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ORIGINAL ARTICLE

Current Implementation of Oslo Sports Trauma Research Center Volleyball Injury Prevention Exercises among Male Professional Volleyball Players in the Gulf Cooperation Council Countries: A Cross-Sectional Survey

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ABSTRACT

Background. Volleyball is a popular non-contact sport around the globe. Unfortunately, volleyball players often suffer from an ankle sprain and knee and shoulder injuries. Proper techniques, education, and preventive exercises such as adequate warm-ups can reduce the risk of injury. **Objectives.** This study aimed to investigate and compare the implementation of the Oslo Sports Trauma Research Center (OSTRC) volleyball injury prevention program's exercises among professional volleyball players in the Gulf Cooperation Council (GCC) countries. **Methods.** A web-based survey was conducted from October 2019 to October 2020 to acquire information regarding implementing the OSTRC volleyball injury prevention program's exercises distributed to 377 professional volleyball players in six GCC countries. Chi-square statistics were used to examine differences among the countries and age groups. **Results.** Three hundred forty-one male volleyball players participated (response rate of 90.5%), mostly 20-29 years old. About half of the volleyball players (range 46.9% to 56.9%) in the GCC countries performed the OSTRC volleyball injury prevention program's exercises in their current practice. Exercise implementation rates varied among age groups and countries with no statistical difference ($p = .973$ and $p = .913$, respectively). **Conclusion.** This study found that about 50% of volleyball players applied the 18 recommended OSTRC injury prevention exercises in the GCC countries. Awareness campaigns and training improvements need to be introduced to increase the implementation rates.

KEYWORDS: ***Athletic Injuries, Exercise Therapy, Sports Medicine, Muscle Strength, Flexibility Exercises.***

INTRODUCTION

Volleyball is played by an estimated 800 million players, making it one of the top five popular sports worldwide (1). In volleyball, players need to practice specific fast movements such as jumping, landing, blocking, and spiking the ball, which is associated with a considerable risk of musculoskeletal injuries (2). The incidence rate of volleyball injuries reached 10.7 per 1000 playing hours (2, 3). Injuries during matchplay days ranged from 2.6 to 4.1 per 1000 playing hours, with a higher incidence of injuries than on training play days. In comparison, the rate of these injuries is lower on training days ranging from 1.5 to 1.8 per 1000 playing hours (2-4).

The rate of injuries per region in volleyball varied based on the location and session type. On average, 0.9 to 1.0 injuries per 1000 playing hours are reported as ankle injuries (4, 5). The estimated ankle injuries in the match and training sessions were 1.7 and 0.8 injuries per 1000 playing hours,

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respectively(4, 5). Acute and overuse injuries to the knee joint were reported as 0.3 per 1000 playing hours (4, 6, 7). Studies related to the knee also reported up to 0.25 injuries per 1000 athlete exposures in match participation and 2.54 injuries in training sessions. Also, higher knee rupture injuries were reported in women than men (0.27 and 0.14 injuries per 10,000 exposures, respectively) (4, 6, 7). It is also reported that shoulder injuries in volleyball have an overall incidence rate of 0.2 per 1000 playing hours for both acute and overuse injuries (4, 6). In contrast, 0.16 to 0.32 injuries per 1000 athlete exposures were reported during training sessions (4, 6).

Compared to age, the incidence of injury among volleyball players is higher in older than young people (2). About 11.9 injuries per 1000 playing hours were reported for the players over 18 years, while junior athletes aged 15 - 18 reported 4.0 injuries per 1000 playing hours (2-4). Furthermore, the incidence of match injuries is 3.8 per 1000 playing hours for elite players officially registered in the Fédération Internationale de Volleyball (FIVB) (2).

According to the risk of injury linked to volleyball, several previous studies focused on prevention programs to prevent such injuries. One of these studies aimed to prevent volleyball injuries among young female players. They found a significant decrease in muscle injuries for the experimental group (8). Another study was conducted on adult volleyball players who performed a four-month injury prevention program to decrease their anterior knee pain (9). They found a decline in the rate of anterior knee pain.

Moreover, another study found a substantial decrease in ankle sprains among intervention groups (10). In addition, a systematic review by James et al. collected several studies that provided exercise programs for reducing shoulder injuries. They found that a stretching exercise contributed to a significant decline in shoulder injuries in overhead sports like volleyball (10).

Similarly, another study utilized a survey method to assess the prevalence of injury and prevention methods among elite Swedish volleyball players (11). They found that prevention programs helped prevent the most common injuries and enhanced overall performance. In addition, female adolescent athletes were surveyed to examine their willingness to perform injury prevention programs before playing several games, including volleyball (12). They found that participants are willing to include injury prevention exercises if they prove to help decrease injuries.

