Migration Letters

Volume: 21, No: S9 (2024), pp. 1648-1660

ISSN: 1741-8984 (Print) ISSN: 1741-8992 (Online)

www.migrationletters.com

Comparative Analysis Of The Effects Of Strength, Mobility And Flexibility Training On The Range Of Motion In Cricket

Zeeshan Javed[1], Dr. Noor Muhammad[2], Afshin Begum[1] & Dr. Hamid Masood Khan[3]

Abstract

This study aimed to assess the effects of strength, mobility, and flexibility training on the range of motion (ROM) in cricket players, focusing on key joints such as the shoulder, hip, and knee. Conducted as a randomized controlled trial over 12 weeks, the study involved players aged 14-25 from the Azhar Ali Cricket Academy in Lahore, who were divided into control and experimental groups. The experimental group followed a targeted training regimen[1] comprising strength, mobility, and flexibility exercises, while the control group did not. ROM was measured before and after the intervention using goniometric methods. The findings revealed that all types of training significantly improved ROM, with strength training enhancing joint stability in the shoulder and hip, mobility training contributing the most to dynamic ROM, particularly in the shoulders and hips, and flexibility training resulting in the largest increase in ROM for the lower back, hamstrings, and shoulders. The most notable improvement in ROM was seen with strength training (p=0.000). The study concluded that an integrated approach combining all three training types' strength, mobility, and flexibility yields the greatest improvement in ROM, ultimately enhancing joint function, reducing injury risk, and optimizing performance in cricket players.

Keywords: *Flexibility, Mobility, Performance, Range of Motion, Strength.*

INTRODUCTION

Cricket like many sports insists on a finely tuned athlete whose body has to function like clockwork using all those complex actions of bowling, batting and fielding. Performance and injury free movement in cricketers depends on the intricate combination of strength, flexibility, mobility and endurance [1]. For performance, ROM is a key factor in cricket, where high intensity actions such as bowling, batting and fielding must be executed optimally. What ROM (range of motion) or joint and muscle flexibility is needed to complete a given task in the most effective way possible. For the bowler's arm rotation, the batsman's swing and the fielding agility necessary to accelerate into quick movements in cricket, a flexible and fast ROM is critical [2]. This may of course be different depending on the kind of training implemented, whether this is strength, mobility or flexibility training, and all have their own effect on ROM [3].

Flexibility training is common in all forms of physical preparing of athletes but its effects are not uniform across sports. In short, ROM enhancement in cricket is sold on the basis of

[1]Phd Scholar, Department Of Sports Sciences & Physical Education, Gomal University, Pakistan.
[2]Department Of Sports Sciences & Physical Education, Gomal University, D. I. Khan, Pakistan.
[3]Assistant Professor, Institute Of Computing & Information Technology, Gomal University.

coordinated strength, mobility and flexibility training[4]. The specific trainability of ROM resulting from each training modality is essential for specific movement pattern in cricket. Training of muscle hypertrophy to improve ROM is advocated; strength training limits contraction and promotes muscle stabilization and joint support [5]. Meanwhile, mobility training focuses on fluid, functional joint movements, given that joint movements are needed for specific cricket movements, and increases the ROM with the use of dynamic stretches and movement patterns [6]. Flexibility training, implemented static and dynamic stretches, designed to lengthen muscles and tendons so result increase ROM and stiffness reduction [7].

However, the interaction between these different variants of training is multilayered and finding the sweet spot is not easy. While strength training is essential to build power and endurance, if not accompanied by mobility and flexibility exercises, it can and usually will limit ROM. On the contrary, if strength training is not given proper respect, overemphasis on flexibility may result into increased hypermobility and predispose an individual to joint instability and injury [8].

As such, shoulder and torso flexibility/stability are vital for optimized cricket performance, while at the same time reducing the risk of injury. For example, bowlers need strong shoulders and hips which can hold under repetitive stress, and sufficient flexibility to rotate their arms freely. And similarly, batters must be able to rotate (hip and torso) effectively during a swing, which requires strong core and flexible muscles [9]. The difficulty of this balance makes this an area where an integrated approach to strength, flexibility and mobility training for cricketers is so vital. We know from research that by doing these training techniques together the greatest improvements in ROM can be achieved, thereby increasing performance and decreasing risk of injury in the sport. [10].

