The Recent Application of the OSTRC Boxing Injury Prevention Program among Boxers in the Gulf Cooperation Council Countries

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Received October 11, 2021; Revised December 8, 2021; Accepted December 27, 2021

Cite This Paper in the following Citation Styles

(a): [1] Wesam Saleh A. Al Attar, Walaa Abutaleb, Nada Alhazmi, Hussain S. Ghulam, "The Recent Application of the OSTRC Boxing Injury Prevention Program among Boxers in the Gulf Cooperation Council Countries," *International Journal of Human Movement and Sports Sciences*, Vol. 10, No. 1, pp. 14 - 21, 2022. DOI: 10.13189/saj.2022.100103.

(b): Wesam Saleh A. Al Attar, Walaa Abutaleb, Nada Alhazmi, Hussain S. Ghulam (2022). The Recent Application of the OSTRC Boxing Injury Prevention Program among Boxers in the Gulf Cooperation Council Countries. *International Journal of Human Movement and Sports Sciences*, 10(1), 14 - 21. DOI: 10.13189/saj.2022.100103.

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Abstract Due to the high probability of injuries seen from boxing, together with the lack of assessment data examining the degree of risk to athletes, this study searched for solutions that may provide updated information to reduce or prevent the risk of injuries in this sport. This study aims to collect updated information about major injury risks among boxers and devise appropriate means to modify or prevent these risks by investigating the implementation of Oslo Sports Trauma Research Center (OSTRC) evidence-based injury prevention exercises among boxers. A survey was published containing a maximum of 23 multiple-choice questions from boxing associations in Gulf Cooperation Council (GCC) countries to 300 boxers in six GCC countries. A total of 261 boxers participated in the study, with core stability exercises being the most frequently implemented at a rate of 52.5%. There were no statistically significant differences between the GCC countries in terms of the average number of injury prevention exercises performed. Finally, all exercise programs were studied in terms of injury prevention, and shoulder stabilization exercises were the only ones where the implementation rates varied widely between the GCC countries. Effective injury prevention strategies must be implemented, an athlete injury form report must be submitted to facilitate this, and information must be collected about the mechanism of the injury.

Keywords Injury Prevention Program, Boxing, Compliance, Skadefri

1. Introduction

Boxing is one of the most popular combat sports worldwide. The International Boxing Association states that boxing first appeared in Egypt in approximately 3000 B.C. [32], and its first Olympic appearance was in 688 BC at the 23rd Ancient Olympic Games [19]. The "Amateur International Boxing Association" (AIBA) is the officially recognized world organization of boxing and has 196 affiliated national federations; the events best known for are the World Championship and the Olympic Games [8]. The organization's structure has subsequently changed and introduced steps to make boxing safer [29]. The amateur boxing competition match consists of three-minute rounds with a recovery period of one minute in between, and punches are permitted exclusively to the head and torso [1,41,42,44].

There has always been some controversies in studies pertaining to boxing injury sites, with studies typically focusing on blows to the head, as this is the most injured

body region, followed by the hands and fingers, with injuries visible as lacerations and bruises [20,37]. The potential risk of lacerating the vertebral artery, in addition to intracranial injuries, is also a suspected cause of death [5,11,14,26]. Moreover, many studies have discussed the long-term implications, such as intracranial injuries and neurodegenerative diseases [14,16,38,39,40,45,46]. Furthermore, superficial facial lacerations and injuries can be inflicted to the nose, eyes, teeth, and cervical spinal column, and a bilateral mandibular fracture can occur [3,6,12,25]. Injuries to the upper limbs (e.g., rupture of the subscapular tendon, hand, or scapular fracture) also occasionally take place [28,36].

Irrespective of the heated debates that surround this sport and the types of injuries sustained, injury prevention exercises in this field are rare. Loosemore et al. [23] reported that the removal of headguards may lower the risk of acute brain injury in AIBA competitions. Additionally, it is hypothesized that the trauma rate will fall as boxers gain more experience without headguards and educational programs start to become effective. Drury et al. [10] discussed “hand and wrist injuries in boxing and the martial arts” and found that preventing hand injuries in boxing revolves around four central pillars: hand and wrist wraps/taping, modifications of glove padding and design, proper striking techniques, and proper conditioning. Rules and restrictions concerning taping in amateur boxing may lower injury rates; the designs of boxing gloves have significantly improved over the past 20 years. Additionally, a poorly coached striking technique can increase the impact on the metacarpals of the ring and small fingers, which can lead to fractures. Traditional martial arts training using proper techniques and correct target selection may lower the risk of injuries to the hands; this is an important part of preventing injuries to the wrists and hands [10,43].

