

**EFFECTS OF TWO WARM-UP PROGRAMS ON BALANCE AND ISOKINETIC
STRENGTH IN MALE HIGH SCHOOL SOCCER PLAYERS**

Running Head: Effects of Two Warm-up Programs on Strength & Balance

Research conducted at
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Abstract:

One of the most common warm-up programs utilized to prevent injury in soccer, FIFA11+, integrates aerobic, strength, and balance. The purpose of this study was to compare FIFA11+ to a new warm-up program (NWP) on balance and isokinetic strength of the quadriceps and hamstrings at 60, 180, and 300 degrees per second in male high school soccer players. Participants at one school (n=17) performed the NWP before practice for six weeks during one soccer season while participants at another school (n =17) performed FIFA11+. There were no differences at baseline. At posttest, players in NWP significantly improved ($p < 0.01$) in Overall Stability Index Balance, Anterior/Posterior Index Balance, and Medial Lateral Index with large effect sizes (ES) > 1.3 . No changes were seen in FIFA11+. Isokinetic strength peak torque increased at 60 degrees per second in quadriceps and hamstrings dominant and nondominant legs NWP ($p < 0.01$, ES 0.59 to 1.02) and in hamstrings in FIFA11+ ($p < 0.05$, ES 0.32 to 0.40). At 180 degrees per second NWP improved peak torque ($p < 0.01$, ES 0.74 to 0.90) except hamstrings in the non-dominant leg, while FIFA11+ showed improvements across all muscle groups ($p < 0.01$), but with smaller ES 0.25 to 0.84. Both programs improved isokinetic peak torque at 300 degrees per second except hamstrings in the non-dominant leg in NWP, although ES were higher in NWP (ES 0.60 to 1.03) than FIFA11+ (ES 0.31 to 0.42). The NWP appears to be effective for soccer conditioning by improving balance and isokinetic strength.

Keywords: athletic performance; sports; athletes; training; warm-up exercise; soccer

INTRODUCTION

Soccer involves over 265 million players worldwide, and is the fastest growing team sport in the United States, especially within the younger populations. As participation grows, improvements in training protocols and concerns of potential injury should be addressed. As a highly physical contact sport, soccer inherently has a higher probability of getting injured than many other sports (13).

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Injuries can occur to anyone engaging in physical activity, regardless of experience or fitness level. Sports injuries to athletes, however, can be very costly. The recovery process can be lengthy, and full recovery is not always possible. As a result, injury prevention, especially prevention of lower extremity injuries, is critical for long term success in many sports, including soccer. Allied health professionals have various suggestions about the prevention of injuries, ranging from exercise programs to restore muscle imbalance, stretching and flexibility programs to decrease muscle stiffness, and balance programs to improve proprioception (9). These suggestions can be used to develop specific strategies for individual players, or as prevention exercises for teams.

There are several strategies that can help soccer players during practices and competitions to reduce injury risk. It is clear that completing a comprehensive warm-up can effectively reduce injury risk for athletes. For soccer players specifically, an appropriate warm-up should focus on balancing ability, as well as knee extensor and knee flexor muscle strength (6). Several structured warm-up programs for soccer have been developed and used by teams across the globe in an attempt to prevent lower limb injuries. One such program was developed by The Assessment and Research Center of the Fédération Internationale de Football Association (FIFA), with a goal to reduce knee sprains and strains in male and female soccer players and is called FIFA11+ (5). This program categorizes the warm-up into three components. Part 1 consists of an aerobic-based general body warm-up. Part 2 targets strength and balance using agility, plyometric, and other neuromuscular exercises, and Part 3 continues with aerobic based activity (12).