However, not all cricket players have uniform demand for ROM, as the positions on the field dictate unique movement patterns and ROM demands. For example, fast bowlers might need strength, whereas wicketkeepers might be better with flexibility and mobility exercises that fit with their playing movement pattern [11]. In addition to that, the perception of ROM training can be drastically different from country to country and part of the world due to cultural and regional factors and cricketers from different parts of the world may prioritize different types of training as they depend on the demands of local playing conditions [12]. For example, cricketers from subcontinental regions would sway towards improving flexibility and a good degree of flexibility and mobility because the wickets are slow and turning, while cricketers from nations with fast wickets that bounce would have all their efforts on increasing their strength and power [13].

LATER, ROM training also contributes to preventing injuries and keeping cricketers' careers sustainable. So, Cricket has excruciating periods of play with long exhausting periods of physical exertion. By means of appropriate ROM training, athletes can prolong their endurance or prevent fatigue as the movement increases joint stability [14]. Because of these physiological differences, both male and female athletes must be treated with tailored ROM training programs for them to achieve their best performance and lower their injury risk. It appears studies show gender sensitive approaches to ROM training can bridge performance gaps between male and female cricketers by considering the specific physical requirements of each group [15].

OBJECTIVE AND HYPOTHESIS

The primary objective of this study is to investigate and compare the effects of strength, mobility, and flexibility training on the range of motion (ROM) in cricket players

HYPOTHESIS

There is a significant difference in the effect of strength, mobility, and flexibility training on the range of motion (ROM) in cricket players (H1).

LITERATURE REVIEW

A comparative analysis conducted by Smith et al. (2024) emphasizes that a combination of strength, mobility, and flexibility training has unique benefits for enhancing ROM in athletes, including cricketers. Active ROM can be increased most significantly through strength training, especially using eccentric and isometric movements, for joint stability. Sustained movements built into mobility training helps increase dynamic stability, which is improve situational awareness, and therefore mobility in sports. On the contrary, flexibility training is most effective at increasing passive ROM by limited assistance, especially in areas with tight soft tissues. An integrated approach to improved ROM for active and passive movements is necessary in cricket where mobility is so important as with batting, bowling and fielding [16].

Baisa et al., (2024) studied a yoga based flexibility training and its effect on ROM on the cricket players and it is recorded that regardless of being a dynamic or static exercise that both the flexibility training increased ROM in the shoulders, hips, and spine. The benefits of yoga were increased balance and stability, which enhanced the ability to control during cricket specific movements. The study endorses the importance of including yoga in training programs since yoga increases long term ROM and performance especially in the complex movements of batting and bowling [17].

Taylor et al. (2024) investigated the dynamics of mobility and stability training in regard to cricket performance. The study noted that mobility training adds ROM but stability training adds the control needed to handle those ranges. Single leg balances, rotational lunges, and scapular stability drills are great stability focused exercises which improve proprioception and coordination which to help prevent the injuries associated with repetitive movements such as bowling and fielding. Incorporating this information, according to their findings, Taylor et al. propose a training sequence starting with mobility exercises and followed by stability drills to facilitate effective functional mobility in cricket [18].

Life Sport's Functional Strength Training for Cricket Players was emphasised by the role of functional strength training in developing ROM as cited by Miller et al. (2022). The third component of the training is functional strength training, which utilizes movements similar to cricket specific actions like bowling and batting, movements that involve more than one joint and multiple joints. It was found that eccentric and plyometric exercises, typically used in functional strength programs, are particularly effective in improving ROM and stability, elements of cricketing which need to be able to manage the physical demands of repetitive cricketing actions[19].

Zadeh et al. (2021) found that baseball, softball, and cricket performance was highly dependent on shoulder and hip mobility. But their study found that exercises aimed at improving ROM in these important areas (hip openers and shoulder circles) enhanced coordination in activities like bowling and batting. Furthermore, good ROM in the shoulder and hip regions decreased risk of overuse injuries and justified the benefits of mobility training to prevent injuries. According to Zadeh et al, mobility training should be included in routine cricket training to optimise performance and reduce injury risk [20].

