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PREVENTIVE TRAINING PROGRAM TO REDUCE COMMON KNEE JOINT INJURIES AMONG WRESTLERS

Jafar Habib Zaher,
College of Medicine, University of Qadisiya, Iraq.
E-mail: jafaarhabebd@gmail.com

Hamdi Chtourou,
High Institute of Sport and Physical Education of Sfax, Sfax 3000, Tunisia,
Email: hamdi.chtourou@isseps.usf.tn

A B S T R A C T

This research aims to reduce knee joint injuries among wrestlers by identifying the most common knee injuries, designing a preventive training program, and assessing the impact of the preventive training program on knee joint injuries among wrestlers. The researcher employed an experimental approach due to its suitability for the nature of the research, using a single-group experimental design. The research sample was purposively selected and consisted of young wrestlers from the researcher's club, belonging to the youth category and registered with the Tunisian Wrestling Federation. The total population of the research sample was 16 wrestlers, divided into 10 wrestlers in the survey sample and 6 wrestlers in the core sample, aged between 14 and 16 years old. The proposed preventive training program was applied, and data were collected through measurements, statistically processed, and important results were obtained. The program had a positive impact on improving the neural conduction velocity of both the right and left arms. Additionally, it led to improvements in muscle strength and range of motion. One of the key recommendations is to generalize the derived preventive program to coaches, load regulators, and injury specialists, utilizing the program's exercises to reduce the physical susceptibility to injuries among athletes.

K E Y W O R D S

Training program, sports injuries, knee joint, wrestling.

Introduction

The world has witnessed tremendous advancements in various sports disciplines, leading to significant progress in training processes, resulting in high performance levels and remarkable records. One of the most notable advancements has been in the field of sports medicine and sports injuries, which has undergone extensive scientific studies regarding preventive and therapeutic aspects. However, sports injuries still occur to varying degrees, whether during training or competition, especially when scientific and technical conditions are not adhered to (Belkasem et al., 2021: p8).

Iman Hussein (2007) emphasizes that striving to bring athletes to their highest levels is one of the primary goals of training. However, the principles and theories of sports training have evolved, and

the athlete's inherent qualities, such as physical and skill abilities and physical characteristics, play a crucial role (Iman Hussein, 2007: 63).

David Chi (2015) notes that wrestling is a sport that demands high levels of skill, physical fitness, and mental strength. Wrestlers must work on developing these abilities through integrated preparation, considering the individual differences among players in terms of physical and skill capabilities. There are two main types of wrestling: Greco-Roman and freestyle. The key difference between them is that Greco-Roman wrestling applies holds and techniques only to the upper body, with competition taking place at two levels: high and medium. In contrast, freestyle wrestling allows play on all parts of the body, including the legs, and comprises three levels: high, medium, and deep (David Chi, 2015: 161).

Various methods and means have been employed in training programs aimed at prevention. Sports injuries can occur for various reasons, including the lack of safety measures, inadequate warm-up, and athletes being subjected to excessive physical loads due to direct contact during wrestling activities.

Abdulrahman Zaher (2004) argues that injury prevention in sports is necessary and crucial for the athlete's own well-being, as well as for all stakeholders and enthusiasts concerned with their performance. These methods are no longer limited to using ankle, wrist, or head protection gear, or carrying a bag filled with first aid supplies at the beginning of each training session or match. Instead, they rely on concerted efforts to determine the correct training methods to avoid injuries (Zaher, 2004: p29).

Osama Kamel (2002) points out that due to the unique requirements of wrestling, including various movement skills and physical contact with opponents, the likelihood of various body injuries, especially upper and lower limbs, increases. These injuries can manifest as bruises, contusions, strains, contractions, muscle tears, fractures, and joint injuries, including sprains, ligament tears, or inflammation. These joints, such as the wrist, elbow, back, knee, and ankle, are vital parts of the wrestler's body (Osama Kamel, 2002: 8:2002).