Contrasting opinions surround the FIFA11+ program. Generally, soccer players perform the FIFA11+ warm-up program of running, jumping, balance, and stretching before physical activity to help prevent injury. In addition, researchers have discovered that the FIFA11+ program increases strength and muscle balance around the knee joint (3). However, recent research raises concern about the efficacy of the FIFA11+ program. In 2008, researchers found that the FIFA11+ failed to prevent injuries and did not improve overall soccer skills or performance (14). Since there is evidence that the FIFA11+ warm-up program may not be effective in preventing injuries, a new program should be considered to provide more sport-specific preparation and injury-reducing benefits than FIFA11+.

We have developed a New Warm-up Program (NWP) to meet the warm-up needs that are not satisfied by the FIFA11+ program, and this program was subject of this research. Our new program consists of similar exercises as FIFA11+, (aerobic, plyometric, balance, and strengthening), but places a heavier emphasis on balance and strength. Aerobic exercises were incorporated to increase blood flow and body temperature (6). Plyometric and balance exercises were included because they have been shown to be beneficial in reducing lower body joint injuries (16). A specific difference in the NWP from the FIFA11+ is a greater emphasis on balance and strength based exercises. There is strong support that performing balance exercises can lower the risk of lower body injuries (9). This support extends specifically to high school soccer, as a study conducted with American high school soccer and basketball players found that performing a balance program significantly decreased the number of ankle sprains among the

athletes (10). The NWP is based on an extensive review of sports conditioning research, and focuses specifically on improving lower limb balance and strength in soccer players, as well as preparing them physically for the game of soccer. The purpose of this study was to examine the effectiveness of the NWP as compared to the FIFA11+ program in high-school aged soccer players as they effect the development of balance and strength.

METHODS

Experimental Approach to the Problem

While both the NWP and FIFA11+ programs include aerobic, balance, strength, and plyometric exercises, the specific exercises included in each differ. The aim of this study was to compare the both programs on balance and strength of soccer players. Each program required approximately 20 minutes to complete. Subjects were assigned to the NWP group or the FIFA11+ group based on the school of attendance. Each group completed the assigned warm-up program three times per week for six weeks. Subjects completed a pre-test before beginning the program, and a post-test upon completion of the six week training period. Pre- and post-testing included five minutes of warm up on a stationary bicycle, five minutes of lower body dynamic stretching, six balance trials, and isokinetic strength testing at 60, 180, and 300 degrees per second.

Subjects

Thirty-four male varsity high school soccer players (age = 16.53 ± 1.080 years) from two high schools in the southeastern United States were recruited to participate. Each subject and his

parents were informed of the experimental risks and parental consent and youth assent documents approved by the university's Institutional Review Board were signed before the investigation began. Subjects who attended High School A ($n = 17$, age = 16.53 ± 1.125 years) were assigned to the NWP group and subjects who attended High School B ($n=17$, age = 16.53 ± 1.068 years) were assigned to the FIFA11+ group.

Procedures

Subjects reported to the testing facility at assigned times and completed a standardized warm up of five minutes on a bicycle ergometer followed by five minutes of lower body dynamic stretching. Upon completion of the warm up, balance was assessed with the Biodex® Balance System SD. All subjects were given standardized instructions by the same researcher. The subject stood on the dominant leg and completed six trials following the Athlete Single Leg Stability Test protocol described in *the Balance System SD Operation/Service Manual* (2). The subject stood in the center of the foot platform while wearing shoes and attempted to maintain the foot platform in a level position. Each trial lasted 20 seconds and the platform stability setting was set at level four. The first three trials were practice trials and the subject could use the support handle to assist in balance. The final three trials were recorded and the subject was instructed to keep the arms comfortably crossed over the chest. Data collected included overall stability, anterior/posterior stability, and medial/lateral stability. The same testing procedure was repeated on the non-dominant leg. When balance testing was completed, knee extensor (quadriceps) and knee flexor (hamstrings) muscle strength was assessed with a concentric/concentric test protocol on the Biodex® System 3. Subjects were tested in a seated

position with stabilization straps securing the trunk, abdomen, and thigh. The arms were held comfortably across the chest. The axis of rotation of the dynamometer was visually aligned with the lateral femoral condyle and the lower leg was strapped to the dynamometer arm with the inferior border of the pad approximately four finger widths above the dorsum of the foot. Subjects completed five repetitions at 60 degrees per second, five repetitions at 180 degrees per second, and ten repetitions at 300 degrees per second on the dominant leg. The speeds selected have been recommended by the Biodex Corporation as representative for an athletic population (1). The testing procedure was then repeated on the non-dominant leg. All strength assessments were performed by the same researcher. Each subject was given standardized instructions.