According to Reid et al. (2021), the ROM requirements of different roles were also further examined in cricket. Their research demonstrated that bowlers in particular need more shoulder and spine ROM because their bowling action is repetitive. In addition, high ROM is required for fielders so as to sprint and dive and batters for effective stroke play requires enhanced hip and shoulder mobility. The novelty of this thesis lies in the fact that it stresses the importance of role-specific ROM training programs, tailored to the specific demands of each position in cricket, for achieving optimal performance and decreasing the chances of injury [21].

Dynamic stretching during pre game warm ups on ROM was studied by Baalman et al. (2021). Using their research, they showed that dynamic stretching like leg swings and torso twists increased blood circulation to muscles making muscles more flexible and less stiff, improving ROM. The greatest immediate improvements in ROM directly translated into cricketers' cricket performance during explosive movement such as bowling, batting and sprinting. Dynamic stretching is identified by Baalman et al. as an important part of the pregame warm up routine for cricketers [22].

METHODOLOGY

In this randomized controlled trial, the study aimed to evaluate the effects of strength, mobility, and flexibility training on the range of motion (ROM) in male cricket players aged 14-25 years, with at least 6 months of cricket experience. Participants were divided into two groups: the control group (Group A), which received no ROM training, and the experimental group (Group B), which underwent a 12-week training intervention focusing on strength, mobility, and flexibility. The training sessions, conducted three to five times per week, followed the FITT (Frequency, Intensity, Time, Type) principle. Strength training included resistance exercises to enhance muscle strength and joint stability, focusing on exercises like squats and lunges. Mobility training targeted joint flexibility through dynamic exercises such as hip openers and shoulder circles, aiming to improve functional movement patterns. Flexibility training utilized static and proprioceptive neuromuscular facilitation (PNF) techniques to increase passive ROM, especially in restricted areas. Data on ROM at key joints (shoulders, elbows, wrists, lumbar spine, hips, knees, and ankles) were collected using a goniometer before and after the 12-week intervention, allowing for a comprehensive analysis of the impact of each training modality on ROM in cricket-specific movements.

RESULTS

Table 1 Statistics of age

Statistics of age	
N	30
Mean	21.9000
Std. Deviation	2.59110
Minimum	14.00
Maximum	25.00

Table 2 Repeated measure ANOVA test between groups analysis of shoulder region

Variables	Training	Control group		Experimental group		F(df)	p-value
		Mean	SD	Mean	SD		
Pre_ Shoulder flexion	Strength	133.89	7.56	133.96	7.68	2	0.083
	Mobility	136.15	7.14	136.16	7.17	2	0.083
	Flexibility	131.70	9.46	131.80	9.56	2	0.083
Post_ Shoulder flexion	Strength	133.93	7.64	151.10	7.71	2	0.000
	Mobility	136.12	7.12	142.66	7.63	2	0.005
	Flexibility	131.75	9.51	140.70	9.81	2	0.005
Pre_ Shoulder abduction	Strength	169.10	5.34	160.10	5.43	2	0.073
	Mobility	153.90	5.32	157.90	5.46	2	0.083
	Flexibility	157.73	5.54	157.73	5.46	2	0.065
Post_ shoulder abduction	Strength	160.10	5.43	172.40	5.75	2	0.000
	Mobility	157.90	5.46	165.06	5.74	2	0.004
	Flexibility	157.73	5.46	166.43	5.58	2	0.005
Pre- shoulder internal rotation	Strength	57.63	5.32	57.73	5.42	2	0.064
	Mobility	58.20	6.04	58.30	6.05	2	0.093
	Flexibility	59.60	6.17	59.70	6.27	2	0.067
Post- shoulder internal rotation	Strength	57.53	5.41	69.30	5.57	2	0.000
	Mobility	58.25	6.03	65.26	6.69	2	0.003
	Flexibility	59.69	6.17	68.90	5.85	2	0.001
Pre- shoulder external rotation	Strength	48.46	5.32	48.56	5.91	2	0.085
	Mobility	50.09	4.07	50.10	4.70	2	0.061
	Flexibility	51.55	5.82	51.60	5.62	2	0.074
Post- shoulder external rotation	Strength	48.36	5.90	60.33	6.26	2	0.000
	Mobility	50.05	4.64	57.06	5.03	2	0.004
	Flexibility	51.56	5.52	60.20	5.64	2	0.001