Along these lines, the Oslo Sports Trauma Research Center (OSTRC) was established to provide evidence-based exercises more focused on preventing the most common injuries in popular sports. An enormous amount of research supported the importance of injury prevention programs in their programs. Relying on this, OSTRC Injury Prevention Programs were developed and published via the Skadefri platform by Olympiatoppen (Norwegian Olympic Committee), the Norwegian High-Performance Center, and the National Sports Federation. Their mission was to understand better the injury, the mechanism of these injuries, and how to prevent them from happening. Skadefri has significant resources that should be used to prevent the most common injuries for more than 50 sports, including volleyball. However, no study has yet investigated the implementation rate of the OSTRC volleyball injury prevention program among volleyball players in the Gulf Cooperation Council (GCC) countries. Therefore, this study aims to investigate the implementation of this program among professional volleyball players in the GCC countries. Also, to compare the two age groups for the same. The study will draw a clear conclusion and provide scientific knowledge to volleyball players, policymakers, and coaches about the importance of implementing this program in their professional career path.

MATERIALS AND METHODS

Survey Development. To the author's knowledge, no existing surveys are related to implementing injury prevention exercises specified for volleyball players. Thus, the current study questionnaire was developed to collect information from volleyball players about their implementation of the injury prevention exercises. The survey consisted of twenty-five questions that were divided into three sets: (1) the study invitation and participation agreement, (2) socio-demographics questions, and (3) the implementation of the OSTRC volleyball injury prevention program.

The third part of the questionnaire consisted of eighteen questions asking whether or not the participants implemented the exercise. Thus, they were in two-choice form, and each question had a dichotomous answer as either yes (given one point) or no (given zero points). Each player was given a maximum score of 18, converted into a percentage score for data analysis and reporting. After submitting their answers, the participants could see

the total score, correct answers, and fill in any missed questions. No open-ended questions were asked.

The survey was available in English and Arabic, supported by videos demonstrating each exercise to ensure a higher participation rate. The questions listed in part two were simple, like any socio-demographical questions found on applications and forms. Regarding the third part, the questions followed the same structure to make them consistent (Table 1).

Survey Validity and Reliability

Before starting the study, the survey questionnaire and the face validity and pilot testing were conducted. The pilot study asked thirty volleyball players to rate each question in part three (the eighteen questions) according to clarity, comprehension, and appropriateness on a scale of 1.0 to 5.0 points (lowest to highest). If an average score of a question was below 4.0 in any of the parameters, they were considered weak and were not considered in the study.

The second step involved construct validity, which was assessed using the exploratory factor analysis (EFA) adequacy. Next, principal component analysis (PCA) with a Varimax rotation was used to explore the structure of the three questions regarding clarity, comprehension, and appropriateness. Then, the exercise questions were subdivided into three categories resulting in the following combinations: flexibility exercises (5 questions x 3 components), control exercises (6 questions x 3 components), and strength exercises (7 questions x 3 components). Lastly, Cronbach's alpha test was utilized to measure the internal consistency.

Survey Dissemination. An invitation was sent via email to introduce the study's aims and provide a web link to access the questionnaire. The survey targeted 377 officially registered professionals in Saudi Arabia, United Arab Emirates (UAE), Kuwait, Bahrain, Oman, and Qatar Volleyball Federations from October 2019 to October 2020. The invitation email provided a brief background to the survey and encouraged players to participate without an incentive voluntarily. A follow-up email was sent again to remind the participants to complete the survey. Before data collection, consent was obtained from each participant included in the study. After obtaining participants' permission and assuring their confidentiality, the participants were asked to complete the questionnaire. All participants were informed that their participation was entirely voluntary and confidential. The survey was filled anonymously and electronically via Google Forms (Google, LLC, Mountain View, California, USA), limited to one response only. Reminders were sent to the participants encouraging them to participate. The distribution period was from October 2019 to October 2020. All questions had to be answered. Therefore, there were no missing data.

Data Analysis. Frequencies and percentages of nominal variables and mean standard deviation (SD), median, and range for the total score were calculated. The total score of participants was calculated as the overall number of exercises performed by each participant from eighteen exercises. The Student's t-test was used to compare the total scores of the two independent age groups (20–29 and 30–39 years). Also, a one-way analysis of variance (ANOVA) was used to compare the total scores of the GCC countries. For each exercise, chi-square statistics were utilized to examine differences among the countries and age groups. A p-value of 0.05 was set for statistical significance. If the participants achieved a higher score in a range of 0-18, it means more implementation and knowledge of the program. The Statistical Package for the Social Sciences (SPSS) version 25 (IBM Corp., Armonk, New York, United States) was used for data analysis. This research project was reviewed and ethically approved by the Biomedical Ethics Committee at Umm Al Qura University (Approval Number. HAPO02K012202010465).

RESULTS

The volleyball players who participated in the pilot study considered the questions clear, appropriate, and comprehensible. All questions received an average score of more than 4.5; therefore, they were included in the actual study (Table I, supplementary material). The EFA analysis identified that the three components of question 1 and two components of question 2 explained 83.7% of the variance in the data related to the flexibility exercises.

The same applied to questions 4 and 12 of the control exercises with 88.7%. Regarding the muscle strength exercises questions, the three components of questions 6 and 7 included in this section explained 92.2% of the variance in the data (Tables II, III, and IV, supplementary material). When the commonalities were examined, all fifty-four components had extraction values ranging between .532 and .996, which were considered high. The only exception was for the comprehension of question 1 with a value of .497. Nonetheless, all questions were considered appropriate and were supported with instructional exercises videos to clear any doubts (Table V, supplementary material). A high level of internal consistency was also observed with Cronbach's alpha value of .967.