Upon completion of the pre-tests, subjects who attended School A performed the NWP as a complete warm-up program for six weeks, three times per week for approximately 20 minutes, before practice sessions. These subjects were supervised by the lead researcher. The NWP is detailed in Table 1.

Insert Table 1 about here

Participants in School B completed the FIFA11+ as a warm-up program for six weeks, three times per week for approximately 20 minutes, before practice sessions. These subjects were supervised by the head soccer coach at the high school. The coach who had over fifteen years head coaching experience was very familiar with the program and was trained in its

implementation by the lead researcher. The FIFA11+ program manual is available online (5). Throughout the course of the study, the intensity of the exercises in both programs increased depending on the subjects' response to the training. Post-test data were collected from all subjects after six weeks using the same protocols of the pre-tests. All pre and post-test data were collected by the same researchers to reduce reliability concerns.

Statistical Analysis

Statistical Package for Social Sciences (SPSS) was used to analyze the data, SPSS V. 22 (IBM Corporation, Armonk, NY). The mean for each variable was used to investigate the differences between pretest to posttest and between the two schools. Independent samples *t*-test were carried out to show the data significance between the two schools. Paired samples *t*-test and General Linear Model Repeated Measures was carried out to find out the effectiveness of the two programs before and after the study. The level of statistical significance was set at $p < 0.05$. Effect sizes were calculated for all variables.

RESULTS

Balance

There were no differences in balance and stability between NWP and FIFA11+ groups at baseline. Results from repeated measures ANOVA revealed significant interaction effects that at posttest balance and stability testing participants who underwent the NWP significantly improved balance in their dominant leg in Overall Stability Index ($p < 0.001$, ES = 1.58), Anterior/Posterior Index ($p < 0.001$, ES 1.42), Medial Lateral Index ($p < 0.001$, ES =1.31), and

in the non-dominant leg Overall Stability Index ($p < 0.001$, ES = 1.62), Anterior/Posterior Index ($p < 0.001$, ES = 2.23), and Medial Lateral Index Balance ($p < 0.001$, ES = 1.64). There were no changes in the FIFA11+ group. See Table 2 for these within-subjects results. There were no significant differences in any of the between-subjects factors by school ($p > 0.05$, data not shown).

Insert Table 2 about here

Isokinetic Strength at 60 Degrees per Second

Baseline values of isokinetic strength peak torque at 60 degrees per second between NWP and FIFA11+ groups were not different. Table 3 shows that at posttest there were significant interaction effects and within-subjects differences in the NWP for peak torque in the quadriceps in the dominant leg ($p < 0.001$, ES = 0.59) and non-dominant leg ($p < 0.001$, ES = 0.61), and hamstrings in the dominant leg ($p < 0.001$, ES = 1.02) and non-dominant leg ($p < 0.001$, ES = 0.92). No significant differences were shown in FIFA11+ in peak torque at 60 degrees per second in the quadriceps in the dominant leg ($p = 0.322$) and non-dominant leg ($p = 0.203$). There were significant, but small-to-moderate improvements in peak torque at 60 degrees per second in FIFA11+ for hamstrings in the dominant leg ($p = 0.015$, ES = 0.40) and non-dominant leg ($p = 0.026$, ES = 0.32).