The researcher believes that the injuries that occur, especially to the knee joint of wrestlers, are the result of immense pressure during training and excessive practice without considering the risks of excessive contact between wrestlers. The researcher observed that most coaches do not take these factors into account when planning training programs. This phenomenon calls for the attention of all those involved in wrestling training, prompting them to provide methods and means that reduce or prevent such injuries. Consequently, the researcher sought to address this issue by identifying common knee joint injuries and their causes, aiming to reduce the likelihood of injuries and keep the wrestler physically fit, ensuring their continued training and participation in competitions to achieve optimal results. This droves the researcher to conduct this study.

Research Objective:

The aim of this research is to reduce knee joint injuries among wrestlers through:

1. Identifying the most common knee injuries among wrestlers.
2. Designing a preventive training program.
3. Assessing the impact of the preventive training program on knee joint injuries among wrestlers.

Research Questions:

1. What are the most common knee injuries among wrestlers?
2. Does the preventive training program contribute to reducing knee joint injuries among wrestlers?

Research Procedures:
Research Methodology: The researcher utilized an experimental methodology to align with the nature of the research.

Research Domains:
- Spatial Domain: The study was conducted at the Sfax Wrestling Club in the Sfax Governorate.
- Temporal Domain: All research procedures were carried out during the training season of 2022/2023.
- Human Domain: The research involved a group of wrestlers from the Sfax Wrestling Club.

Research Population and Sample:
The research population consists of 14 wrestlers, from which the research sample was purposefully selected. The sample was divided as follows:
- Experimental Group: Consisting of 6 wrestlers who were subjected to the proposed preventive training program.
- Control Group: Comprising 8 wrestlers who followed the traditional training program provided by the coaches.

Sample Criteria:
1. Being registered with the Tunisian Wrestling Federation.
2. Not being subject to any other preventive training program.
3. Having a history of knee joint injuries.

Table 1 Statistical Description of the Primary Sample in the Pre-Measurement Variables

Variable	Group	N	Mean	Standard Deviation	Mean Difference	t-Value	Significance Level
Height (cm)	Experimental group	6	164.500	5.683	0.000	0.000	1.000
	Control group	8	164.500	3.964			
Weight (kg)	Experimental group	6	64.167	9.218	0.542	0.154	0.880
	Control group	8	63.625	3.420			
Age (years)	Experimental group	6	26.667	1.211	0.792	1.078	0.302
	Control group	8	25.875	1.458			
Training Age (years)	Experimental group	6	6.833	1.329	1.208	1.792	0.098
	Control group	8	5.625	1.188			

Statistically, at the 0.05 significance level, the critical t-value is 2.179.

From Table 1, which displays the differences between the experimental group and the control group in the primary pre-measurement variables, it is evident that the calculated t-values range from 0.00 to 1.792. These values are smaller than the critical t-value at the 0.05 significance level (2.179). This

indicates that there are no statistically significant differences between the two groups, confirming that there is equivalence between the research groups in the primary pre-measurement variables before the experiment.

Table (2) Statistical Description of the Primary Research Sample in Muscle Strength Tests for the Knee Joint (Pre-measurement) n=14

Variable	Group	N	Mean	Standard Deviation	Mean Difference	t-Value	Significance Level
Right Grip	Experimental Group	6	18.083	2.764	0.021	0.015	0.989
	Control Group	8	18.063	2.570			
Right Extension	Experimental Group	6	31.167	2.994	-1.208	-0.577	0.575
	Control Group	8	32.375	4.406			
Right Flexion	Experimental Group	6	15.500	1.517	0.000	0.000	1.000
	Control Group	8	15.500	1.982			
Right Abduction	Experimental Group	6	20.667	1.966	1.667	1.034	0.321
	Control Group	8	19.000	3.536			
Left Grip	Experimental Group	6	17.667	2.338	2.354	1.650	0.125
	Control Group	8	15.313	2.840			
Left Extension	Experimental Group	6	22.333	3.011	-1.917	-1.001	0.337
	Control Group	8	24.250	3.882			
Left Flexion	Experimental Group	6	15.000	2.098	-0.313	-0.226	0.825
	Control Group	8	15.313	2.840			
Left Abduction	Experimental Group	6	24.167	2.483	-4.083	-1.553	0.146
	Control Group	8	28.250	6.018			

