, resulting in:

- The duration of the proposed preventive program is (4) weeks.
- The program includes (4) units per week with a total number of (16) units.
- The total time of the unit is (50: 75 minutes).
- A combination of strength and flexibility training was used as well as massages and cold water baths (with ice cubes).

The researchers took into account the following conditions when developing the proposed program:

- Comprehensive and balanced development of all muscles of the body such as the muscles of the legs - back - arms).
- Adaptability of the exercises contained in the level program players
- Pay attention to the rules of warm-up and cooldown.
- Rest needed between each workout.
- Take into account the gradation of exercises.
- Take into account the principle of individual differences when implementing the exercises for the program.

In implementing the program, the researchers also took into account the following:

1. Administer a profound and rejuvenating manual sports massage by an expert, using menthol oil for a duration of 25 uninterrupted minutes, without the use of any instruments.
2. A bathtub of 170×70 cm was filled with ice cubes and water to achieve a temperature of 13^0-16^0, and the application persisted for a continuous duration of (6-10 minutes).
3. Individually organising the application with the assistance of personnel while considering comprehensive health conditions.
4. Collecting blood samples in two phases: per-exercise to exercise and immediately post-exercise, under the direct observation of a specialised analytical physician and supported by three laboratory technicians.

The control and experimental research sample was subjected to the trainer's training unit, and the experimental research sample is only subjected to the preventive program, where the proposed preventive program was divided into two stages:

The first: It is the pre-training phase of the team, where the researcher used strength and flexibility training before the start of the team's daily training for a period of (20-30 minutes).

Second: It is the post-training phase of the team, where manual massage was applied by a specialist for several (25-35 minutes), then a cold water bath was used, which was filled with ice cubes to reach a temperature equivalent to (13^0: 16^0) and for several (10-6 minutes).

Scientific transactions

The researchers calculated the arithmetic mean, standard deviation, torsion and flattening coefficient for the research sample in the following variables age - height - weight - training age), as shown in Table (1), then the results were analyzed using the significance coefficient of differences and the percentage of variation as shown in tables from (1).

Table 1: Statistical description in the variables of age, height, c and training age of the research sample

Variables	Unit of measurement	M	SD	Torsion coefficient
Age	Year	24.59	3.28	1.849
Height	CM	174.26	2.73	1.656
Height	KG	74.60	6.88	0.427
Training age	Year	10.47	4.20	0.503

Table (1) demonstrates that the statistical significance of the torsion coefficient variables age, years of experience, height, and weight ranges between about ±3, indicating a modest distribution of these values.

Table 2: Significance of the differences between the experimental and control research groups in the pre-program pre-exertion measurement in some physiological variables - under research

Variables	Measurement	M	Average squares	Sum of squares	Percentage variation	Z-Score	Sig
IL6	Experimental	0.762	4	16	6.16	0.449	0.846
	Control	0.882	4	12			
IL10	Experimental	4.95	4.78	11	3.36	0.618	0.723
	Control	4.69	5.36	17			

Table (2) clearly reveals that there are no statistically significant changes in the concentration levels of (IL-10), (IL- 10) between the experimental and control groups, demonstrating their comparability.

Table 3: Significance of the differences between the experimental and control research groups in the pre-program measurement after the effort in some physiological variables - under research

Variables	Measurement	M	Average squares	Sum of squares	Percentage variation	Z-Score	Sig
IL6	Experimental	4.82	4	16	5.45	0.381	0.388-
	Control	4.93	4	12			
IL10	Experimental	3.86	3.96	11	3.17	0.145	0.196
	Control	4.02	4.89	17			

Table (3) illustrates that there are no statistically significant variations in the concentration level of (IL-6), (IL-10) between the experimental and control groups, demonstrating their comparability.

Results

Table 4: Significance of differences between pre-exertion / post-exertion measurement of the control group in the concentration level (IL-6), (IL-10) in the blood - under research

Variables	Measurement	M	Average squares	Sum of squares	Percentage variation	Z-Score	Sig
IL6	Tribal (before exertion)	0.782	2.50	7.50	78.62	**2.44	0.000
	Tribal (after exertion)	3.99	2.50	2.50			
IL10	Tribal (before exertion)	5.82	2.50	10	36.12	**2.33	0.000
	Tribal (after exertion)	4,82	0	0			

Table (4) clearly indicates statistically significant differences between the pre-exertion and post-effort measurements of the control group regarding the physiological variables under investigation, favouring the pre-measurement after exertion, which does not benefit the player physiologically.

Table 5: Significance of the differences between the dimensional measurement (before exertion/ after exertion) of the control group in the concentration level (IL-6), (IL-10) in the blood - under research

Variables	Measurement	M	Average squares	Sum of squares	Percentage variation	Z-Score	Sig
IL6	Tribal (before exertion)	0.982	1.50	1.50	81.47	**2.99	0.000
	Tribal (after exertion)	4.88	3.49	13.60			
IL10	Tribal (before exertion)	7.22	2.00	12	47.68	**2.38	0.000
	Tribal (after exertion)	3.98	2.50	10			

Table (5) indicates statistically significant differences between the dimensional measurements (pre-effort/post-effort) of the control group regarding the physiological variables under investigation, favouring the post-effort measurement; however, these differences do not favour the players physiologically.