Table 1. The Questionnaire

Agree to Participate:	**Yes/No**
Country:	
Gender:	Male/Female
Age:	
Do you implement any of the following exercises?	
Prone leg cross	Yes/No
Purpose: To improve hip and back flexibility. Keep both shoulders firmly on the floor. Take one foot towards the opposite hand. Alternate legs rotate your back. Bend your knee. 2–3 x 6–8 repetitions.	
Supine leg cross	Yes/No
Purpose: To improve hip and back flexibility. Keep both shoulders firmly on the floor. Cross one knee toward the opposite hand. Progression: Perform with straight legs. 2–3 x 6–8 repetitions.	
Hip flexor stretch	Yes/No
Purpose: To improve hip flexibility. Move weight slowly forwards. Keep upper body straight. Lean your upper body to the same side as your front foot. 3 x 5–8 repetitions.	
Leg curl	Yes/No
Purpose: To improve control of the hips, pelvis and low back. Lift up your pelvis and extend your hips. Slowly roll the ball towards you by bending your knees. Roll the ball backwards until your knees are extended. Keep your lower back and pelvis stable throughout the movement. 3 x 8–16 repetitions.	
Rotation	Yes/No
Purpose: To improve back flexibility. Start in a 4-point kneeling position. Rotate one arm at a time. Keep your eyes on your hand during the exercise. 3 x 20 seconds.	
Side plank	Yes/No
Purpose: To improve hip and trunk strength. Support yourself on your elbow and lift your body. Your body should be in a straight line. Lift your top leg as high as possible. 3 x 20 seconds.	
Push up +	Yes/No
Purpose: To improve upper body strength and shoulder stability. Perform pushups. At the top, keep elbows straight. Push upper back as high as possible. 3 x 8–16 repetitions.	
Shoulder external rotation	Yes/No
Purpose: To strengthen the shoulder rotator muscles. The shoulder should be elevated, and the elbow bent to 90 degrees. Rotate the upper arm, keeping your elbow in the same place. Start with a handball, then progress to a lightly weighted ball. 3 x 8–16 repetitions.	
Sleeper stretch	Yes/No
Purpose: To improve shoulder rotation flexibility. Lie on your side with your body weight over your shoulder blade. Flex your shoulder and elbow to 90 degrees. Use your opposite hand to rotate your shoulder inwards. 3 x 30 seconds per side.	
Y exercise	Yes/No
Purpose: To strengthen the shoulders and upper back. Elevate arms in a Y–pattern. Keep shoulders low. Keep your arms straight. In the end position pull shoulder blades back and down. 3 x 8–16 repetitions.	
Squat	Yes/No
Purpose: To develop good squat technique. Keep your feet hip width apart. Start the movement from the hip. Keep your knees aligned with toes. Sit down as if you are sitting on a chair. Keep your back straight. 3 x 8–16 repetitions.	
Multi-directional jumps	Yes/No
Purpose: To improve hip, knee and ankle control. Perform large jumps from one foot to another in different directions. Land softly with your knee bent and aligned over your toes. 3 x 8–16 repetitions.	
Squat +	Yes/No
Purpose: To improve hip and knee control. Stand on bosu. Keep feet hip–width apart. Start the movement from the hip. Keep knees aligned with toes. Sit down as if you are sitting on a chair, keeping your upper body straight. 3 x 8–16 repetitions.	
The diver	Yes/No
Purpose: To improve trunk control and hamstring strength. Balance on one leg, with your knee slightly bent. Tilt your upper body forwards from the hip. Keep your head, back and opposite leg in a straight line. Raise your arms overhead. Progression: Hold a medicine ball or dumbbell. 3 x 8–16 repetitions.	
Forward lunge	Yes/No
Purpose: To improve hip and knee control. Perform forward lunges. Keep your knee aligned over your toes. Keep your trunk upright and your back straight. 3 x 8–16 repetitions.	
Forward lunge +	Yes/No
Purpose: To improve hip and knee control. Perform forward lunges. Keep your knee aligned over your toes. Keep your trunk upright and your back straight. 3 x 8–16 repetitions.	
Side lunges	Yes/No
Purpose: To improve hip flexibility and control. Perform deep squats to each side. Keep knees aligned with toes. Simulate a serve. 3 x 8–16 repetitions.	
Push up + backwards toe walk	Yes/No
Purpose: To strengthen the chest, arms, and abdomen. Start by doing a normal push up. Walk your whole body backwards and forwards using your ankles. Maintain a neutral spine throughout the whole exercise. 3 x 8–16 repetitions.	

