



ORIGINAL SCIENTIFIC ARTICLE

COMPARISON OF BODY COMPOSITION CHANGES AND NON-CONTACT MUSCULOSKELETAL INJURIES AMONG PROFESSIONAL FIRST-CLASS CRICKET PACE BOWLERS

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Abstract

Background. Pace bowling is the most injury susceptible position in cricket due to repeated high intensity maneuvers. Previous studies on pace bowlers have considered anthropometric, biomechanical, and kinesiological factors for deciphering the injury etiology.

Study purpose. The purpose of this study was to prospectively investigate the association of body composition parameters with the incidence of musculoskeletal injuries among pace bowlers in cricket.

Materials and methods. A total of 44 healthy professional male pace bowlers (N=44; Age: 22.89±4.5 years; Height: 176±9 cm; Body weight: 76.34±8.09 kg; BMI: 21.4±3.1) were recruited from various cricket academies. They were assessed on anthropometrics, body composition, and aerobic fitness before the start of Indian cricket season (typically mid-September). Any non-contact sports injury accounting for significant time loss during the season was recorded followed by assessment of change in body composition status among injured and non-injured pace bowlers.

Results. We found hamstring injury as the most prevalent injury (05/12). Lower back injury accounted for highest severity with time loss of 48 matches. Injured pace bowlers underwent higher training volume (hours/day; p=.009) prior to injury incidence, were significantly heavier, and had greater volume of total body water. All the pace bowlers gained significant amount of fat-free mass (FFM) from pre- to post-season.

Conclusions. Higher training workload and higher body weight were associated with more injury risk among pace bowlers. Further research accommodating other predictive factors of body composition and psychomotor learning must be carried out to precisely predict injury risk among pace bowlers in cricket.

Keywords: pace bowling, musculoskeletal injury, body composition, fat-free mass (FFM), training load.

Introduction

Multi-format cricket (Test cricket, One-day, and T20) has placed greater physiological and psychological demands on the players to fulfil national and franchise-level commitments. Since pace bowling requires high number of explosive sprints, jumps, twist and throws, it is considered as the most injury-susceptible department in cricket (Olivier et al., 2015). With the increment in number of fixtures, they have limited time for recovery and hence, are at greater risk of sustaining acute and/or overuse injuries (Dennis et al., 2004; Dennis et al., 2005; Dovbysh et al., 2021; Orchard et al., 2015). Common injuries related to pace bowling are

lumbar spine pathologies (particularly stress fractures), muscle strains, acute and chronic knee, ankle, hip and shoulder sprains (Constable et al., 2021; Pardiwala et al., 2018; Stronach et al., 2014). A high bowling workload along with other intrinsic and extrinsic factors contributes to a higher risk of injury among pace bowlers (Olivier et al., 2016). Body weight and body composition have turned out to be potentially modifiable intrinsic risk factor for sport injury risk (Caine et al., 2008; Emery, 2003).

Most researches have focused only on epidemiology, anthropometric measurements, and biomechanical analysis for deciphering the injury etiology in cricket pace bowlers (Johnstone et al., 2014; Pyne et al., 2006; Stuelcken et al., 2007) and there has been limited amount of research on the association of body composition to musculoskeletal injuries among pace bowlers in cricket. Since, BMI has

been an inconsistent indicator of body composition in sports (Lambert et al., 2012; Ode et al., 2007; Torstveit & Sundgot-Borgen, 2012); we aimed to analyze the association of different body composition parameters with the incidence of musculoskeletal injuries among pace bowlers in cricket.