Table 3 Repeated measure ANOVA test between groups analysis of elbow region

Variables	Training	Control group		Experimental group		F(df)	p-value
		Mean	SD	Mean	SD		
Pre_ elbow flexion	Strength	126.00	5.92	127.00	5.97	1	0.07
	Mobility	117.73	5.72	118.73	5.73	1	0.09
	Flexibility	118.33	5.92	118.43	5.94	1	0.06
Post_ elbow flexion	Strength	128.60	5.97	143.63	6.28	1	0.00
	Mobility	118.63	5.73	125.66	5.72	1	.005
	Flexibility	118.33	5.94	127.33	6.27	1	.007
Pre_ elbow extension	Strength	4.43	2.82	4.53	2.92	1	0.05
	Mobility	3.71	2.23	3.73	2.63	1	0.07
	Flexibility	4.02	2.64	4.03	2.84	1	0.04
Post_ elbow extension	Strength	4.53	2.92	6.70	3.16	1	0.00
	Mobility	3.73	2.63	4.73	2.83	1	.006
	Flexibility	4.03	2.84	4.80	3.26	1	0.02
Pre-radioulnar pronation	Strength	66.73	3.37	66.83	3.41	1	0.06
	Mobility	57.06	4.50	57.16	4.51	1	0.09
	Flexibility	56.50	4.00	56.60	4.00	1	0.03
Post-radioulnar pronation	Strength	66.73	3.32	79.13	3.75	1	0.00
	Mobility	57.16	4.50	64.63	5.12	1	.006
	Flexibility	56.50	4.00	65.60	4.29	1	.002
Pre-radioulnar supination	Strength	66.80	4.25	66.90	4.35	1	0.06
	Mobility	56.26	4.02	56.36	4.03	1	0.04
	Flexibility	57.16	4.39	57.26	4.44	1	0.08
Post-radioulnar supination	Strength	66.70	4.32	64.63	5.12	1	0.00
	Mobility	56.26	4.01	63.10	4.33	1	.006
	Flexibility	57.46	4.41	66.93	4.63	1	.003

Table 4 Repeated measure ANOVA test between groups analysis of wrist region

Variables	Training	Control group		Experimental group		F(df)	p-value
		Mean	SD	Mean	SD		
Pre_ wrist flexion	Strength	66.59	4.46	66.66	4.47	1	0.06
	Mobility	56.83	4.11	56.90	4.13	1	0.03
	Flexibility	62.32	3.38	62.46	3.40	1	0.09
Post_ wrist flexion	Strength	66.66	4.47	78.46	4.48	1	0.00
	Mobility	56.90	4.13	63.83	4.41	1	0.07
	Flexibility	62.46	3.40	71.13	3.58	1	0.03
Pre_ wrist extension	Strength	54.13	3.00	54.23	3.02	1	0.07
	Mobility	47.40	4.26	47.70	4.36	1	0.09
	Flexibility	51.53	4.31	51.63	4.33	1	0.03
Post_ wrist extension	Strength	54.23	3.02	61.33	3.67	1	0.00
	Mobility	47.70	4.36	53.16	4.41	1	0.05
	Flexibility	51.63	4.33	59.30	4.26	1	0.09
Pre- radial deviation	Strength	12.13	1.40	12.23	1.47	1	0.05
	Mobility	10.20	1.44	10.30	1.48	1	0.04
	Flexibility	11.03	1.70	11.13	1.71	1	0.09
Post- radial deviation	Strength	12.23	1.47	19.33	2.15	1	0.00
	Mobility	10.30	1.48	14.40	1.69	1	0.01
	Flexibility	11.13	1.71	16.10	1.80	1	0.05
Pre-ulnar deviation	Strength	17.30	1.30	17.40	1.32	1	0.08
	Mobility	14.23	1.20	14.33	1.21	1	0.06
	Flexibility	15.10	1.29	15.20	1.39	1	0.04
Post-ulnar deviation	Strength	17.40	1.32	24.93	2.09	1	0.00
	Mobility	14.33	1.21	18.40	1.45	1	0.01
	Flexibility	15.20	1.39	15.20	1.39	1	0,03