Table 2. Demographic Characteristics of the Participants

Variable	n (%)
Gender	
Male	341 (100 %)
Age (years)	
20 – 29	183 (53.7 %)
30 – 39	158 (46.3 %)
Countries	
Saudi Arabia	51 (15.0 %)
Bahrain	58 (17.0 %)
Kuwait	49 (14.4 %)
Oman	68 (19.9 %)
United Arab Emirates	57 (16.7 %)
Qatar	58 (17.0 %)

Table 3. Volleyball Injury Prevention Exercises Implementation Rate

Exercise	N (%)
Flexibility exercises	
Prone leg cross	160 (46.9 %)
Supine leg cross	179 (52.5 %)
Hip flexor stretch	173 (50.7 %)
Rotation	167 (49.0 %)
Sleeper stretch	179 (52.5 %)
Control exercises	
Leg curl	173 (50.7 %)
Multi-directional jumps	189 (55.4 %)
Squat+	170 (49.9 %)
Forward lunge	183 (53.7 %)
Forward lunge+	171 (50.1 %)
Side lunges	179 (52.5 %)
Muscle strength exercises	
Side plank	170 (49.9 %)
Push up+	163 (47.8 %)
Shoulder external rotation	176 (51.6 %)
Y-exercise	176 (51.6 %)
Squat	162 (47.5 %)
The diver	174 (51.0 %)
Push up+ with backward toe walk	194 (56.9 %)

Table 4. Volleyball Injury Prevention Exercises Implementation Comparison between Age Groups

Exercise	Age Group		P
	20 – 29 y (n = 183)	30 – 39 y (n = 158)	
Flexibility exercises			
Prone leg cross	94 (51.4 %)	66 (41.8 %)	0.077
Supine leg cross	98 (53.6 %)	81 (51.3 %)	0.673
Hip flexor stretch	93 (50.8 %)	80 (50.6 %)	0.973
Rotation	92 (50.3 %)	75 (47.5 %)	0.605
Sleeper stretch	92 (50.3 %)	87 (55.1 %)	0.377
Control exercises			
Leg curl	99 (54.1 %)	74 (46.8 %)	0.181
Multi-directional jumps	99 (54.1 %)	90 (57.0 %)	0.596
Squat+	100 (54.6 %)	70 (44.3 %)	0.057
Forward lunge	99 (54.1 %)	84 (53.2 %)	0.863
Forward lunge+	91 (49.7 %)	80 (50.6 %)	0.867
Side lunges	100 (54.6 %)	79 (50.0 %)	0.392
Muscle strength exercises			
Side plank	97 (53.0 %)	73 (46.2 %)	0.210
Push up+	86 (47.0 %)	77 (48.7%)	0.748
Shoulder external rotation	88 (48.1 %)	88 (55.7 %)	0.161
Y-exercise	105 (57.4 %)	71 (44.9 %)	0.022*
Squat	89 (48.6 %)	73 (46.2 %)	0.654
The diver	85 (46.4 %)	89 (56.3 %)	0.069
Push up+ with backward toe walk	108 (59.0 %)	86 (54.4 %)	0.394

Notes: *, significant at P = 0.05

Table 5. Volleyball Injury Prevention Exercises Implementation Comparison among the GCC Countries

	Countries						
	Bahrain (n = 58)	Kuwait (n = 49)	Oman (n = 68)	Qatar (n = 58)	Saudi Arabia (n = 51)	UAE (n = 57)	p
Flexibility exercises							
Prone leg cross	23 (39.7 %)	26 (53.1 %)	28 (41.2 %)	28 (48.3 %)	22 (43.1 %)	33 (57.9 %)	0.310
Supine leg cross	33 (56.9 %)	24 (49.0 %)	35 (51.5 %)	24 (41.4 %)	30 (58.8 %)	33 (57.9 %)	0.406
Hip flexor stretch	29 (50.0 %)	27 (55.1 %)	31 (45.6 %)	28 (48.3 %)	29 (56.9 %)	29 (50.9 %)	0.847
Rotation	31 (53.4 %)	26 (53.1%)	32 (47.1 %)	28 (48.3 %)	25 (49.0 %)	25 (43.9 %)	0.913
Sleeper stretch	30 (51.7 %)	24 (49.0 %)	35 (51.5 %)	40 (69.0 %)	25 (49.0 %)	25 (43.9 %)	0.129
Control exercises							
Leg curl	28 (48.3 %)	28 (57.1 %)	37 (54.4 %)	27 (46.6 %)	21 (41.2 %)	32 (56.1 %)	0.514
Multi-directional jumps	28 (48.3 %)	31 (63.3 %)	44 (64.7 %)	29 (50.0 %)	25 (49.0 %)	32 (56.1 %)	0.275
Squat+	28 (48.3 %)	28 (57.1 %)	32 (47.1 %)	30 (51.7 %)	21 (41.2 %)	31 (54.4 %)	0.639
Forward lunge	32 (55.2 %)	32 (65.3 %)	32 (47.1 %)	29 (50.0 %)	34 (66.7 %)	24 (42.1 %)	0.056
Forward lunge+	28 (48.3 %)	24 (49.0 %)	37 (54.4 %)	32 (55.2 %)	22 (43.1 %)	28 (49.1 %)	0.819
Side lunges	32 (55.2 %)	22 (44.9 %)	32 (47.1 %)	35 (60.3 %)	26 (51.0 %)	32 (56.1 %)	0.565
Muscle strength exercises							
Side plank	22 (37.9 %)	28 (57.1 %)	38 (55.9 %)	32 (55.2 %)	23 (45.1 %)	27 (47.4 %)	0.253
Push up+	27 (46.6 %)	25 (51.0 %)	33 (48.5 %)	32 (55.2 %)	26 (51.0 %)	20 (35.1 %)	0.367
Shoulder external rotation	37 (63.8 %)	21 (42.9 %)	36 (52.9 %)	21 (36.2 %)	27 (52.9 %)	34 (59.6 %)	0.035*
Y-exercise	30 (51.7 %)	24 (49.0 %)	35 (51.5 %)	40 (69.0%)	25 (49.0%)	25 (43.9%)	0.586
Squat	27 (46.6 %)	26 (53.1 %)	29 (42.6 %)	26 (44.8 %)	26 (51.0 %)	28 (49.1 %)	0.883
The diver	29 (50.0 %)	27 (55.1 %)	37 (54.4 %)	28 (48.3 %)	23 (45.1 %)	30 (52.6 %)	0.900
Push up+ with backward toe walk	30 (51.7 %)	29 (59.2 %)	42 (61.8 %)	28 (48.3 %)	31 (60.8 %)	34 (59.6 %)	0.602