Table 6: Significance of differences between pre-exertion/post-exertion measurement) of the experimental group in the concentration level (IL-6), (IL-10) in the blood - under research

Variables	Measurement	M	Average squares	Sum of squares	Percentage variation	Z-Score	Sig
IL6	Post (before exertion)	0.862	0	0	78.88	**2.74-	0.000
	Post (after exertion)	3.82	3.60	21.00			
IL10	Post (before exertion)	5.95	4.00	28	38.99	**2.38	0.017
	Post (after exertion)	3.74	0	0			

Table (6) clearly indicates statistically significant differences between the pre-exertion and post-exertion measurements of the experimental group regarding the physiological variables under investigation, favouring the pre-exertion measurements; these differences are not advantageous for the players physiologically.

Table 7: Significance of the differences between the dimensional measurement (before exertion / after exertion) of the experimental group in the level of concentration (IL-6), (IL-10) in the blood - under research

Variables	Measurement	M	Average squares	Sum of squares	Percentage variation	Z-Score	Sig
IL6	Post (before exertion)	1.22	4.00	28	67.29	**2.99-	0.000
	Post (after exertion)	3.39	0	0			
IL10	Post (before exertion)	5.99	4.50	4.50	49.92	**2.49	0.015
	Post (after exertion)	3.16	3.30	16.50			

Table (7) indicates statistically significant differences between the dimensional measurements (pre-effort/post-effort) of the experimental group concerning the physiological variables under investigation, favouring the post-effort measurements; however, these differences do not benefit the players physiologically.

Table 8: Significance of differences between experimental and control research groups in pre-measurement (after exertion \ before program) in the concentration level (IL-6), (IL-10) in the blood - under research

Variables	Measurement	M	Average squares	Sum of squares	Percentage variation	Z-Score	Sig
IL6	Experimental	3.82	0	0	5.38	1.00	0.228
	Control	3.99	3.00	6.00			
IL10	Experimental	3.74	0	0	3.32	1.18	0.272
	Control	3.81	3.26	13.00			

Table (8) indicates that there are no statistically significant changes between the experimental and control study groups in the pre-measurement after the pre-program intervention across all physiological variables under investigation.

Table 9: Significance of the differences between the experimental and control research groups in the post-exertion / after the program in the concentration level (IL-6), (IL-10) in the blood - under research

Variables	Measurement	M	Average squares	Sum of squares	Percentage variation	Z-Score	Sig
IL6	Experimental	4.39	1.50	6.00	34.58	**2.78-	0.000
	Control	5,83	0	0			
IL10	Experimental	3.16	4.25	17.00	22.17	**2.48-	0.017
	Control	3.98	3.78	11.00			

Table (9) indicates statistically significant differences between the experimental and control study groups in the dimensional assessment (post-effort / post-program) across all physiological variables under investigation.

Discussion and interpretation of results

Based on the statistical findings used by the researchers and the constraints of the measurements conducted within the defined parameters of the research sample, the researcher analyses and deliberates on the data to validate the objectives and hypotheses of the study.

First: Discussion of the first hypothesis

The results indicated statistically significant differences at a significance level of 0.05 between the pre-measurement (before and after exertion) for the experimental group regarding concentration levels (IL-6), (IL-10) valid pre-measurement after exertion. These differences do not favour the player physiologically, which the researcher attributes to the increase in concentration of (IL-6) in response to physical load performance. Nourpetelian (2022) [25] asserts that the release rate of IL-6 from human muscles is positively correlated with training intensity and the concentration of adrenaline in the muscle arteries. Beigpoor's study (2021) [3] confirms that higher levels of IL-6 resulting from intensive exercise lead to increased fatigue in the glucose and water groups. Table (7) demonstrates statistically significant differences at a 0.05 significance level between the dimensions measures (pre-effort/post-effort) for the experimental group, with concentrations of (IL-6) and (IL-10) favouring the post-effort measurement. The researchers assert that the observed differences favouring telemetry do not benefit the players physiologically, a conclusion supported by Rhibi *et al*., (2022) [30] study, which indicates that high-intensity physical exertion results in elevated concentrations of CRP, (IL-6), and ketones, while decreasing levels of (IL-10). Kruk *et al*., (2019) [14] revealed that intense physical effort elevates the release of free radicals, significantly impacting bodily tissues, particularly cell membranes, hence exacerbating muscle laceration. The research by Nash *et al*., (2023) [23] demonstrates that interleukin-10 (IL-10) is influenced by variations in interleukin-6 (IL-6), with the two exhibiting an adverse relationship regarding physical exertion performance. The research conducted by Bezuglov *et al*., (2021) [4] and by Davis, Alabed, and Chico (2020) [8] demonstrated that the proposed program utilising massage and cold baths influenced recovery speed in athletes, alongside beneficial effects on various physiological variables, notably the concentration of blood plasma proteins following high-intensity physical exertion in certain athletes. This aligns with the findings of Pawłowska *et al*. (2021) [26], which determined that immersion in cold water correlates with modest elevations in post-exercise IL-6 levels, offering an anti-inflammatory advantage after physical activity. A study by Pertiwi, Yulianti, and Rustiasari (2022) [27] indicates that manual massage influences physiological variables, specifically IL-6, IL-10, and TNF-α. The researchers advocate for the application of massage therapy as it improves the precision of inflammatory markers post-exercise. The initial hypothesis was confirmed, indicating statistically significant changes

between the pre-measurement and post-measurement levels of concentration (IL-6) and (IL-10) in the blood of the experimental group, favouring the post-measurement results.