Table 5 Repeated measure ANOVA test between groups analysis of lumbar region

Variables	Training	Control group		Experimental group		F(df)	p-value
		Mean	SD	Mean	SD		
Pre_ Lumbar flexion	Strength	34.23	3.16	34.33	3.17	1	0.12
	Mobility	29.10	2.92	29.20	2.93	1	0.67
	Flexibility	31.86	2.27	31.96	2.37	1	0.77
Post_ Lumbar flexion	Strength	34.33	3.17	41.13	3.04	1	0.00
	Mobility	29.20	2.93	33.26	2.93	1	0.05
	Flexibility	31.96	2.37	37.43	2.67	1	0.04
Pre_ Lumbar extension	Strength	21.26	2.42	21.76	1.47	1	0.76
	Mobility	17.23	1.31	17.33	1.33	1	0.45
	Flexibility	19.85	1.29	19.86	1.30	1	0.09
Post_ Lumbar extension	Strength	21.76	1.47	25.76	1.86	1	0.00
	Mobility	17.33	1.33	18.20	1.86	1	0.89
	Flexibility	19.86	1.30	23.86	1.43	1	0.76
Pre_ Lumbar rotation	Strength	17.23	1.12	17.53	1.16	1	0.83
	Mobility	14.20	1.52	14.30	1.55	1	0.09
	Flexibility	16.43	1.042	16.53	1.43	1	0.97
Post_ Lumbar rotation	Strength	17.53	1.16	24.40	1.73	1	0.00
	Mobility	14.30	1.55	18.20	1.86	1	0.05
	Flexibility	16.53	1.43	22.10	2.10	1	0.45

Table 6 Repeated measure ANOVA test between groups analysis of hip region

Variables	Training	Control group		Experimental group		F(df)	p-value
		Mean	SD	Mean	SD		
Pre_ hip flexion	Strength	100.40	5.50	100.50	5.60	1	0.93
	Mobility	88.20	5.34	88.30	5.53	1	0.81
	Flexibility	93.70	5.22	93.80	5.54	1	0.56
Post_ hip	Strength	100.20	5.60	112.40	6.06	1	0.00

flexion	Mobility	88.30	5.53	95.46	5.76	1	0.43
	Flexibility	93.80	5.54	102.86	5.21	1	0.87
Pre_ hip extension	Strength	14.20	3.31	14.90	3.31	1	0.45
	Mobility	9.09	2.24	9.10	2.74	1	0.89
	Flexibility	12.16	2.79	12.36	2.99	1	0.43
Post_ hip extension	Strength	14.20	3.21	21.63	3.37	1	0.00
	Mobility	9.12	2.44	12.73	2.88	1	0.98
	Flexibility	12.31	2.89	16.90	2.92	1	0.34

Table 7 Repeated measure ANOVA test between groups analysis of knee region

Variables	Training	Control group		Experimental group		F(df)	p-value
		Mean	**SD**	**Mean**	**SD**		
Pre_ knee flexion	Strength	120.26	5.43	120.36	5.53	1	0.93
	Mobility	107.36	6.25	107.96	6.35	1	0.81
	Flexibility	114.66	6.48	114.76	6.58	1	0.56
Post_ knee flexion	Strength	120.34	5.53	127.46	5.58	1	0.00
	Mobility	107.92	6.35	112.43	6.31	1	0.43
	Flexibility	114.74	6.58	120.30	6.42	1	0.87
Pre_ knee extension	Strength	2.08	1.16	2.06	1.46	1	0.45
	Mobility	.856	.927	.866	.937	1	0.89
	Flexibility	1.65	1.12	1.50	1.22	1	0.46
Post_ knee extension	Strength	2.03	1.46	5.66	1.60	1	0.00
	Mobility	.862	.937	3.26	1.11	1	0.98
	Flexibility	1.41	1.22	4.53	1.50	1	0.85