Note: *, significant at P = 0.05

Table 6. Comparison Volleyball Injury Prevention Exercises ImplementationTotal Score between the Age Groups

Total score	Age		P
	20 – 29 years, (n = 183)	30 – 39 years, (n = 158)	
M ± SD	9.37 ± 2.08	9.01 ± 2.22	0.118
Med	9	9	0.118
Range (Min. – Max.)	2 - 14	4 - 15	0.118

*** T-test for two independent groups, M, mean; SD, standard deviation; Med, median; Min, Minimum; Max, Maximum.**

Table 7. Comparison of the Volleyball Injury Prevention Exercises the Total Score Implementation among the GCC Countries

Country	N	M	SD	Med	Min	Max	P
Bahrain	58	9.10	1.734	9	5	13	0.641
Kuwait	49	9.67	2.202	10	5	13	0.641
Oman	68	9.24	2.546	9	2	15	0.641
Qatar	58	9.03	2.286	9	5	15	0.641
Saudi Arabia	51	8.98	1.975	9	5	13	0.641
United Arab Emirates	57	9.23	1.991	9	4	13	0.641
Total	341	9.20	2.148	9	2	15	0.641

***M, mean; SD, standard deviation; Med, median; Min, Minimum; Max, Maximum.**

Three hundred forty-one male volleyball players responded to the survey with a response rate of 90.5%. Most respondents were aged 20 to 29 years old (n = 183, 53.7%). Moreover, most professional players were from Oman (n = 68, 19.9%), Bahrain and Qatar (n = 58, 17% each), while the lowest participation rate was from Kuwait (n = 49, 14.4%) (Table 2).

Regarding the overall implementation rate, supine leg cross and sleepers stretch were the most common in the flexibility exercises category (n = 179, 52.5% each), while multi-directional jumps (n = 189, 55.4%) and forward lunge (n = 183, 53.7%) were the most implemented control exercises. For the muscle strength, the results showed a high implementation rate for the push-up+ with backward toe walk (n = 194, 56.9 %), shoulder external rotation and the Y exercises (n = 176, 51.6%) (Table 3).

There were no statistically significant differences between the implementation rate of exercises for both age groups (20-29 and 30-39 years) (p = 0.973). The only exception was observed for the Y-exercise, which was implemented by the 20-29 years old group (n = 107, 57.4 %) significantly more than the other group (n = 71, 44.9 %, p = 0.022). Moreover, push-up+ with backward toe walk was the highest implemented exercises in the 20-29 years old group (n = 108, 59.0 %), while the least implemented exercises was the shoulder external rotation (n = 88, 48.1 %). In contrast, multi-directional jumps and prone leg cross were the most (n = 90, 57.0%) and least common (n = 66, 41.8%) exercises for the 30-39 years old group (Table 4). The t-test results indicated that the overall implementation scores of both groups were not statistically different (p = 0.118) (Table 6).

Chi-square test results indicated no significant differences in the implementation rate of the exercises among the countries (p = 0.913) except for the shoulder external rotation, which was statistically significantly different (p = 0.035). It was mostly implemented by players from Bahrain (n = 37, 63.8 %) and the UAE (n = 34, 59.6 %), while it was least implemented in Qatar (n = 21, 36.2%). Athletes in Bahrain highly implemented the shoulder external rotation exercise (n = 37, 63.8%), while those in Kuwait and Saudi Arabia showed a high implementation rate of the forward lunge (n = 32, 65.3 % and n = 34, 66.7 %, respectively). Multi-directional jumps (n = 44, 64.7 %) and Y-exercise (n = 40, 69.0 %) were the highest implemented exercises in Oman and Qatar, respectively. Lastly, professional athletes in the UAE highly implemented the shoulder external rotation and push-up+ with backward toe walk exercises (n = 34, 59.6 %, each) (Table 5). Nonetheless, the volleyball injury prevention exercises' total score did not differ between the six countries (P = 0.641) (Table 7).