In 2013, the AIBA proposed rule changes in response to high injury rates. These regulation amendments included increasing the glove sizes, adjusting the scoring system, and banning the headgear. Therefore, amateur boxing and the type of boxing in the Olympics have largely moved toward safer conditions [9,17]. However, these rule changes were not inherently mirrored in professional boxing, with regular knockouts and high levels of injury frequently taking place [18]. Lemme et al. [22] reported that injuries to the upper extremities (UE) because of boxing were responsible for thousands of annual visits to the emergency department in the United States of America (USA). They also noticed significant declines in boxing-related UE injuries, which are potentially the result of the 2013 rule changes [22]. After 2011, the American Academy of Pediatrics investigated child and adolescent participation in boxing and stated that neither Canada nor the USA recorded injury rates among boxing participants [2].

To date, no data have been published in the literature regarding the effectiveness of implementing injury prevention exercises to prevent boxing injuries. In 2000,

the Oslo Sports Trauma Research Center (OSTRC) was founded with the aim of focusing on the prevention of sports injuries and associated health issues. Skadefri which is evidence-based injury prevention exercise was developed for anyone participating in sports and provides information on common sports injuries, injury risk factors, and prevention exercises for some injuries based on each sport type, and it has been already proofed its effectiveness among professional basketball, handball, soccer, and volleyball players. This program (Skadefri) has a number of injury prevention exercises which include core stability, explosive partner squats, shoulder stability, supine neck strength +, raising and lowering, prone neck strength, advanced wheelbarrow, rowing, neck strength against wall, diagonal arm pulls, neck stability, forearm strength 2, wheelbarrow +, supine neck strength, forearm strength 1, cockfight, and wiper. Therefore, the aim of this study is to investigate the implementation of “Skadefri” evidence-based injury prevention exercises among boxers from Gulf Cooperation Council (GCC) countries. This would provide evidence-based insights to coaches and players into whether Skadefri injury prevention exercises should be included and implemented in the training sessions for boxers to prevent overall injuries.

2. Materials and Methods

2.1. Study Design and Questionnaire

This study was a cross-sectional survey targeting GCCs’ players. To date, no validated survey has addressed the implementation of OSTRC injury prevention exercises among boxers. Therefore, a survey was developed specifically for this study by several authors’ expert experience in sport medicine and injury prevention programs. Pilot testing was conducted prior to the commencement of the study to assess the validity of each question. The survey was conducted on 30 GCC boxers, who were expected to represent the final testing cohort because of their diverse experiences. Each question was rated for clarity, comprehension, and appropriateness on a scale from 1.0 to 5.0 (lowest to highest). Questions that scored an average of fewer than 4.0 points on any parameter were considered weak in terms of clarity, comprehension, and appropriateness, and therefore were discarded. Nevertheless, any question that scored above 4.5 was considered suitable for the study.

Respondents were asked to answer all the survey questions before answering the next set of questions. Respondents answered a maximum of 23 questions categorized into three sections: (1) the study invitation and participation agreement, (2) socio-demographic questions, and (3) the implementation of OSTRC boxing injury prevention exercises. The questions were multiple-choice, and the scoring of each item was dichotomous (correct answer = 1; incorrect answer = 0).

The maximum score of the survey was 17, which was the sum of all items. This was then converted into a percentage score for ease of data analysis and data reporting. Similarly, the survey domain scores were transformed into percentages. When questions are correctly answered, higher scores reflect greater implementation and knowledge (potential correct answers ranging from 0 to 17). The respondents could see the total score, correct answers, and questions they missed immediately after submission. This project was reviewed and ethically approved by the Biomedical Ethics Committee at Umm Al Qura University, approval number. HAPO02K012202010465. Consent was obtained from each participant in the study before data collection began.

2.2. Survey Software and Administration

A survey invitation was distributed through the Saudi Arabia, UAE, Kuwait, Bahrain, Oman, and Qatar boxing federations. This provided a brief background of the survey and encouraged participation. Respondents who were interested clicked on a hyperlink that led them to the survey description. Once the participants had read the scope and aim of the study, they were asked to provide informed consent before being granted access to the survey. The survey was completed anonymously and electronically via a web-based form (Google Forms). Responses were limited to one response only and were provided voluntarily. The survey distribution was from June 2019 to October 2020.