Materials and Methods

Participants of the study

A total of 44 previously healthy professional male pace bowlers (N=44; Age: 22.89±4.5 year; Height: 176±9 cm; Body weight: 76.34±8.09 kg; BMI: 21.4±3.1) with a minimum of inter-state level cricket participation were recruited at the start of the cricket season. This prospective study expanded over one year comprising one cricket season and one off-season (typically mid-September to mid-June). Dhillon et al. (2012) defined cricket season as “the time period when players play competitive matches whereas off season is defined as the one when players keep on practicing daily and often play local matches on weekends” (Dhillon et al., 2012). The purpose of research was explained to them and they provided their written informed-consent. All the players completed a questionnaire on general details, details about sports training, and history of any injury at the time of data collection. The study involved data collection in non-invasive manner and conducted in accordance with the guidelines of the Declaration of Helsinki.

Design of the study

The anthropometric, aerobic fitness, and body composition were evaluated at the start of the season. Height was measured using stadiometer (AVI Healthcare Stadiometer, India). Body weight was measured to the nearest 0.1 kg on an electronic scale (Tanita BWB-800S, Tanita Corporation, Tokyo, Japan). BMI was calculated using the formula: Weight (kg)/Height (m)². Body composition parameters were measured using Bio-Electrical Impedance (BIA) (BioScan 916, Maltron International Ltd, Rayleigh, Essex, UK) according to the standard protocol (Walter-Kroker et al., 2011). Aerobic fitness was assessed using the Yo-Yo Intermittent Recovery Test Level 1 (YYIRTL1) at the start of the season. The details about testing protocol and scientific authenticity of this field-based test can be found elsewhere (Bangsbo et al., 2008; Deprez et al., 2014).

To record their injury status, we encouraged the pace bowlers to immediately report any playing-related injury

or discomfort to us telephonically. Thereafter we met them in-person and assessed their injury severity as described (Orchard et al., 2016). Severity was determined based on the numbers of matches missed until the player returned to play (Blanch et al., 2015). Any acute or chronic injury during competition/training accounting for significant loss of playing time fell into the category of sports injury, as described previously (Orchard et al., 2016). We took their body composition assessment within a day of injury incidence at their places. We recorded only non-contact injuries during pace bowling and those occurring during batting and fielding were not considered.

Statistical analysis

The statistical analysis of the collected data was performed using IBM SPSS 22 (IBM Corp. USA). The mean and standard deviation were calculated for the continuous variables. Groupwise comparisons were made using independent sample t-test between healthy and injured pace bowlers' groups. Also, pairwise comparisons were made between pre- and post-season body composition parameters among healthy and injured pace bowlers. P-value <0.05 was considered statistically significant.

Results

The descriptive characteristics of the pace bowlers included in the present study are presented in Table 1. Shapiro-Wilk test for normality showed insignificance for all the descriptive variables except for Yo-Yo test (p=0.03) among healthy pace bowlers because the participants were physically active and participated in training and match-play uniformly. Levene's test for equality of variances showed insignificance for all the variables except training hours (hours/day; p=0.023), so we performed independent sample t-test with unequal variances.

The injured pace bowlers had undergone significantly greater amount of training volume (training hours (hours/day)) than healthy pace bowlers (p=0.009; table 1). The incidence of hamstring injury was the most among 05 pace bowlers with mean severity (no. of matches missed due to injury) of 13.2 matches (figure 1).

Among injured pace bowlers, the one with lower back injury suffered the highest time loss of 48 matches, followed by one with knee injury (21 matches' loss due to injury) (table 2).

Injured pace bowlers also had greater amount of total body water as compared to healthy pace bowlers (table 3).

Table 1. Descriptive statistics of the pace bowlers included in the present study

Parameter	Healthy Pace Bowlers (n=32)			Injured Pace Bowlers (n=12)			Levene's testa	p-value ^b
	Mean±SD	95% CI	Shapiro-Wilk	Mean±SD	95% CI	Shapiro-Wilk		
Age (yrs)	22.2±2.2	21.4-23.03	0.26	22.5±2.5	20.9-24.1	0.63	0.704	0.743
Height (cm)	171.9±5.4	169.9-173.8	0.52	170.9±5.4	167.5-174.4	0.55	0.888	0.606
TrainingHour (hour/day)	5.7±1.2	5.2-6.1	0.13	6.4±0.7	6.0-6.9	0.25	0.023 ^c	0.009 ^c
Yo-Yo Test (m)	1584.4±191.7	1515.2-1653.5	0.03 ^c	1590.8±164.7	1486.2-1695.5	0.05	0.414	0.918

a. Levene's test for equality of variance among groups.

b. P-value for independent sample Student's t-test statistics.

c. P-value significant at 0.05.