DISCUSSION

The primary aim of this study was to evaluate the implementation of the OSTRC volleyball injury prevention program among the GCC countries. Three hundred forty-one volleyball players were included in this cross-sectional study, representing the six Gulf countries (Saudi Arabia, UAE, Kuwait, Bahrain, Oman, and Qatar). Overall, this study found that the implementation rate of the eighteen exercises ranged from 46.9% to 56.9%, even though convincing evidence suggests that these exercises help prevent common injuries in sports. A 10-minute, five-step program was developed as a prevention measure for an adult tennis player (13). Similarly, a lower extremity injury prevention intervention was also developed for recreational field hockey players (14). In volleyball, a pre-season training program was observed to improve physical performance and reduce the risk of injury even if the body mass and composition did not change (15). Gouttebarge et al. (2017) developed an evidence-based warm-up program to reduce common injuries encountered by young and adult recreational volleyball players, which was found to be feasible (16).

Volleyball is a popular non-contact sport around the globe and is safer than contact sports (17). The volleyball players often suffer from an ankle sprain, knees, and shoulder injuries (3). A systematic review of the literature conducted in 2017 concluded that anterior knee injuries and ankle injuries were common among volley players. Authors of the same review recommended that effective preventive measures be applied to reduce such injuries (18). Hence, proper playing technique, players' education, adequate warm-up, and stretching can reduce the risk of injury (19). It has been reported that a movement control exercise program similar to the OSTRC injury prevention exercises reduced overall match injuries by 72% in youth rugby players (20). Moreover, the 11+ injury prevention program was reported to reduce the injury risk ratio in football players by 39% (21). Even though these studies were based on contact sports, which are different from volleyball, implementing injury prevention programs remains essential.

The performance of volleyball players depends on the development of physical fitness parameters such as strength, velocity, endurance, and coordination (21-24). Maintaining optimal performance in sports requires a balance between physical fitness parameters (25). Thus, an injury prevention program should consist of various exercises covering a range of physical abilities. The exercises included in the current study involved flexibility, control, and muscle strengthening exercises. Nevertheless, the data showed that the players did not implement all exercises. The push up+ with backward toe walk was the most common exercise.

In contrast, prone leg cross stretching was the least common. In the current study, it is found that there are huge discrepancies among volleyball players in terms of the practiced preventative exercises. Such differences might place the

players to be at greater risk of injuries. Few studies evaluated the implementation of exercises practiced among volleyball players (2, 26, 27). Consequently, more emphasis should be placed on increasing the awareness of the volleyball players about the importance of implementing the 18 recommended preventive exercises.

The current study results also indicated apparent variability in the exercises implemented by the volleyball players based on the country. Equivalent results were stated by a systematic review which found that there was a difference between the preferences for warm-up exercises; even with the same sporting activity, they found the differences between the applied exercises (28). The differences in such rates among the six GCC countries may be attributed to the lack of knowledge about these exercises and unstructured formal or semi-formal training programs. Compared to football, a more common sport in the region, volleyball receives less financial and media support. Moreover, volleyball is practiced mainly in elite and semi-elite sports clubs. Thus, the players may not be aware of the exercises in their disposable to prevent or reduce the likelihood of developing injuries. The authors believe that widespread physical inactivity is a challenge by itself. Chaabane et al. indicated that the hot weather and lack of well-equipped sports clubs, facilities, and support contribute to physical inactivity in the Middle East and North Africa (29). Moreover, no officially released data or research in this area of sport in the GCC countries makes comparisons of the study findings challenging.

About half of the volleyball players included in this study did not perform the recommended prevention exercises. This finding reinforces the importance of implementing these exercises to decrease the risk of sports-related injuries. In other words, coaches and athletic trainers may need to emphasize the significance of implementing these exercises for volleyball players and encourage them to do them regularly. It can be done through national awareness campaigns targeting the volleyball teams and official training programs for coaches and players.

Study Limitations. This study has limitations that need to be considered when interpreting the results. The number of injuries among volleyball players has not been reported; therefore, the effect of these exercises on preventing or reducing injuries was not evaluated. Moreover, the players were not asked about the reasons behind the low implementation rates of such exercises. Despite these limitations, it is the first study in the GCC region to investigate this topic. Future studies are needed to examine the reasons behind this lower level of implementation of the prevention exercises among volleyball players and evaluate whether implementing these exercises will reduce the number of sports-related injuries.

CONCLUSION

This study found that about 50% of volleyball players did not perform the 18 recommended preventive exercises. Implementing these exercises may contribute to reducing the injuries experienced by those players. However, the impact of such a prevention program on injury rates needs to be examined.

APPLICABLE REMARKS

- Up to 50% of the volleyball players performed the OSTRC injury prevention exercises. This finding may emphasize the importance of implementing these exercises to reduce the risk of sports-related injuries.