2.3. Sample Size and Data Analysis

The target number of boxers was 300, with a 5% margin of error at a 95% confidence level. Following data extraction, the data were revised, coded, and entered the statistical software IBM SPSS version 22 (SPSS, Inc. Chicago, IL). All statistical analyses were performed using two-tailed tests. Statistical significance was set at a p-value of less than 0.05. Comparative analysis (cross-tabulation) was also performed based on the frequency and percentage distribution for the study regions regarding different types of boxing exercises. Because of the small frequencies, the significance of the relations in a cross-tabulation was tested using the exact probability test. The mean number of different exercises was calculated after summing all "yes" responses for the different exercises. One-way analysis of variance (ANOVA) was used to test for differences in mean scores for the performed exercises among the different countries

and divisions. An independent samples t-test was used to assess the differences in the mean scores of the performed exercises according to the boxers' ages and levels.

3. Results

The participants' sociodemographic characteristics are displayed in (Table 1). The total number of participants was 261 from the GCC countries. Of these, 31.4% were from Saudi Arabia, 69.3% were aged 20-29 years, and 62.1% were amateur boxers. Almost 25% of the respondents were in the heavyweight division, while the fewest respondents (14.9%) were in the welterweight division. The overall distribution of the injury prevention exercises among the study participants is shown in (Table 2). The results showed that core stability exercises were the most frequently implemented exercises (52.5%). This was followed by explosive partner squats (51.7%). Other exercises including shoulder stability, supine neck strength+, raising and lowering, and prone neck strength exercises were experienced by over half of the participating boxers. Conversely, the remaining assessed exercises were implemented by fewer than half of the participants, and the lowest implementation rate was for the wiper exercise at 43.3%. Generally, the mean ($\pm$ SD) of the overall number of injury prevention exercises implemented by the current study boxers was 8 ($\pm$ 2), ranging from 3-13, with a median of 8 exercises. No statistically significant difference ($P = 0.128$) was found between the GCCs in terms of the mean number of committed injury prevention exercises; the highest was in Oman with a mean of 8.7 ($\pm$ 2.0), and the lowest means reported were from Bahrain and Qatar at 7.9 ($\pm$ 2.0) and 7.9 ($\pm$ 2.1), respectively. Younger (20-29) boxers showed a higher mean number of implemented programs [8.4 ($\pm$ 2.1)] compared to those aged 30-39 years [8.2 ($\pm$ 2)], amateur boxers [8.4 ($\pm$ 2.1)], and professional boxers [8.2 ($\pm$ 2.0)]. Heavyweight boxers had the highest mean number of committed injury prevention programs at 8.5 ($\pm$ 2.3) compared to other weight divisions. However, these differences were all statistically non-significant, as all P values were >0.05 . The data are presented in (Table 3). The differences between the GCCs in terms of each addressed injury prevention exercise are shown in (Table 4). Among all injury prevention programs, only the shoulder stability prevention exercise implementation rate was significantly different between the GCCs. The highest implementation rate was in Oman (72.0%), while the lowest was in Bahrain (34.2%), with a P -value of 0.042.

Table 1. Personal data and nationality of the study group participants

Personal Data & Country	No	%
Saudi Arabia	82	31.4%
Kuwait	46	17.6%
Qatar	39	14.9%
Bahrain	38	14.6%
United Arab Emirates	31	11.9%
Oman	25	9.6%
Age		
20-29	181	69.3%
30-39	80	30.7%
Level		
Amateur	162	62.1%
Professional	99	37.9%
Divisions		
Heavyweight	64	24.5%
Light heavyweight	61	23.4%
Middleweight	51	19.5%
Lightweight	46	17.6%
Welterweight	39	14.9%
No: Numbers of the participants %: Percentage		

Table 2. Overall distribution of injury prevention exercises among study participants

Injury Prevention Exercises	No	%
Core stability	137	52.5%
Explosive partner squats	135	51.7%
Shoulder stability	133	51.0%
Supine neck strength +	133	51.0%
Raising and lowering	132	50.6%
Prone neck strength	131	50.2%
Advanced wheelbarrow	130	49.8%
Rowing	130	49.8%
Neck strength against wall	129	49.4%
Diagonal arm pulls	128	49.0%
Neck stability	128	49.0%
Forearm strength 2	127	48.7%
Wheelbarrow +	126	48.3%
Supine neck strength	125	47.9%
Forearm strength 1	122	46.7%
Cockfight	117	44.8%
Wiper	113	43.3%
Overall Number of Exercises		
Range	3-13	
Mean ± SD	8 ± 2	
Median	8	
SD: Standard deviation		