Insert Table 3 about here

Isokinetic Strength at 180 Degrees per Second

Isokinetic strength measured by peak torque at 180 degrees per second was not different at baseline between the NWP and FIFA11+ groups. At posttest peak torque at 180 degrees per second showed significant interactions and increased in NWP in the quadriceps in the dominant leg ($p < 0.001$, ES = 0.74), quadriceps of the non-dominant leg ($p < 0.001$, ES = 0.90), and hamstrings in the dominant leg ($p = 0.004$, ES = 0.82), but there were no interactions and differences in the hamstrings in the non-dominant leg ($p = 0.100$). At this speed of 180 degrees per second the FIFA11+ group showed increases in peak torque in the quadriceps in the dominant leg ($p = 0.005$, ES = 0.44), quadriceps in the non-dominant leg ($p = 0.003$, ES = 0.25), hamstrings in the dominant leg ($p < 0.001$, ES = 0.82), and hamstrings in the non-dominant leg ($p < 0.001$, ES = 0.54) though these changes were less than the NWP.

Isokinetic Strength at 300 Degrees per Second

There were no differences in isokinetic strength measured as peak torque at 300 degrees per second between the NWP and FIFA11+ groups at baseline. Peak torque at 300 degrees per second in the NWP group showed significant interactions and increases in the quadriceps of the dominant leg ($p < 0.001$, ES = 0.60), quadriceps of the non-dominant leg ($p < 0.001$, ES = 0.83), and hamstrings in the dominant leg ($p = 0.002$, ES = 1.03). There were no interactions and pre-

to-post changes in the hamstrings in the non-dominant leg in NWP ($p = 0.400$). The FIFA11+ group showed improvements at this test speed in the quadriceps in the dominant leg ($p = 0.004$, $ES = 0.30$) and non-dominant leg ($p = 0.002$, $ES = 0.31$) as well as hamstrings in the dominant leg ($p = 0.010$, $ES = 0.42$) and non-dominant leg ($p = 0.010$, $ES = 0.35$) though these changes were smaller than the NWP.

DISCUSSION

The NWP was developed to address the inadequacies of the FIFA11+ warm-up program, specifically as they relate to improving balance and strength. Previous research has found FIFA11+ to be ineffective for preventing injuries in soccer players that performed the training for eight months (15). Other researchers have shown support for warm-up programs positive effects on knee proprioception and balance (17). As a result, training aimed at improving balance and strength should be implemented in order to reduce risk of injury. The results of this study showed that the participants who completed the NWP significantly improved in balance and strength after six weeks of training. No significant improvement in balance was found from pre to posttest in those that trained with the FIFA11+ program for the same period. It has been reported that lack of balance among athletes is one of the most common causes of ankle sprains (7). There is evidence that the FIFA11+ program did not adequately improve balance among soccer players (14). Additionally, researchers found that FIFA11+ did not increase quadriceps or hamstring isokinetic strength among soccer players, as there were no improvements in maximal concentric, eccentric and isometric hamstring torque between the pretest and the posttest (14). The literature is clear, however, that increased muscular strength can reduce the

risk of injury (8, 9, 10, 11). The implementation of a program such as the NWP that focuses on the development of balance and strength should enhance athlete performance and reduce injury risk.

Peak torque at 180 and 300 degrees per second among both groups significantly increased in the quadriceps of both legs and the hamstrings of the dominant leg, although the FIFA11+ increased significantly in the hamstrings of both legs. It should be noted that higher speed values are more indicative of power and explosiveness and less indicative of slow-speed strength. Faster paced activities such as games, competitions, daily practices, and technique drills can improve strength at faster speeds. Previous research reported that the strength of quadriceps and hamstrings at 500 degrees per second increased significantly after a competitive season, however, those subjects did not make significant gains at speeds of 60 and 300 degrees per second (4). The researchers reported that to improve strength at slower speeds (60 degrees per second) a training protocol that includes slower exercises for balance, muscular stability, and slow speed strength must be incorporated into the athlete's regimen.