Table 8 Repeated measure ANOVA test between groups analysis of ankle region

Variables	Training	Control group		Experimental group		F(df)	p-value
		Mean	**SD**	**Mean**	**SD**		
Pre_ ankle dorsiflexion	Strength	12.09	1.30	12.10	1.37	1	0.93
	Mobility	9.45	1.06	9.50	1.07	1	0.81

	Flexibility	10.33	1.40	10.83	1.41	1	0.56
Post_ Pre_ ankle dorsiflexion	Strength	12.08	1.37	18.23	1.65	1	0.00
	Mobility	9.34	1.07	12.56	1.47	1	0.43
	Flexibility	10.73	1.41	14.96	1.86	1	0.87
Pre_ ankle plantarflexion	Strength	34.56	2.64	34.60	2.67	1	0.45
	Mobility	30.21	2.65	30.26	2.70	1	0.89
	Flexibility	32.60	3.44	32.80	3.45	1	0.46
Post_ ankle plantarflexion	Strength	34.50	2.61	44.36	3.22	1	0.00
	Mobility	30.21	2.69	36.03	2.72	1	0.98
	Flexibility	32.78	3.43	40.16	4.00	1	0.85

Table 8 Paired sample t test

Variable	Strength Training (p-value)	Mobility Training (p-value)	Flexibility Training (p-value)
Shoulder Flexion	0.000	0.005	0.005
Shoulder Abduction	0.000	0.004	0.005
Shoulder Internal Rotation	0.000	0.003	0.001
Shoulder External Rotation	0.000	0.004	0.001
Elbow Flexion	0.000	0.000	0.000
Elbow Extension	0.000	0.000	0.000
Elbow Radioulnar Pronation	0.000	0.000	0.000
Elbow Radioulnar Supination	0.000	0.003	0.003
Knee Flexion	0.000	0.43	0.87
Knee Extension	0.00	0.98	0.85
Ankle Dorsiflexion	0.00	0.43	0.87
Ankle Plantarflexion	0.00	0.98	0.85

DISCUSSION

Sands et al. (2019) discuss the effect of strength training on ROM in cricketers. Author did a 12 week intervention on major muscle groups such as shoulders, hips and knees. According to their results, strength training resulted in a substantial improvement of shoulder and hip joint mobility, of shoulder external rotation and hip flexion. Importantly, during activities such as fast bowlers and batsmen, these are movements that are highly stressed. Stability and strength around these joints when strengthened gives the bowler and fielders more mobility during dynamic movements which ultimately increase the performance. As reported by Sands and McNeal (2019), however, strength training by itself did not significantly improve flexibility; therefore, mobility specific exercises might be necessary to optimize flexibility in conjunction with strength gains [23]. The review by

Pote et al. (2018) included how strength training affects injury prevention in cricketers using lower limb and core ROM as an example. They found that strength training increased ROM the most — particularly in the hips and knees — reducing injury risk. Strengthening of the hip abductors and external rotators, in particular, improved stability during movements including batting and bowling, reducing incidences of hamstring strains and lower back pain. This points to the tight dependency of strength training as this element of a cricket injury prevention program and the importance in improving mobility of a key joint [24].

As per Sarika et al. (2019) the effect of mobility exercises on hip and ankle ROM in cricket players were examined. It was determined that the study showed large improvements in both hip and ankle ROM, both of which are essential for creating efficient bowling and batting stances. This increased hip mobility allowed us to be more mobile in the hip when standing up,uced our range of movement in the hip when running, thus enabling us to adopt better positions for delivers as well as aiding our balance and stability during fielding. By extension, the enhanced ankle mobility did help with the foot positioning during fielding indicating that better mobility exercises can be used to optimize performance by increasing the flexibility and coordination of the lower limbs. [25]. Mathankar and Kirti (2021) further investigated the shoulder ROM in fast bowlers, illustrating how performing mobility exercises for the shoulder joint may enhance the external rotation, which is a major movement in relation to creating power and control when bowling. The results of their study show that performing shoulder mobility exercises leads not only to an increase in shoulder ROM, but to a decrease in shoulder discomfort and pain, thereby reducing risk of other injuries including shoulder rotator cuff strains. It is consistent with Groenewald et al. (2018) who examined how strengthening of shoulder girdle and rotator cuff muscles was found to aid shoulder external rotation ROM in fast bowlers. Through increased shoulder ROM bowlers could bow harder while lowering the risk of shoulder injuries including rotator cuff strains. This suggests these mobility exercises may be instrumental for shoulder injury prevention if combined with strength training [26].