Factors	Total			P-value
	Range	Mean	SD	
Country				.128
Bahrain	4-12	7.9	2.0	
Kuwait	3-13	8.6	2.2	
Oman	5-13	8.7	2.0	
Qatar	4-12	7.9	2.1	
Saudi Arabia	3-13	8.4	2.1	
United Arab Emirates	4-13	8.5	2.0	
Age				.336
20-29	3-13	8.4	2.1	
30-39	4-13	8.2	2.0	
Level				.336
Amateur	3-13	8.4	2.1	
Professional	3-13	8.2	2.0	
Divisions				.285
Heavyweight	3-13	8.5	2.3	
Light heavyweight	3-12	8.1	2.0	
Lightweight	4-13	8.6	2.2	
Middleweight	4-13	8.3	1.9	
Welterweight	5-13	8.2	2.0	

P: One Way ANOVA test #: Independent t-test SD: Standard deviation

Activity	Country												P-value
	Bahrain		Kuwait		Oman		Qatar		Saudi Arabia		United Arab Emirates		
	No	%	No	%	No	%	No	%	No	%	No	%	
Prone neck strength	15	39.5%	26	56.5%	12	48.0%	22	56.4%	41	50.0%	15	48.4%	.673
Supine neck strength	19	50.0%	25	54.3%	11	44.0%	15	38.5%	41	50.0%	14	45.2%	.759
Shoulder stability	13	34.2%	23	50.0%	18	72.0%	22	56.4%	45	54.9%	12	38.7%	.042*
Forearm strength 2	19	50.0%	27	58.7%	12	48.0%	19	48.7%	36	43.9%	14	45.2%	.734
Forearm strength 1	22	57.9%	22	47.8%	9	36.0%	16	41.0%	36	43.9%	17	54.8%	.457
Diagonal arms pull	13	34.2%	21	45.7%	16	64.0%	16	41.0%	47	57.3%	15	48.4%	.107
Core stability	16	42.1%	29	63.0%	15	60.0%	21	53.8%	39	47.6%	17	54.8%	.397
Neck strength against wall	13	34.2%	25	54.3%	12	48.0%	21	53.8%	44	53.7%	14	45.2%	.403
Advanced wheelbarrow	15	39.5%	25	54.3%	12	48.0%	20	51.3%	41	50.0%	17	54.8%	.794
Wiper	18	47.4%	18	39.1%	14	56.0%	13	33.3%	40	48.8%	10	32.3%	.274
Supine neck strength +	25	65.8%	25	54.3%	12	48.0%	14	35.9%	40	48.8%	17	54.8%	.184
Neck stability	17	44.7%	19	41.3%	14	56.0%	20	51.3%	42	51.2%	16	51.6%	.823
Raising and lowering	22	57.9%	22	47.8%	13	52.0%	16	41.0%	41	50.0%	18	58.1%	.684
Cockfight	17	44.7%	22	47.8%	13	52.0%	19	48.7%	30	36.6%	16	51.6%	.585
Wheelbarrow +	17	44.7%	25	54.3%	11	44.0%	21	53.8%	36	43.9%	16	51.6%	.806
Rowing	21	55.3%	18	39.1%	11	44.0%	17	43.6%	44	53.7%	19	61.3%	.346
Explosive partner squats	17	44.7%	25	54.3%	13	52.0%	16	41.0%	46	56.1%	18	58.1%	.581

P: Pearson X2 test * P < 0.05 (significant); No: Numbers of the participants; %: Percentage

4. Discussion

Many injury prevention programs were used before with deferent athletes and different sporting activities and they were found to be effective in preventing several injuries related to upper and lower extremities. These programs include the implementation of Nordic hamstring exercises to prevent hamstring injuries, the OSTRC cycling injury prevention program, the OSTRC back injury prevention program, the FIFA 11+ injury prevention program, the FIFA 11+ Referees injury prevention program, and the Copenhagen adduction exercise.