***Significant at the 0.05 level = 2.179**

It is evident from Table (2), which deals with the differences between the experimental group and the control group in the muscle strength tests for the knee joint before the experiment, that the calculated t-values ranged from (0.00 to 1.650). These values are smaller than the critical t-value at the 0.05 level, indicating the absence of statistically significant differences between the two groups. This confirms the equivalence between the research groups in the muscle strength tests for the knee joint before the experiment.

Table (3) Statistical Description of the Primary Research Sample in Flexibility Tests (Range of Motion) for the Knee Joint (Pre-measurement) n=14

Variable	Group	n	Mean	Standard Deviation	Difference between Means	t-value	Significance Level
Right Flexion	Experimental Group	6	16.833	1.602	0.396	0.307	0.764
	Control Group	8	16.438	2.821			
Right Extension	Experimental Group	6	22.667	1.751	-0.708	-0.511	0.619
	Control Group	8	23.375	3.021			
Left Flexion	Experimental Group	6	14.333	2.066	-0.667	-0.682	0.508
	Control Group	8	15.000	1.604			
Left Extension	Experimental Group	6	21.833	2.483	-4.917	-2.089	0.062
	Control Group	8	26.750	2.121			

***Significant at the 0.05 level = 2.179**

From Table (3), which represents the differences between the experimental group and the control group in the flexibility tests (range of motion) for the knee joint before the experiment, it is evident that the calculated t-values ranged from 0.307 to 2.089. These values are smaller than the tabled t-value at the 0.05 significance level (2.179), indicating that there are no statistically significant differences between the two groups. This confirms that there is equivalence between the research groups in the flexibility tests for the knee joint before the experiment.

Table (4)

Statistical Description of the Basic Research Sample in Leg Mobility Tests (Measured Pre-Experiment) n=14

Variable	Group	n	Mean	Standard Deviation	Difference between Means	t-value	Significance Level
Pushing Competitor Outward	Experimental Group	6	10.833	2.483	-1.792	-1.407	0.185
	Control Group	8	12.625	2.264			
Falling Forward in the Middle from the Front	Experimental Group	6	11.167	1.169	-0.708	-0.933	0.369
	Control Group	8	11.875	1.553			

Encircling Arm and Neck and Throwing Backward	Experimental Group	6	10.833	2.483	-1.792	-1.407	0.185
	Control Group	8	12.625	2.264			
Encircling Arm from the Outside and Pushing Outward	Experimental Group	6	36.167	2.927	4.917	2.007	0.053
	Control Group	8	31.250	3.845			
Encircling Arm, Neck, and Throwing Backward	Experimental Group	6	2.383	0.492	0.671	1.984	0.066
	Control Group	8	1.713	0.253			
Pulling the Neck Down and Encircling Arm and Neck	Experimental Group	6	36.167	2.927	4.917	2.007	0.053
	Control Group	8	31.250	3.845			
Pivot Points	Experimental Group	6	2.383	0.492	0.671	984.1	0.066
	Control Group	8	1.713	0.253			
	Control Group	8	30.750	2.053			

***Statistical Significance at 0.05 Level = 2.179**

Data Collection Tools:

1. Literature Analysis: Review of relevant literature and scientific studies related to the research topic.
2. Questionnaires:
   - Expert Opinion Questionnaire in Wrestling and Sports Training to Determine the Most Important Physical Abilities that Reduce Knee Joint Injuries (Attachment 2).
   - Data Recording Form for Research Sample (Attachment 3).
   - Data Recording Form for Knee Joint Muscle Strength Tests (Attachment 4).
   - Data Recording Form for Knee Joint Flexibility Tests (Attachment 5).
   - Data Recording Form for Leg Movements Tests (Attachment 6).