Table 2. Descriptive details of the pace bowlers with injury-wise stratification of data

Parameter	Healthy PB (n=32) Mean±SD	Injured PB (n=12) Mean±SD					
		GI (n=01)	LBI (n=01)	CI (n=02)	HI (n=05)	KI (n=01)	AI (n=02)
Age (years)	22.2±2.2	20	24	21.5±0.77	21.92±3.08	26	23.65±2.19
Height (cm)	171.9±5.4	172	177	173.5±2.12	169.6±6.98	172	167.5±6.36
TrainingHour (hour/day)	5.7±1.2	6.5	6	6.5±0.70	6.8±0.57	6	6±1.41
Yo-Yo Test (m)	1584.4±191.7	1690	1180	1680±28.3	1592±151.39	1580	1660±42.43
Severity (match loss)		08	48	11±1.41	13.2±2.95	21	12.5±0.71
Pre Body weight	68.09±4.33	77.0	78.1	73.95±2.75	68.36±4.05	68.4	71.5±3.53
Post Body weight	68.58±4.02	76.4	76.9	73.6±1.55	69.04±5.20	68.3	71.45±1.91
Pre BMI	23.05±1.13	26.02	24.93	24.58±1.52	23.78±1.14	23.12	25.49±0.68
Post BMI	23.23±1.28	25.82	24.54	24.46±1.11	23.99±0.91	23.08	25.49±1.25
Pre FFM	83.58±2.36	81.4	78.9	81.8±0.28	83.6±1.83	82.6	82.3±3.25
Post FFM	84.47±2.43	81.9	80.9	82.65±0.07	84±2.18	83.2	82.5±3.25
Pre FM	16.41±2.36	18.6	21.1	18.2±0.28	16.4±1.83	17.4	17.7±3.25
Post FM	15.53±2.43	18.1	19.1	17.35±0.07	16±2.18	16.8	17.5±3.25
Pre TBW	40.18±2.55	45.43	46.08	43.63±1.63	40.33±2.39	40.35	42.18±2.08
Post TBW	40.46±2.37	45.07	45.37	43.42±0.92	40.73±3.07	40.3	42.15±1.12

PB: Pace bowlers; GI: Groin injury; LBI: Lower back injury; CI: Calf injury; HI: Hamstring injury; KI: Knee injury; AI: Ankle injury; Pre: Pre-season; Post: Post-season

Table 3. Comparative analysis for Body Composition parameters among cricket pace bowlers

Parameter	Pace Bowlers	Pre-season (Mean±SD)	Post-season (Mean±SD)	Mean Diff.	t-statistics (p-value)
Body Weight (kg)	Healthy	68.1±4.3	68.6±4.0	0.48	-1.8 (0.087)
	Injured	71.4±4.6	71.4±4.4	0.05	-0.13 (0.899)
	Mean Diff.	3.3	2.8		
	t-statistics (p-value)	2.2 (0.034*)	2.0 (0.049*)		
BMI	Healthy	23.1±1.1	23.2±1.3	0.18	-1.9 (0.065)
	Injured	24.4±1.2	24.4±1.1	0.01	-0.09 (0.923)
	Mean Diff.	1.4	1.2		
	t-statistics (p-value)	3.5 (0.001*)	2.9 (0.006*)		
FFM (kg)	Healthy	83.6±2.4	84.5±2.4	0.89	-6.5 (0.000*)
	Injured	82.4±2.0	83.0±1.9	0.60	-3.8 (0.003*)
	Mean Diff.	1.2	1.5		
	t-statistics (p-value)	-1.5 (0.140)	-1.9 (0.071)		
FM (kg)	Healthy	16.4±2.4	15.5±2.4	0.89	6.5 (0.000*)
	Injured	17.6±2.0	17.0±1.9	0.60	3.8 (0.003*)
	Mean Diff.	1.2	1.5		
	t-statistics (p-value)	1.5 (0.140)	1.9 (0.071)		
TBW (liter)	Healthy	40.2±2.6	40.5±2.4	0.28	-1.8 (0.087)
	Injured	42.1±2.7	42.1±2.6	0.03	-0.13 (0.899)
	Mean Diff.	1.9	1.7		
	t-statistics (p-value)	2.2 (0.034*)	2.0 (0.049*)		