This study assessed the rate of implementation of OSTRC boxing injury prevention exercises among boxers in several GCCs. Overall, the results indicate that the implementation rate was poor and did not differ by age or country. To the best of our knowledge, this is the first study to assess OSTRC boxing injury prevention exercises among boxers in GCCs, even globally, making it difficult to compare our results.

Results from large-scale randomized controlled trials showed that exercise-based prevention programs can significantly lower injuries among football players [4] and this could also be applicable to other sports, including boxing. Moreover, evidence and scientific-based injury prevention programs with regular performance could prove to have a protective effect on injury complaints in both the short and long terms [31]. In contrast with this study, which showed a low implementation rate, McCall et al. [24] reported high compliance with injury prevention measures. These differences between the findings could be attributed to a lack of knowledge about OSTRC boxing injury prevention exercises, barriers to implementation, unavailability, or inadequate time and equipment.

Core stability exercise as a part of the knee control exercise program reduced the rate of anterior cruciate ligament injuries by 64% in a trial involving over 4500 adolescent female players [35]. Of the boxers who participated in the current study, this exercise was the most implemented injury prevention exercise. Core training is a fundamental part of the boxing science training program due to the large correlation between trunk muscle mass and estimated punch force [7].

Shoulder stability exercise was the third most implemented injury prevention exercise and it was the only exercise shows significant differences among the GCCs in terms of implementation this exercise. These differences could be due to the fact that there are variations in the awareness level between the players and coaches in the GCCs. Therefore, action should be taken to determine these variations from the relative federations and increase their awareness and knowledge about the importance of this exercise by conducting seminars, workshops, and distributing booklets before practicing this sport.

In a previous study on elite athletes, risk factors, and injury prevention, the injury prevention strategy cited by interviewees most often involved muscle-strengthening exercises. Most participants reported that they included this strategy as part of their training or clinical treatment [30]. A previous systematic review found that the number of injury prevention programs that were based on training changes was larger in comparison to the total of programs that included changes in equipment or rules and educational strategies [13]. Among the programs that were based on preventative changes regarding training, most were focused on coordination, followed by interventions that were aimed at improving muscle power and strength [30].

Previous studies have highlighted that educating athletes on rehabilitation or training options could be one of the main factors in preventing sports injuries [33,34]. The lack of information on these injuries may hinder the efficacy of, and adherence to, injury prevention programs [15,21]. Moreover, the provision of performance-enhancing benefits in addition to injury prevention could help to change the attitudes of both athletes and coaches toward implementing injury prevention programs into a daily routine.

The number of injuries affecting boxers' performance and their absenteeism often increased, in addition to the high cost of their treatment. A recently published systematic review reported that sports-specific injury prevention programs strongly influence most performance indices and result in large-scale improvements to balance (66%), power (83%), strength (75%), and speed/agility (62%) [27]. These findings reinforce the importance of implementing an injury prevention exercise program among boxers, which could reduce injuries and their consequences.

Based on the results of the current study, the OSTRC boxing injury prevention program should reach multiple target players, program deliverers, and policymakers. This can be achieved by embedding the program in the education provided by coaches and into social media, apps, and websites. The compliance of boxers with the implementation of injury prevention programs could be increased by providing adequate supporting materials (apps, online resources, manuals), together with feedback, training, and mentoring.

Limitations of the current study include the small sample size, which is restricted to boxers from GCCs. Consequently, the results cannot be generalized globally. We did not assess the causes of non-implementation. Therefore, further large-scale studies are required to investigate this hypothesis.

5. Conclusions

This study found that the implementation of OSTRC boxing injury prevention exercises was poor; however, core stability exercises were most frequently implemented.

This indicates that players and coaches should be aware of the importance of such programs; increasing their awareness and knowledge about this program is necessary and this can be performed through seminars, workshops, and booklets distributed before practicing this sport. Therefore, increasing the athletes' awareness would increase the practice level which might potentially reduce the risk of sustaining injuries. Core training is a fundamental part of boxing science training programs. Correspondingly, this does not diminish the importance of the other exercises. Nevertheless, effective injury prevention strategies must be implemented, and according to our need to collect more information about injury mechanisms, regular reports of player injuries will facilitate this. Moreover, further studies can be done to investigate the knowledge of athletes about the importance and effectiveness of such program and to investigate the reasons causing this low practice.

Acknowledgements

The authors would like to thank the Deanship of Scientific Research at Umm Al-Qura University for supporting this work by Grant Code: (22UQU4331100DSR01). The authors would like to thank all Boxers who participated in this project.

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