Muscle Strength Measurements:

The muscle strength measurements included the following:

- Measurement of muscle strength for the quadriceps and hamstring muscles of the knee joint using a tensiometer.
- Measurement of flexibility (range of motion).

Secondly, the devices and tools used for the research sample:
- Thermometer for measuring body lengths (in centimeters).
- Medical scale for measuring weight (in kilograms).
- Goniometer for measuring flexibility.
- Dynamometer for measuring muscle strength.
- Medicine balls.
- Iron bar.
- Wrestling arena.

Proposed Preventive Training Program:

The proposed preventive training program aims to develop a specialized preventive training regimen for wrestlers to prevent or reduce knee joint injuries. This is achieved by strengthening the ligaments, joints, and muscles to avoid injury.

Basic Principles of Developing the Proposed Preventive Training Program:

After reviewing various scientific references, reference studies, and the survey conducted by the researcher, the basic principles for developing the program were determined as follows:
- Developing specialized training exercises suitable for the research sample.
- Clearly defining the objectives of each stage of program preparation.
- Flexibility of the preventive training program during its implementation.
- Ease of providing the resources and tools used in the research.
- Gradual progression of training from easy to difficult and from simple to complex.
- Implementation of the preventive training program from the physical preparation stage to warm-up.
- Continuous variety in specialized training exercises.
- Consideration of individual differences among the research sample.
- Consideration of safety factors.
- The training unit should be comprehensive.
- Using the periodization training approach (low-high) for intensity.

Steps for Building the Proposed Preventive Training Program:

The researcher identified the necessary specialized exercises for wrestlers through the expert opinion questionnaire.

The period for the proposed program was determined based on scientific references and studies.

Table 5

Proposed Time Division for the Preventive Training Program (n = 6)

Program Content	Number of Units
Total Program Duration	12 weeks
Training Units per Week	3 units
Total Training Units in Program	36 units
Training Unit Duration	90 minutes
Total Proposed Training Program Duration	90 minutes * 36 = 3240 minutes

Program Content:

The program content consists of plyometric exercises that have been planned and are intended to be practiced. After reviewing specialized scientific research in the field of sports training and scientific studies, some content was modified, and some was removed based on expert opinions and experimentation with the research sample. The program content includes the following:

A. Warm-Up (Preparation) Phase: (10 minutes)

This phase involves preparing and conditioning the body's muscles and internal systems to adapt to the demands of the program, prevent injuries, and reduce muscle fatigue. It includes light exercises for various parts of the body and stretching exercises for all body parts.

Objective of General Warm-Up:

- Provide muscles and joints with elasticity and flexibility through progressive warm-up from easy to hard.
- Increase body temperature.
- Prepare for the main part of the training unit.

B. General Physical Preparation: (30 minutes)

General physical preparation aims to prepare the body's muscles and joints for the training program. It includes both general preparation (15 minutes) and specific physical preparation (15 minutes).

Objective of General Physical Preparation:

- Prepare the body's muscles and joints for the exercises.
- Develop the range of motion for the knee joint.

C. Main Part: (40 minutes):

The main part of the training unit focuses on plyometric exercises that target the muscles involved in the knee joint. The aim is to strengthen these muscles to achieve muscular balance and reduce deviations in knee movement patterns. Additionally, it aims to improve the range of motion of the knee joint.

D. Cool-Down: (10 minutes:

The cool-down phase, which concludes the training unit, involves gradually reducing the training load and allowing the body to recover.

This includes:

- Light arm and leg rotations.
- Slow, relaxed movements coordinated with natural breathing patterns.
- Gentle stretching exercises for all body parts.

Objective of Cooling Down:

- Gradually reduce heart rate.
- Reduce muscle stiffness and congestion.
- Gradually relax muscles.
- Improve flexibility.
- Return the body to its natural state.

Primary Study:

The researcher conducted the following measurements on the research sample:

- Pre-program measurements were conducted from March 1, 2023, to March 5, 2023, before implementing the training program.
- The proposed preventive training program was applied from March 7, 2023, to May 29, 2023.
- Post-program measurements were conducted immediately after completing the training program from June 2, 2023, to June 4, 2023.