*P-value significant at 0.05.

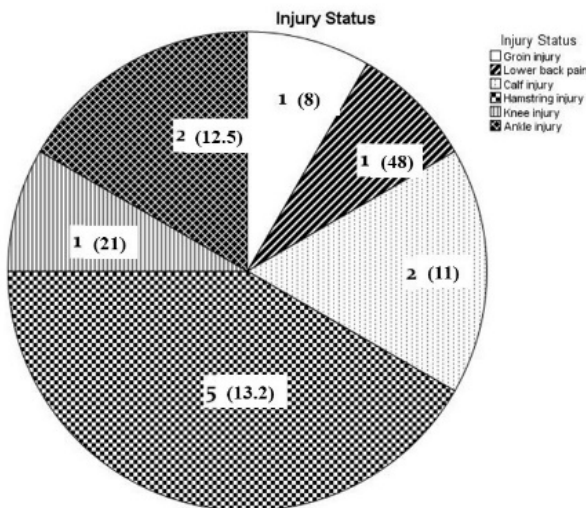


Fig. 1. Frequency of Injuries among professional first-class cricket pace bowlers with severity (no. of matches missed due to injury) shown in parentheses

Discussion

Pace bowling is the most injury susceptible playing position in cricket due to performing high intensity movements repeatedly (Dovbysh et al., 2021). This season-long study investigated the association of different body composition parameters with musculoskeletal injury risks among pace bowlers in cricket. Twelve pace bowlers (12/44; 27.3%) sustained acute/chronic musculoskeletal injuries during the course of this study with hamstring injury being the most prevalent (41.7%; 05 out of 12; figure 1), in line with the previously published literature (Dovbysh et al., 2021). The pace bowlers included in our study were relatively younger with mean age of injured and healthy pace bowlers being 22.5 ± 2.5 years and 22.2 ± 2.2 years respectively (table 1). Younger age is associated with an increased injury risk among pace bowlers probably due to skeletal immaturity, disproportionate bowling workload, and nutritional limitations (Blanch et al., 2015).

Our results showed that the injured pace bowlers had undergone greater training volume or workload (hours/day) as compared to healthy pace bowlers before the onset of injury (6.4 ± 0.7 vs. 5.7 ± 1.2 hours/day; $P = .009$; table 1). Amount of bowling workload (the number of overs bowled) has been directly related to the risk of lower back and other musculoskeletal injuries among pace bowlers (Constable et al., 2021; Dennis et al., 2003). The pace bowlers who sustained injury during the season were significantly heavier than healthy pace bowlers at pre- (71.4 ± 4.6 kg vs. 68.1 ± 4.3 kg; $P = .034$) and post-season (71.4 ± 4.4 kg vs. 68.6 ± 4.0 kg; $P = .049$). We also investigated the training-associated changes in body composition parameters among pace bowlers from pre- to post-season and found that FFM increased significantly from pre-season to post-season among healthy (83.6 ± 2.4 vs. 84.5 ± 2.4 ; $P = .000$) as well as among injured fast bowlers before injury onset (82.4 ± 2.0 vs. 83.0 ± 1.9 ; $P = .003$) (table 3). Similar trend was observed among injured and healthy pace bowlers in TBW composition (table 3).