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CONFLICTS OF INTEREST

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SUPPLEMENTARY MATERIAL

Table I. Descriptive Statistics of the Items Included in the Factorial Analysis Based on the Type of Exercise

Item	Mean	SD	N
Questions related to flexibility exercises			
Q1 Clarity Score out of 5	4.950	0.1526	30
Q1 Comprehension Score out of 5	4.917	0.1895	30
Q1 Appropriateness Score out of 5	4.933	0.1729	30
Q2 Clarity Score out of 5	4.900	0.2034	30
Q2 Comprehension Score out of 5	4.933	0.1729	30
Q2 Appropriateness Score out of 5	4.917	0.1895	30
Q3 Clarity Score out of 5	4.850	0.2330	30
Q3 Comprehension Score out of 5	4.817	0.2451	30
Q3 Appropriateness Score out of 5	4.767	0.2537	30
Q5 Clarity Score out of 5	4.900	0.2034	30
Q5 Comprehension Score out of 5	4.933	0.1729	30
Q5 Appropriateness Score out of 5	4.917	0.1895	30
Q9 Clarity Score out of 5	4.850	0.2330	30
Q9 Comprehension Score out of 5	4.817	0.2451	30
Q9 Appropriateness Score out of 5	4.767	0.2537	30
Questions related to control exercises			
Q4 Clarity Score out of 5	4.933	0.1729	30
Q4 Comprehension Score out of 5	4.900	0.2034	30
Q4 Appropriateness Score out of 5	4.933	0.1729	30
Q12 Clarity Score out of 5	4.850	0.2330	30
Q12 Comprehension Score out of 5	4.817	0.2451	30
Q12 Appropriateness Score out of 5	4.767	0.2537	30
Q13 Clarity Score out of 5	4.933	0.1729	30
Q13 Comprehension Score out of 5	4.917	0.1895	30
Q13 Appropriateness Score out of 5	4.933	0.1729	30
Q15 Clarity Score out of 5	4.933	0.1729	30
Q15 Comprehension Score out of 5	4.917	0.1895	30
Q15 Appropriateness Score out of 5	4.933	0.1729	30
Q16 Clarity Score out of 5	4.650	0.2330	30
Q16 Comprehension Score out of 5	4.750	0.2543	30
Q16 Appropriateness Score out of 5	4.583	0.1895	30
Q17 Clarity Score out of 5	4.933	0.1729	30
Q17 Comprehension Score out of 5	4.867	0.2249	30
Q17 Appropriateness Score out of 5	4.933	0.1729	30
Questions related to muscle strength exercises			
Q6 Clarity Score out of 5	4.850	0.2330	30
Q6 Comprehension Score out of 5	4.800	0.2491	30
Q6 Appropriateness Score out of 5	4.767	0.2537	30
Q7 Clarity Score out of 5	4.933	0.1729	30
Q7 Comprehension Score out of 5	4.917	0.1895	30
Q7 Appropriateness Score out of 5	4.933	0.1729	30
Q8 Clarity Score out of 5	4.900	0.2034	30
Q8 Comprehension Score out of 5	4.933	0.1729	30
Q8 Appropriateness Score out of 5	4.917	0.1895	30
Q10 Clarity Score out of 5	4.933	0.1729	30
Q10 Comprehension Score out of 5	4.917	0.1895	30
Q10 Appropriateness Score out of 5	4.933	0.1729	30
Q11 Clarity Score out of 5	4.900	0.2034	30
Q11 Comprehension Score out of 5	4.933	0.1729	30
Q11 Appropriateness Score out of 5	4.917	0.1895	30
Q14 Clarity Score out of 5	4.933	0.1729	30
Q14 Comprehension Score out of 5	4.917	0.1895	30
Q14 Appropriateness Score out of 5	4.933	0.1729	30
Q18 Clarity Score out of 5	4.900	0.2034	30
Q18 Comprehension Score out of 5	4.933	0.1729	30

***SD, standard deviation**

Table II. Total Variance of the Components in the Factorial Analysis for the Flexibility Exercises Questions

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.677	37.843	37.843	5.677	37.843	37.843	3.183	21.218	21.218
2	2.612	17.411	55.255	2.612	17.411	55.255	2.453	16.351	37.569
3	1.702	11.347	66.602	1.702	11.347	66.602	2.434	16.226	53.795
4	1.519	10.123	76.726	1.519	10.123	76.726	2.351	15.673	69.467
5	1.041	6.943	83.668	1.041	6.943	83.668	2.130	14.201	83.668
6	0.846	5.638	89.307						
7	0.695	4.635	93.941						
8	0.638	4.254	98.196						
9	0.271	1.804	100.000						
10	< 0.001	< 0.001	100.000						
11	< 0.001	< 0.001	100.000						
12	< 0.001	< 0.001	100.000						
13	< 0.001	< 0.001	100.000						
14	< 0.001	< 0.001	100.000						
15	< 0.001	< 0.001	100.000						

Extraction Method: Principal Component Analysis

Table III. Total Variance of the Components in the Factorial Analysis for the Control Exercises Questions

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.192	45.512	45.512	8.192	45.512	45.512	4.316	23.977	23.977
2	3.009	16.716	62.228	3.009	16.716	62.228	4.048	22.489	46.467
3	1.997	11.095	73.323	1.997	11.095	73.323	3.656	20.309	66.776
4	1.535	8.526	81.850	1.535	8.526	81.850	2.053	11.407	78.183
5	1.234	6.858	88.707	1.234	6.858	88.707	1.894	10.525	88.707
6	0.864	4.799	93.507						
7	0.382	2.121	95.628						
8	0.293	1.630	97.258						
9	0.268	1.487	98.745						
10	0.159	0.885	99.630						
11	0.067	0.370	100.000						
12	< 0.001	< 0.001	100.000						
13	< 0.001	< 0.001	100.000						
14	< 0.001	< 0.001	100.000						
15	< 0.001	< 0.001	100.000						
16	< 0.001	< 0.001	100.000						
17	< 0.001	< 0.001	100.000						
18	< 0.001	< 0.001	100.000						

Extraction Method: Principal Component Analysis.