We believe the NWP is more beneficial than the FIFA11+ program for developing balance and strength in high school soccer players. The NWP group had significant and meaningful improvements in balance than the FIFA11+ group. Both programs showed change in several strength variables; however, the effect size of the change within the NWP group was greater than that for the FIFA11+ group. We believe that the main reason for the differences seen

within the two groups is the implementation of balance and strength components in the NWP design. Based on evidence from the literature, incorporating specific exercises can effectively improve balance and strength (7), which was the ultimate goal of the NWP. There is support that a neuromuscular training program of jumping, balance, agility training, and landing mechanics can decrease lower extremity injury rates among athletes (11). Although we did not measure injury rates among the group, the NWP incorporates these training elements, and can possibly be beneficial in reducing injuries.

Limitations of the study included a quasi-experimental design using samples of convenience with only one school each implementing the NWP and FIFA11+. The lead researcher implemented the NWP while the head coach, who was knowledgeable in the FIFA11+ program, led the program at his school. The study population was high school male soccer players, and it is unknown if similar results would be found in other groups such as females or players at higher levels such as collegiate or professional. No injury data were collected during the study period, and injury rates would need to be studied in future research.

PRACTICAL APPLICATIONS

The NWP was designed to be used before each practice session in order to improve balance and strength in athletes, and, potentially, to reduce injury risk. In this study, the NWP achieved improvement in balance and strength over a six week training period. Effective development of balance and strength in a short period of time can allow coaches to incorporate

an effective warm up program into their practice schedule without worry of time constraints. The NWP group performed this program during pre-season practice and the early weeks of the competitive season. Continuing the program during the entire season should yield continued gains for the athletes.

While this program was studied among high school male soccer players and completed before soccer practice, the results of this program can generalize to other athletes and training states. The utilization of this type of warm-up program can extend to benefit strength and conditioning professionals. Incorporating this type of warm-up before training and conditioning during offseason, preseason, or in-season could be beneficial in maximizing balance and strength gains for the athlete. It is also feasible to generalize that this type of training program can be easily adapted for other sports, specifically ones that are similar in movement and metabolic demand. Applying a few sport-based modifications to this program would make it applicable to sports such as basketball, field hockey, and lacrosse, especially since the rates and types of lower body injuries across these sports are similar. The NWP was effective in increasing balance and strength of lower body in soccer players due to its carefully and strategically developed combination of aerobic, balance, and strength drills. Although we did not measure injury rates in the groups, improvements in balance and strength have been shown to reduce injuries among athletes (8, 9, 10). Further study is needed to confirm whether the improvements in balance and strength created by the NWP will reduce injuries among athletes that may utilize the program.

Table 1
NWP (New Warm-up Program) Protocol

Week One			
Aerobic Exercises	Distance	Reps	Rest
High steps, shuffle back	10 meters	2	N/A
Double steps, shuffle back	10 meters	2	N/A
Skip & grab, shuffle back	10 meters	2	N/A
Walking hip stretch	10 meters	1	N/A
Leg kick	10 meters	1	N/A
Straight sprint	10 meters	1	N/A
Lateral shuffle	10 meters	1	N/A
Up & shuffle	10 meters	1	N/A
Up & back	10 meters	1	N/A
Zig-zag	4 meter square	1	N/A
Plyometric Exercises			
Single leg hop	5 meters	1	
High knee crossover	5 meters	1	
Single leg hop	5 meters	2	30 seconds
Ladder Drills			
One step agility, shuffle back	10 meters	1	10 seconds
Side step	10 meters	1	10 seconds
Crossover, shuffle back	10 meters	1	10 seconds
In & outs	10 meters	1	10 seconds
River dance	10 meters	1	10 seconds
Side step	10 meters	1	10 seconds
Straddle hop	10 meters	1	10 seconds
Two step agility	10 meters	1	10 seconds
Mini/micro hurdle (6-12 inches)			
Sprint	10 meters	1	10 seconds
Double leg jump	10 meters	1	10 seconds
Single leg hop	10 meters	1	10 seconds
BOSU® Exercises			
Jump, circle roll, kick	N/A	10	
Lateral agility	N/A	10	
Strength			

Squats	Day 1	2*20	30 seconds
	Day 2	3*20	
	Day 3	2*20	
Lunges		2*10	30 seconds
Kneeling squat jump	Day 1	1	
	Day 2	3	
	Day 3	3	

Balance Exercises

DL Lateral SB Pass: players side by side on both feet, knees flexed 30°, pass ball L to R. Repeat.