The researcher conducted all measurements and tests for all research variables using the same devices and tools used for pre-program measurements, under the same conditions and instructions, and in the same measurement locations and within the same time frame.

Statistical Analysis:

Statistical analyses were performed using the SPSS software version 20.

Presentation and Discussion of Results:

Presentation and Discussion of the First Hypothesis:

Table (6)
Most Common Knee Injuries for Wrestlers

Injury Type	Location	Yes		No		Rank
		Repet	Percent	Repet	Percent	
Bruises	Knee Joint	1	1.88	52	98.12	1
Sprains (MCL)	Knee Joint	2	3.77	51	96.23	2
Ligament Tears	Anterior Cruciate Ligament	3	5.69	50	94.34	4
	Posterior Cruciate Ligament	2	3.77	51	96.22	3
Fractures	Kneecap (Patella)	7	13.21	46	86.79	5

The information from Table (6) regarding the repetitions, percentages, and statistical significance of responses from the research sample about common knee joint injuries is evident. In the first position, "Knee contusions" were the most frequently reported, followed by the second position, "Knee sprains (MCL)," and in the third position, "Torn posterior cruciate ligament (PCL)" injuries. The fourth position was occupied by "Anterior cruciate ligament (ACL) injuries," and the first position was "Knee bone fractures."

Presentation and Discussion of the Results of the Third Assignment: There are statistically significant differences between pre-test measurement, inter-test measurement, and post-test measurement in motor performance tests.

Table (7) Analysis of Variance (ANOVA) among the three measurements(pre, intermediate, post) for the experimental group of leg movements. n=6

Variable	Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	Significance Level
Pushing Competitor Outside	Between Measurements	2	14.778	7.389	1.550	0.244
	Within Measurements	15	71.500	4.767		
	Total	17	86.278			
Falling Forward in Front	Between Measurements	2	16.333	8.167	*8.963	0.003
	Within Measurements	15	13.667	0.911		
	Total	17	30.000			
Arm Encirclement and Backward Throw	Between Measurements	2	14.778	7.389	1.550	0.244
	Within Measurements	15	71.500	4.767		
	Total	17	86.278			
Arm Encirclement, Push Competitor	Between Measurements	2	109.000	54.500	*8.984	0.003
	Within Measurements	15	91.000	6.067		
	Total	17	200.000			
Neck Pull Down, Arm Encirclement	Between Measurements	2	1.524	0.762	3.048	0.078
	Within Measurements	15	3.752	0.250		
	Total	17	5.276			
Neck Pull Down, Arm Encirclement	Between Measurements	2	109.000	54.500	*8.984	0.003
	Within Measurements	15	91.000	6.067		
	Total	17	200.000			
Axis	Between Measurements	2	1.524	0.762	3.048	0.078
	Within Measurements	15	3.752	0.250		
	Total	17	5.276			

***Significant at the 0.05 level. The critical (F) value at the 0.05 level = 3.682.**

Table (8)

Significance of Differences between the Three Measurements (pre, intermediate, post) for the Experimental Group of Leg Movements using Least Significant Difference (LSD) Test. n=6.

Variable	Measurements	Mean	Standard Deviation	Significance of Differences Between Means			LSD Value
				pre	within	post	
Pushing Competitor Outside	Pre	10.83	2.48		-1.50	-2.17	1.26
	Within	9.33	2.25			-0.67	
	Post	8.67	1.75				
Falling Forward in Front	Pre	11.17	1.17		-1.17	-2.333-*	0.55
	Within	10.00	0.89			-1.17	
	Post	8.83	0.75				
Arm Encirclement and Backward Throw	Pre	10.83	2.48		-1.50	-2.17	1.26
	Within	9.33	2.25			-0.67	
	Post	8.67	1.75				
Arm Encirclement, Push Competitor Outside, and Carpet	Pre	36.17	2.93		-3.50-*	-6.0-*	
	Within	32.67	2.34			-2.50	
	Post	30.17	2.04				
Neck Pull Down, Arm Encirclement	Pre	2.38	0.49		0.47	.70000*	
	Within	2.85	0.52			0.23	
	Post	3.08	0.48				
Pulling the Neck Down and then Arm and Neck Encirclement.	Pre	36.17	2.93		-3.50-*	-6.000-*	1.42
	Within	32.67	2.34			-2.50	
	Post	30.17	2.04				
Axis	Pre	2.38	0.49		0.47	.700*	0.29
	Within	2.85	0.52			0.23	
	Post	3.08	0.48				
	Within	28.83	2.04			-4.333-*	
	Post	24.50	2.35				