Conclusions

These results indicate positive changes towards a loss in FM as a result of training. We did not find any meaningful differences between injured and healthy pace bowlers in other body composition parameters at pre- and post-season (table 2 & 3). The findings of present study must be interpreted cautiously keeping certain limitations in mind. The participants in our study were male only and since, gender has a proven impact on anatomical, anthropometric, and physiological aspects of sports performance, similar studies must be carried out on female participants. Since most of the assessment was field-based, the effect of temperature, climate, and sun could have an impact over the outcomes of our study. Nutritional and dietary information of participants was self-reported and the type and amount of nutritional supplementation might affect the body composition of the participants.

Recommendations

Pace bowlers in cricket should be strictly screened for body composition before, during and after the competitive seasons to maximize injury prevention. With BMI unable to predict sports injury accurately, other techniques of body composition assessment should be extensively utilized. Further research should be carried out to accommodate more predictive factors needed to accurately predict injury risk among pace bowlers in cricket. Variables related to psychomotor learning should be included in future studies.

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Conflict of Interests

The authors report there are no competing interests to declare.

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ПОРІВНЯННЯ ЗМІН СКЛАДУ ТІЛА ТА БЕЗКОНТАКТНИХ ТРАВМ ОПОРНО-РУХОВОГО АПАРАТУ СЕРЕД ПРОФЕСІЙНИХ ШВИДКИХ БОУЛЕРІВ У КРИКЕТІ ПЕРШОГО РІВНЯ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 6 с., 3 табл., 1 рис., 24 джерела.

Історія питання. Швидкий боулінг є найуразливішою до травм позицією в крикеті через багаторазові високоінтенсивні маневри. У попередніх дослідженнях швидких боулерів для визначення етіології травм брали до уваги антропометричні, біомеханічні та кінезіологічні фактори.

Мета дослідження. Метою цього дослідження було перспективне вивчення зв'язку параметрів складу тіла із частотою травм опорно-рухового апарату серед швидких боулерів у крикеті.

Матеріали та методи. Загалом у дослідженні взяли участь 44 здорові професійні швидкі боулери чоловічої статі (N=44; вік: 22,89±4,5 року; зріст: 176±9 см; маса тіла: 76,34±8,09 кг; ІМТ: 21,4±3,1) з різних академій крикету. Перед початком сезону крикету в Індії (зазвичай у середині вересня) їх оцінювали за антропометричними характеристиками, складом тіла та рівнем аеробної підготовленості. Реєстрували будь-яку безконтактну спортивну травму, яка зумовлює значні втрати часу протягом сезону, з подальшою оцінкою зміни стану складу тіла серед травмованих і нетравмованих швидких боулерів.

Результати. За результатами дослідження було встановлено, що найпоширенішою травмою (05/12) є травма підколінного сухожилля. Травма нижнього (поперекового) відділу спини відповідала найвищому ступеню тяжкості із втратою часу 48 матчів. Травмовані швидкі боулери проходили більший обсяг тренувань (годин/день; p=0,009) до випадків травмування, були значно важчими та мали більший об'єм загального вмісту води в організмі. За час від передсезонного до післясезонного періоду всі швидкі боулери набрали значний обсяг маси тіла без жиру (FFM).

Висновки. Більше тренувальне навантаження та більша вага тіла були пов'язані з більшим ризиком травмування серед швидких боулерів. Для точного прогнозування ризику травмування серед швидких боулерів у крикеті необхідно проводити подальші дослідження з урахуванням інших прогностичних факторів складу тіла та психомоторного навчання.

Ключові слова: швидкий боулінг, травма опорно-рухового апарату, склад тіла, маса тіла без жиру (FFM), тренувальне навантаження.

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