Second: Discussion of the second hypothesis

The findings indicated no statistically significant differences in the levels of concentration (IL-6) and (IL-10) in the blood between the experimental and control groups during the pre-measurement (post-exertion/before the program), suggesting that both groups exhibited equivalent rates of (IL-6) and (IL-10) prior to the implementation of the preventive program. The findings indicated statistically significant differences at the 0.05 level between the experimental and control groups in the dimensional measurement (post-exertion / post-program) regarding blood concentration levels (11-6). The researchers ascribe this outcome to the implementation of the proposed preventive program within the experimental group, which incorporated modalities such as massage and snow baths. This intervention positively influenced the reduction of (6-IL) levels, whereas the control group exhibited elevated (6-IL) levels, indicative of high-intensity physical exertion coupled with the absence of preventive and therapeutic measures, resulting in heightened fatigue perception. Jurch and Tosch (2020) [12] assert that massage has a crucial role in alleviating tiredness by relaxing muscles, relieving discomfort, and reducing tension, hence enhancing blood circulation and enabling the lymphatic system to effectively eliminate these effects from the body. The research conducted by Laskowska *et al*. (2021) [15] concurs that therapeutic modalities such as massage, sauna, and snow baths have contributed to the alleviation of inflammation and muscular discomfort, expedited recuperation and energy restoration, and decreased the frequency of injuries. Małkowska and Sawczuk (2023) [19] assert that plasma interleukin-6 (IL-6) levels rise immediately after physical exertion, particularly during intense training, and that this elevation in IL-6 correlates with heightened macrophage and neutrophil activity. Consequently, elevating their concentration in the muscles results in an augmented generation of prostaglandins (PGE2) inside the muscle, which subsequently leads to a rise in creatine kinase (CK) and is followed by the experience of muscular discomfort. The findings of the table indicated statistically significant differences at a significance level of 0.05 between the experimental and control study groups in the dimensional measurement (post-exertion / post-program) regarding the concentration level of IL-10 in the blood. The researchers attribute this phenomenon to the elevation of interleukin-10 (IL-10) in the control group, which leads to an increase in interleukin-6 (IL-6) due to high-intensity exercises. This elevation correlates with the heightened concentration of IL-10, while the preventive program implemented for the experimental group effectively reduces the blood concentration levels of IL-10. A research indicates that interleukin-6 (IL-6) produced by contractile muscle may initiate an anti-inflammatory response, shown by elevated levels of C-Reactive Protein (CRP), IL-6, interleukin-10 (IL-10), interleukin-1 receptor antagonist (IL-1ra), and cortisol. A research concurs. White G. *et al*. (220) showed that massage treatment positively influenced the return of interleukin-6 (IL-6) and interleukin-10 (IL-10) levels to baseline more rapidly in the experimental group than in the control group. The second hypothesis was confirmed, indicating statistically significant changes in the dimensional measures of the experimental group compared to the control group regarding the concentration levels of IL-6 and IL-10 in the experimental group's blood.

Conclusions

1. A concentration program (IL-6) is influenced by physical load performance, and (IL-10) is impacted by variations in concentration levels (IL-6), with both being inversely proportional to the impact of physical effort.
2. The suggested preventative program positively influences physiological variables, namely concentration levels IL-6 and IL-10 in the experimental group relative to the control group.
3. The integration of strength training, flexibility exercises, and massage with cold water immersion significantly decreased the occurrence of sports injuries in the experimental group relative to the control group.
4. The period of the preventive program's implementation is adequate, effective, and favourably influences the study variables, favourably impacting the performance of the experimental group regarding the research variables.

Recommendations

1. The implementation of the proposed preventive program is crucial in the training process during the special preparation and competition phases due to its beneficial effects on injury prevention during this critical period, as well as its enhancement of physical performance capabilities.
2. The necessity of administering physical and physiological assessments periodically throughout the training season is essential to ascertain the potential for physical and performance advancements, as well as their physiological responses to imposed loads, due to their significance in adjusting physical demands and mitigating injuries.
3. Organising scientific seminars and courses for trainers to elucidate the uses of preventive approaches, particularly strength and flexibility training, as well as recovery techniques, including massage and cold immersion, and their utilisation in training and competitions.
4. Undertaking more study on athletes across diverse sports to mitigate the risk of sports injuries and alleviate the effects of fatigue and its symptoms linked to high-intensity training.

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