Table (9) Analysis of Variance (ANOVA) among the three measurements (pre, intermediate, post) for leg movements in the control group. n=8.

Variable	Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	Significance Level
Pushing Competitor Outside	Between Measurements	2	45.583	22.792	*7.449	0.004
	Within Measurements	21	64.250	3.060		
	Total	23	109.833			
Falling Forward in Front	Between Measurements	2	45.750	22.875	*21.000	0.000
	Within Measurements	21	22.875	1.089		
	Total	23	68.625			
Arm Encirclement and Backward Throw	Between Measurements	2	45.583	22.792	*7.449	0.004
	Within Measurements	21	64.250	3.060		
	Total	23	109.833			
Arm Encirclement, Push Competitor	Between Measurements	2	134.333	67.167	*4.781	0.019
	Within Measurements	21	295.000	14.048		
	Total	23	429.333			
Neck Pull Down, Arm Encirclement	Between Measurements	2	1.376	0.688	*11.615	0.000
	Within Measurements	21	1.244	0.059		
	Total	23	2.620			
Neck Pull Down, Arm Encirclement	Between Measurements	2	134.333	67.167	*4.781	0.019
	Within Measurements	21	295.000	14.048		
	Total	23	429.333			
Axis	Between Measurements	2	1.376	0.688	*11.615	0.000
	Within Measurements	21	1.244	0.059		
	Total	23	2.620			

***Significant at the 0.05 level. The critical (F) value at the 0.05 level = 3.467.**

Table (10) Significance of Differences between the Three Measurements (pre, intermediate, post) for leg movements in the control group using the Least Significant Difference (LSD) Test. n=8.

Variable	Measurements	Mean	Standard Deviation	Significance of Differences Between Means			LSD Value
				pre	within	post	
Pushing Competitor Outside	Pre	12.63	2.26		-1.75	-3.375-*	0.87
	Within	10.88	1.64			-1.63	
	Post	9.25	1.16				
Falling Forward in Front	Pre	11.88	1.55		-1.875-*	-3.375-*	
	Within	10.00	0.76			-1.500-*	
	Post	8.50	0.53				
Arm Encirclement and Backward Throw	Pre	12.63	2.26		-1.75	-3.375-*	0.87
	Within	10.88	1.64			-1.63	
	Post	9.25	1.16				
Arm Encirclement, Push Competitor Outside, and Carpet	Pre	31.25	3.85		-3.50	-5.750-*	1.87
	Within	27.75	3.73			-2.25	
	Post	25.50	3.66				
Neck Pull Down, Arm Encirclement	Pre	1.71	0.25		0.14	.56250*	
	Within	1.85	0.21			.42500*	
	Post	2.28	0.27				
Pulling the Neck Down and then Arm and Neck Encirclement.	Pre	31.25	3.85		-3.50	-5.750-*	1.87
	Within	27.75	3.73			-2.25	
	Post	25.50	3.66				
Axis	Pre	1.71	0.25		0.14	.56250*	0.12
	Within	1.85	0.21			.42500*	
	Post	2.28	0.27				
	Within	28.25	2.19			-4.000-*	
	Post	24.25	2.19				

Table (11) Illustrates the Differences Between the Experimental Group and the Control Group in Post-measurement Leg Movements. n=14.