SL SB Toss: players face each standing on one leg, toss ball back and forth. Repeat on left leg.

SL MB Toss. Same as SL SB Toss, but with a medicine ball.

Week Two

Aerobic Exercises: The same as Week One

Plyometric Exercise: The same as Week One

Ladder Drills: The same as Week One

Mini/micro hurdle (6-12 inches): The same as Week One

BOSU® Exercises: Add 1.5 pound weight to Week One Exercises

Strength

Squats, add dumbbell weights	2*20	30 seconds
Lunges, add dumbbell weights	2*10	30 seconds
Kneeling squat jump, add dumbbell weights	3	

Balance Exercises

Partner Rotation Balance: Players back to back on one leg, .5 meter apart. Arms extended at shoulder height, rotate until hand contact for 10 reps. Repeat to opposite direction; repeat other leg.

Partner SB Pass: Assume Partner Rotation Balance; SB pass. 10 each direction. Repeat other leg.

Individual Lateral Trunk Flexion: Stand on right leg, perform lateral trunk as far as possible without touching the ground, return to upright position. Complete 10 reps. Repeat on left leg.

Week Three

Aerobic Exercises: The same as Week One

Plyometric Exercise: The same as Week One

Ladder Drills: The same as Week One

Mini/micro hurdle (6-12 inches)

Front-back single leg hops	10 meters	10/leg	10 seconds
Lateral single leg hops jump	10 meters	10/leg	10 seconds

BOSU® Exercises:

T-jump	N/A	5/leg
Single leg jump	N/A	5/leg

Strength

Squats, add dumbbell weights	2*20	30 seconds
Lunges, add dumbbell weights	2*10	30 seconds
Kneeling squat jump, add dumbbell weights	3	

Balance Exercises

SL Balance on Firm Surface and Volley Kick. Complete 10 per leg.

SL Balance on Disk Pillow and Volley Kick. Complete 10 per leg.

SL Balance on Trampoline and Ball Pass. Complete 10 per leg.

Week Four

Aerobic Exercises: The same as Week One

Plyometric Exercise: Add 1.5 pound weight to Week One Exercises; Add Standing box jump (40cm)

Ladder Drills: Add 1.5 pound weight to Week One Exercises

Mini/micro hurdle (6-12 inches): The same as Week Three

BOSU® Exercises: Add 1.5 pound weight to Week Three Exercises

Strength

Squats, add dumbbell weights	3*20	30 seconds
Lunges, add dumbbell weights	3*10	30 seconds
Kneeling squat jump, add dumbbell weights	3	

Balance Exercises

SL Balance on Disk Pillow: Maintain balance for 15 seconds. Complete 3 reps per leg.

SL Balance on Disk Pillow w/ MB Bounce Off Mini-trampoline. 10 reps per leg.

Week Five

Aerobic Exercises: The same as Week One

Plyometric Exercise: The same as Week Four

Ladder Drills: Add 1.5 pound weight to Week One Exercises

Mini/micro hurdle (6-12 inches): Add 1.5 pound weight Week Three

BOSU® Exercises:

Travelling squat	N/A	10
Forward lunge	N/A	10/leg

Strength

Squats, add dumbbell weights	3*20	30 seconds
Lunges, add dumbbell weights	3*10	30 seconds
Kneeling squat jump, add dumbbell weights	3	

Balance Exercises

SL Balance on Disk Pillow: Maintain balance for 20 seconds. Complete 3 reps per leg.