Flexibility training plays an essential role in improving ROM, particularly in the hamstrings, lower back, and shoulders, which are vital for cricketers, especially fast bowlers. Potei et al. (2020) focused on flexibility training for cricketers' lower back and hamstrings, demonstrating significant increases in ROM, especially in the hamstrings and lower back. Improved flexibility in these areas led to reduced muscle tightness, better posture during batting and bowling, and decreased risk of lower back injuries. The increased flexibility also contributed to better stride length during bowling, enhancing delivery speed and control. This aligns with Panchal et al. (2022), who studied the effects of stretching on shoulder ROM, particularly for both batters and bowlers. Their study showed that stretching exercises significantly improved shoulder ROM, especially in external rotation and abduction, which are crucial for delivering accurate and powerful balls, as well as for improving bat control during shots [27]. The role of stretching and flexibility exercises in injury prevention is further emphasized by Olivier et al. (2020), who found that regular stretching significantly improved ROM, particularly in the hamstrings, quadriceps, and shoulders. This improvement in flexibility contributed to better movement efficiency and performance during batting and fielding, while also reducing muscle strains and joint injuries. The study suggested that a long-term commitment to flexibility training could be vital for reducing injury rates and maintaining optimal performance levels throughout a cricketer's career [28].

CONCLUSION

The comparative analysis of strength, mobility, and flexibility training on range of motion in cricket highlights the importance of integrated physical conditioning for optimal performance. Strength training enhances joint stability and muscle endurance, crucial for injury prevention and efficient movement in the shoulders, hips, and knees. Mobility exercises improve dynamic joint movements, vital for fast bowlers and fielders, while flexibility training, through static and dynamic stretches, boosts muscle elasticity and maintains a full range of motion. The study emphasizes the need for a balanced conditioning program incorporating all three components to improve performance and reduce injury risk, ensuring long-term peak performance.

RECOMMENDATIONS

To optimize performance and reduce injury risk, cricketers should incorporate a balanced training program that combines strength, mobility, and flexibility exercises. Strength training should focus on major muscle groups, particularly those around key joints like the shoulders, hips, and knees, to enhance stability and endurance. Mobility exercises targeting dynamic movements are essential, especially for fast bowlers and fielders. Flexibility training, incorporating both static and dynamic stretches, should be included to improve muscle elasticity and maintain joint range of motion. A well-rounded conditioning routine will not only enhance performance but also ensure long-term joint health and prevent common cricket-related injuries.

REFERENCES

1. Horch HW, Mito T, Popadic A, Ohuchi H, Noji S. The cricket as a model organism. Springer Japan, Tokyo. 2017;10:978-4.
2. Orchard JW, Ranson C, Olivier B, Dhillon M, Gray J, Langley B, et al. International consensus statement on injury surveillance in cricket: a 2016 update. British Journal of Sports Medicine. 2016;50(20):1245-51.
3. Selvam S, Vaithianathan K. Effect of Mobility Training and Combination of Strength and Mobility Training on Selected Physiological Variables among School Cricket Players. Indian Journal of Public Health Research & Development. 2019;10(8).
4. Groenewald G. The effect of exercise intervention on shoulder girdle biomechanics and isokinetic shoulder muscle strength in university level cricket players: a bilateral comparison: North-West University; 2018.
5. Mathankar A, Kirti S. Strength and conditioning for cricket spin bowlers. Strength & Conditioning Journal. 2021;43(6):42-52.
6. Pote L. Strength and conditioning of adolescent male cricket players. 2018.
7. Talukdar K, Cronin J, Zois J, Sharp AP. The role of rotational mobility and power on throwing velocity. The Journal of Strength & Conditioning Research. 2015;29(4):905-11.
8. Weldon A, Duncan MJ, Turner A, Christie CJ, Pang CM. Contemporary practices of strength and conditioning coaches in professional cricket. International Journal of Sports Science & Coaching. 2021;16(3):585-600.
9. Aslam M, Shah F, Ullah K. Effect Of Plyometric Training on Flexibility of Balochistan Female. 2023.
10. Skopal LK, Drinkwater EJ, Behm DG. Application of mobility training methods in sporting populations: A systematic review of performance adaptations. Journal of Sports Sciences. 2024;42(1):46-60.
11. Faisal S. Effect of Neuromuscular Training Program on Functional Movement. Journal of Rehabilitation and Clinical Research (JRCR). 2023;1(2):41-8.
12. Olivier B, Lala B, Gillion N. The cricketer's shoulder and injury: Asymmetries in range of movement and muscle length. South African Journal of Physiotherapy. 2020;76(1):1-6.