Variable	Groups	Total	n	Mean	Standard Deviation	Differences Between Means	t-Value	Significance Level
Pushing Competitor Outside	Experimental Group	6	8.667	1.751	-0.583	-0.751	0.467	-6.31
	Control Group	8	9.250	1.165				
Falling Forward in Front	Experimental Group	6	8.833	0.753	0.333	0.973	0.350	3.92
	Control Group	8	8.500	0.535				
Arm Encirclement, Neck, and Backward Throw	Experimental Group	6	8.667	1.751	-0.583	-0.751	0.467	-6.31
	Control Group	8	9.250	1.165				
Arm Encirclement and Push Competitor Outside on the Mat	Experimental Group	6	30.167	2.041	4.667	*2.793	0.016	18.30
	Control Group	8	25.500	3.665				
Arm Encirclement, Neck, and Backward Throw	Experimental Group	6	3.083	0.483	0.808	*4.020	0.002	35.53
	Control Group	8	2.275	0.266				
Neck Pull Down, Arm Encirclement	Experimental Group	6	30.167	2.041	4.667	*2.793	0.016	18.30
	Control Group	8	25.500	3.665				
Control Variables	Experimental Group	6	3.083	0.483	0.808	*4.020	0.002	35.53
	Control Group	8	2.275	0.266				
	Experimental Group	8	24.250	2.188				

***Significant at the 0.05 level. The critical (t) value at the 0.05 level = 2.179.**

The table number (11) and the differences between the experimental and control groups in the results of post-measurement leg movements reveal the following:

- There are significant differences between the experimental and control groups in the results of leg movements (Pushing Competitor Outside, Falling Forward in Front, Arm Encirclement and Backward Throw, Arm Encirclement, Push Competitor Outside, and Carpet, Neck Pull Down, Arm

Encirclement, and Axis). The calculated t-values range from 2.793 to 4.020, which are greater than the critical t-value at the 0.05 level.

- There are no significant differences between the experimental and control groups in the results of motor performance tests (Pushing Competitor Outside, Falling Forward in Front) as the calculated t-values range from 0.205 to 1.607, which are less than the critical t-value at the 0.05 level.

These results suggest that the training program focusing on muscle strength development of the muscles involved in knee joint movement using modern techniques led to an increase in muscle strength. This increase in strength is translated into improved performance by optimizing the wave planning of muscles. Strength training that focuses on working muscles at the required angles helps achieve the maximum force with minimal effort, preventing the dispersion of applied force. This leads to smoother and more efficient performance, reducing the risk of injuries.

Additionally, the results align with previous studies by Sherif Mahrous Mohamed Qandeel (2006) and Nader Ismail Saeed Halawa (2007) that found significant differences in pre and post-measurement variables related to muscle strength and physical performance in various training groups.

Conclusions:

The researcher was able to reach the following conclusions:

1. The preventive training program led to improvements in physical variables related to the muscles involved in the knee joint by a percentage ranging from 2.87% to 3.95% for wrestlers.
2. Common injuries among wrestlers include sprains, muscle tears, muscle contractions, and bruises.
3. The preventive training program resulted in an improvement in muscle strength for the muscles involved in the knee joint by a percentage ranging from 14.08% to 21.34% for wrestlers.
4. There were differences between pre-measurement and post-measurement in terms of range of motion.
5. Major causes of sports injuries among wrestlers include insufficient warm-up, lack of physical fitness preparation before training and competitions, and inadequate supervision during training or competitions.

Recommendations:

1. It is essential to develop injury prevention programs tailored to the most common injuries in wrestling.
2. The researcher recommends using plyometric exercises for all types of sports due to their effective impact on improving muscle balance.
3. There is a need to enhance muscle strength through plyometric exercises and proprioceptive neuromuscular facilitation (PNF) exercises to reduce knee joint injuries.
4. The researcher suggests implementing standardized training programs for injury prevention among wrestlers.
5. The results of this research should be applied to individual sports and tournaments.

These conclusions and recommendations highlight the importance of injury prevention programs, proper warm-up, and fitness training for wrestlers to reduce the risk of common injuries and enhance their performance.

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