SL Balance on Disk Pillow w/ MB Bounce Off Mini-trampoline. Increase weight. 10 reps per leg.

Week Six

Aerobic Exercises: The same as Week One

Plyometric Exercise: The same as Week Four

Ladder Drills: Add 1.5 pound weight to Week One Exercises

Mini/micro hurdle (6-12 inches): Add 1.5 pound weight Week Three

BOSU® Exercises: Add 1.5 pound weight to Week Five Exercises

Strength

Squats, add dumbbell weights	3*20	30 seconds
Lunges, add dumbbell weights	3*10	30 seconds
Kneeling squat jump, add dumbbell weights	3	

Balance Exercises

SL Balance on Disk Pillow: Maintain balance for 20 seconds. Complete 4 reps per leg.

SL Balance on Disk Pillow w/ MB Bounce Off Mini-trampoline. Increase ball weight. Complete 10 reps per leg.

Note: SL = Single Leg; DL = Double Leg; SB = Soccer Ball; MB = Medicine Ball

Table 2

Within-subjects balance pretest and posttest between NWP (n = 17) and FIFA11+ (n =17) groups in dominant and non-dominant legs.

Variables	Pretest dominant leg (Mean \pm SD)	Posttest dominant leg (Mean \pm SD)	<i>p</i>	Pretest non- dominant leg (Mean \pm SD)	Posttest non- dominant leg (Mean \pm SD)	<i>p</i>
Overall Stability Index NWP	3.7 \pm 1.8	1.6 \pm 0.5	<0.001 [§]	6.3 \pm 3.2	1.9 \pm 0.8	<0.001 [§]
Overall Stability Index FIFA11+	3.8 \pm 2.4	3.3 \pm 2.3	0.237	5.5 \pm 2.4	5.5 \pm 3.1	0.985
Anterior/Posterior Index NWP	1.9 \pm 0.8	1.0 \pm 0.4	0.001 [§]	2.8 \pm 1.0	1.1 \pm 0.4	<0.001 [§]

Anterior/Posterior	2.0 ± 1.0	1.7 ± 0.9	0.142	2.6 ± 1.0	2.2 ± 1.1	0.215
Index FIFA11+						
Medial Lateral	2.7 ± 1.8	1.0 ± 0.3	0.001 [§]	5.1 ± 3.2	1.3 ± 0.7	<0.001 [§]
Index NWP						
Medial Lateral	2.9 ± 2.2	2.5 ± 2.4	0.382	4.4 ± 2.4	4.7 ± 3.0	0.595
Index FIFA11+						

NWP = new warmup program. FIFA11+ = FIFA11+ warmup program.

[§] $p < .01$.

Table 3

Within-subjects isokinetic strength at 60 degrees per second pretest and posttest between NWP (n = 17) and FIFA11+ (n =17) groups in dominant and non-dominant legs.

Variables	Pretest dominant leg (Mean ± SD)	Posttest dominant leg (Mean ± SD)	<i>p</i>	Pretest non- dominant leg (Mean ± SD)	Posttest non- dominant leg (Mean ± SD)	<i>p</i>
Peak torque quadriceps NWP	129.0 ± 30.9	146.7 ± 28.5	<0.001 [§]	128.5 ± 28.2	145.1 ± 26.3	<0.001 [§]
Peak torque quadriceps FIFA11+	128.2 ± 31.1	126.3 ± 24.2	0.322	123.0 ± 20.7	119.3 ± 22.3	.203

Peak torque hamstrings NWP	68.6 ± 13.9	84.1 ± 16.3	<0.001 [§]	67.7 ± 13.3	80.9 ± 15.1	<0.001 [§]
Peak torque hamstrings FIFA11+	66.6 ± 15.9	73.1 ± 16.3	0.015 [‡]	63.9 ± 15.3	68.9 ± 15.1	0.026 [‡]

NWP = new warmup program. FIFA11+ = FIFA11+ warmup program.

[‡] $p \leq 0.05$.

[§] $p < 0.01$.