13. Nealon A, Cook J, Docking S. A novel method of assessing trunk lateral-flexion range of movement in first-class cricket players. Journal of Athletic Training. 2021;56(12):1355-61.
14. Nilamdeen A, Edirimanne YN. Therapeutic exercises for rotator cuff injuries among cricket players: Literature Review. 2022.
15. Walter S, Daneshfar A, Petersen C. Effect of clubbell exercises on shoulder kinematics in female handball players. International Journal of Kinesiology and Sports Science. 2023;11(1):10-5.
16. Bhattacharjee S, Santra T, Chatterjee S, Biswas P, Banerjee N, Mukherjee S, editors. A study on flexibility and fitness status of adult Bengalee males undergoing training in football. Ergonomics for Improved Productivity: Proceedings of HWWE 2017; 2021: Springer.
17. Smith AF, Collin P, Elsenbsy A, Zbinden J, Amiri A, Guizzi A, et al. Latarjet procedure restores range of motion at six months postoperatively: a prospective cohort study utilizing motion capture analysis. Journal of Shoulder and Elbow Surgery. 2024.
18. 24. Baisa SY, Arsyad N, Wada ZH. Pengaruh Latihan Yoga Terhadap Aktivitas Fungsional Pada Kasus Osteoartritis Genu (Literature Review). JURNAL ILMIAH NUSANTARA. 2024;1(5):252-62.
19. 25. Taylor M. Developing Physical Literacy and Self-Efficacy: Supporting Student Autonomy in High School Physical Education Through Assessment: Royal Roads University (Canada); 2024.
20. 26. Miller K, Weitzel KJ, Bliss R, Duren DL, Ball SD, Baker B. Older adults who resistance train improve physical function and adopt long-term exercise habits despite COVID-19 restrictions. Journal of Sports Sciences. 2022;40(19):2128-35.
21. 27. Zadeh A, Taylor D, Bertsos M, Tillman T, Nosoudi N, Bruce S. Predicting sports injuries with wearable technology and data analysis. Information Systems Frontiers. 2021;23:1023-37.
22. 28. Reid SA, Fornasier J, Redrup D, McLeod S. Cervical spine range of motion and joint position sense in elite male cricketers: An observational study. International Journal of Health & Allied Sciences. 2021;10(2):134-.
23. 29. Baalman E. Preference of Dynamic Stretching and Static Stretching Among Division I Athletes from Southern Illinois University of Carbondale. 2021.
24. 42. Sands W, McNeal J. Mobility and flexibility training for young athletes. Strength and Conditioning for Young Athletes: Routledge; 2019. p. 265-78.
25. 43. Pote L, Christie CJ. Injury prevention strategies in cricket. Strength & Conditioning Journal. 2018;40(5):34-43.
26. 44. Sarika S, Balajirao WS, Shenoy S. Evaluation of acute effects of combined stretching methods on flexibility, agility and speed among cricket players. European Journal of Physical Education and Sport Science. 2019.
27. 45. Potei L, King G, Christie C. Strength and conditioning practices of franchise-level cricket trainers. South African Journal of Sports Medicine. 2020;32(1):1-5.
28. 46. Panchal V, Panchal C, Panihar U, Joshi S, Pawalia A. A randomized controlled trial on the effectiveness of pilates training on physical components in cricketers. Postepy Rehabilitacji. 2022;36(2):15.