Table IV. Total Variance of the Components in the Factorial Analysis for the Muscle Strength Exercises Questions

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.629	45.850	45.850	9.629	45.850	45.850	4.672	22.248	22.248
2	3.044	14.496	60.346	3.044	14.496	60.346	3.488	16.608	38.856
3	2.262	10.769	71.115	2.262	10.769	71.115	3.205	15.262	54.118
4	1.858	8.850	79.965	1.858	8.850	79.965	3.190	15.192	69.310
5	1.548	7.374	87.339	1.548	7.374	87.339	2.820	13.431	82.741
6	1.022	4.866	92.205	1.022	4.866	92.205	1.987	9.464	92.205
7	0.800	3.808	96.013						
8	0.569	2.711	98.723						
9	0.268	1.277	100.000						
10	< 0.001	< 0.001	100.000						

11	< 0.001	< 0.001	100.000
12	< 0.001	< 0.001	100.000
13	< 0.001	< 0.001	100.000
14	< 0.001	< 0.001	100.000
15	< 0.001	< 0.001	100.000
16	< 0.001	< 0.001	100.000
17	< 0.001	< 0.001	100.000
18	< 0.001	< 0.001	100.000
19	< 0.001	< 0.001	100.000
20	< 0.001	< 0.001	100.000
21	< 0.001	< 0.001	100.000

Extraction Method: Principal Component Analysis.

Table V - Communalities of the items included in the factorial analysis

Item	Initial	Extraction
Questions related to flexibility exercises		
Q1 Clarity Score out of 5	1.000	0.621
Q1 Comprehension Score out of 5	1.000	0.497
Q1 Appropriateness Score out of 5	1.000	0.598
Q2 Clarity Score out of 5	1.000	0.899
Q2 Comprehension Score out of 5	1.000	0.963
Q2 Appropriateness Score out of 5	1.000	0.917
Q3 Clarity Score out of 5	1.000	0.772
Q3 Comprehension Score out of 5	1.000	0.960
Q3 Appropriateness Score out of 5	1.000	0.907
Q5 Clarity Score out of 5	1.000	0.899
Q5 Comprehension Score out of 5	1.000	0.963
Q5 Appropriateness Score out of 5	1.000	0.917
Q9 Clarity Score out of 5	1.000	0.772
Q9 Comprehension Score out of 5	1.000	0.960
Q9 Appropriateness Score out of 5	1.000	0.907
Questions related to control exercises		
Q4 Clarity Score out of 5	1.000	0.989
Q4 Comprehension Score out of 5	1.000	0.881
Q4 Appropriateness Score out of 5	1.000	0.992
Q12 Clarity Score out of 5	1.000	0.587
Q12 Comprehension Score out of 5	1.000	0.824
Q12 Appropriateness Score out of 5	1.000	0.740
Q13 Clarity Score out of 5	1.000	0.989
Q13 Comprehension Score out of 5	1.000	0.939
Q13 Appropriateness Score out of 5	1.000	0.992
Q15 Clarity Score out of 5	1.000	0.989
Q15 Comprehension Score out of 5	1.000	0.939
Q15 Appropriateness Score out of 5	1.000	0.992
Q16 Clarity Score out of 5	1.000	0.829
Q16 Comprehension Score out of 5	1.000	0.711
Q16 Appropriateness Score out of 5	1.000	0.861
Q17 Clarity Score out of 5	1.000	0.989
Q17 Comprehension Score out of 5	1.000	0.732
Q17 Appropriateness Score out of 5	1.000	0.992
Questions related to muscle strength exercises		
Q6 Clarity Score out of 5	1.000	0.667
Q6 Comprehension Score out of 5	1.000	0.532
Q6 Appropriateness Score out of 5	1.000	0.826
Q7 Clarity Score out of 5	1.000	0.941
Q7 Comprehension Score out of 5	1.000	0.988
Q7 Appropriateness Score out of 5	1.000	0.987
Q8 Clarity Score out of 5	1.000	0.932
Q8 Comprehension Score out of 5	1.000	0.996
Q8 Appropriateness Score out of 5	1.000	0.935
Q10 Clarity Score out of 5	1.000	0.941
Q10 Comprehension Score out of 5	1.000	0.988
Q10 Appropriateness Score out of 5	1.000	0.987
Q11 Clarity Score out of 5	1.000	0.932
Q11 Comprehension Score out of 5	1.000	0.996

Q11 Appropriateness Score out of 5	1.000	0.935
Q14 Clarity Score out of 5	1.000	0.941
Q14 Comprehension Score out of 5	1.000	0.988
Q14 Appropriateness Score out of 5	1.000	0.987
Q18 Clarity Score out of 5	1.000	0.932
Q18 Comprehension Score out of 5	1.000	0.996
Q18 Appropriateness Score out of 5	1.000	0.935

Extraction Method: Principal Component Analysis.