Association of Intrinsic Factors with Non-contact Low Back Pain Among Fast Bowlers Aged between 15 – 19 Years in Division 1 Boys' Schools in Colombo

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Research note

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Abstract

Objective: Cricket fast bowlers are identified as the greatest injury risk players who are more prone to sustain with low back pain (LBP). The current study was aimed to investigate how intrinsic factors associate with LBP among fast bowlers aged between 15-19 years. A descriptive cross-sectional study was conducted with one hundred and two (102) fast bowlers in Colombo division 1 boys' schools in Sri Lanka. Bowlers were prospectively monitored over the competition period of 2019 cricket season and the demographic data, severity of LBP, general characteristics and intrinsic factors related data were recorded.

Results: Thirty-seven (43.5%) of the subjects were presented with LBP. Reduction of quadriceps strength of dominant side, hamstring strength of non-dominant side and increased ankle dorsiflexion of non-dominant side were found to be significantly associated with non-contact LBP ($P < 0.05$). There were significant differences for the quadriceps strength of dominant side and hamstring strength and ankle dorsiflexion of non-dominant side between the fast bowlers with and without LBP. The results indicated that reduced quadriceps muscle strength of dominant side, reduced hamstring muscle strength and high ankle dorsiflexion of non-dominant side have an important role in predisposing a fast bowler to have an increase in non-contact LBP.

Introduction

Cricket fast bowlers are more prone to get injuries due to their heavy workload and repetitive stress acts through body alignments which results from ground reaction force (GRF) [1]. GRF will result stress force on lumbar spine through foot, ankle, knee and hip kinetic chain. Incorrect techniques, less physical preparation, high intensity and excessive workload will put fast bowlers at a high risk of having non-contact LBP [2,3]. The prevalence of injury among fast bowlers was 8% in the international cricket [4]. Australian, South African, English, West Indian and Indian bowlers experienced more injuries (41.3%) and among young fast bowler's lumbar stress fractures is the most severe condition [5]. Lower limbs and lower back strains and sprains are at greatest injury incidence in Sri Lankan junior cricket bowlers with 20.3% and match injury incidence rate is 5.7 [6].

Non-contact LBP is the occurrence of pain without any collision mechanism with an external force; players or objects [7]. Intrinsic factors are considered as factors which are related to players themselves (techniques, structural alignment) for being injured. These factors are related with quadriceps strength, hamstring flexibility, hip internal rotation, ankle dorsiflexion, back muscles strength and trunk movements [8].

Thus, the aim of this study was to examine the association of intrinsic factors with non-contact LBP among fast bowlers aged between 15-19 years in division 1 boy's schools in Colombo district. School fast bowlers those who are yet having time to mature physically are susceptible for injuries and they are the ones who are going to represent the national team in near future. This research will open up the

pathways to evolving of many other research topics related to school level cricketers about what they are going to face in the future.

Methods

Subjects

This descriptive cross-sectional study was conducted with 102 subjects in the competition period of 2019 cricket season among all the division 1 boys' schools in Colombo. Among them, the subjects with a history of any neurological disorders, cardio-vascular diseases, experience of pain in any area that different from lower back region, complaint of pain more than 6 in the Numerical Pain Rating Scale (NPRS) of any joint which was used in the test procedures, intolerable pain during the measurement gaining procedures and the subjects with contact LBP were excluded.

The data provided by the fast bowlers were collected and recorded following taking the written informed consent and explaining the procedure of the research. Selected subjects performed a 5 minutes warm up session and 5 minutes static stretching exercises to minimize the variability and the standard error of the measurements by reducing the impact of different muscle temperature on muscle flexibility. There was one specific examiner all the time to examine the specific task to avoid the inter-examiner error. 30 seconds rest was allowed during each trial and 2-3 minutes resting time was allowed during each station.

Before administrating the questionnaire (Additional file 1) which was developed for this study as the data collection tool for the study participants, it was administered to randomly select 10 male fast bowler between 15-19 years old, who were outside the defined study area.

Measurements and procedures

Back extensor strength was measured by using Back-Leg-Chest dynamometer. Subject was asked to stand with both feet on base in lined with erect trunk and bent knees, as hands were able to grasp the chain of the dynamometer at a proper height. Adjust chain to accommodate a suitable height for the test. The body would be inclined forward about 60 degrees. Then subject was asked to straighten the knees, lift the chain, and apply a pulling force on the handle. Subject should lift in a gradual vertical motion.

Quadriceps and hamstring muscle strength and muscle strength were measured by using a calibrated modified sphygmomanometer. When taking the measurement of quadriceps strength, athlete was sitting in 90 degrees flexed hip and 90 degrees flexed knee position. When assessing the hamstring strength, the athlete was in prone lying position with knees extended fully. During the test, athletes were asked to perform maximum isometric contractions. The modified-modified Schober was used to measure ROM of trunk flexion and extension [9]. Trunk lateral flexion was measured by using the fingertip-to-floor method

[10]. Hip internal rotation and external rotation were measured by using goniometer modified with a spirit level while lunge test was used to assess the ROM of ankle dorsiflexion.

Hamstring flexibility was measured by using sit and reach test. Athlete has to reach forward as much as possible along the measuring line and touch the extreme point. Intensity of pain was measured by NPRS in interviewer administered questionnaire.

Statistical analysis

All statistical analysis was conducted by the SPSS version 22. As the variable data did not express a normal distribution across the sample, nonparametric tests were used to analyze the data. Mann Whitney U test was used to assess the difference between the fast bowlers with and without LBP. Spearman correlation was used to assess the association between two variables. $P < 0.05$ was considered for significant level.

Results

Eighty-five (85) fast bowlers were recruited and 17 were excluded from a preliminary sample of 102. The mean age of study population was 16.6 ± 1.0 years. The Prevalence of LBP was 43.5% in the study population. The majority of the population is with right arm bowlers (91%) while the remaining of the population (9%) is with left arm. Distribution of the type of seeking health care professionals by fast bowlers with LBP is shown in Additional file 2: Figure S1.

As the data did not show a normal distribution, non-parametric median values were used to assess the difference between two variables (Table 1). The age, bowling experience, training period, height, weight and BMI did not show any significant difference between the fast bowlers with and without LBP ($p > 0.05$).

Table 1
Distribution of general characteristics of the study population (n=85)

Variable	Median		p-value
	With LBP (n=37)	Without LBP (n=48)	
Age (years)	17.0	17.0	0.81
Bowling experience (years)	6.0	6.0	0.83
Training period (hours per week)	2.0	3.0	0.08
Height (meters)	1.7	1.7	0.58
Weight (kilograms)	56.3	61.7	0.17
Body Mass Index (kg/m ²)	20.0	21.1	0.26
p-value: significant level result from Mann Whitney U test; LBP: Low Back Pain; kg/ m ² : kilograms per square meter			

Table 2 reflects the intrinsic factors of the study population with and without LBP. It showed a highly significant difference only for the quadriceps strength of dominant side, hamstring strength and ankle dorsiflexion of non-dominant side between the fast bowlers with and without LBP ($p < 0.05$). However, no significant difference was identified for other intrinsic factors between the fast bowlers with and without LBP ($p < 0.05$).

Table 2
Distribution of intrinsic factors of the study population (n=85)

Variable	Median		p-value
	With LBP (n=37)	Without LBP (n=48)	
Quadriceps strength of non-dominant side (mmHg)	142.0	152.5	0.12
Quadriceps strength of dominant side (mmHg)	147.0	163.0	0.01*
Hamstring strength of non-dominant side (mmHg)	101.0	117.0	0.04*
Hamstring strength of dominant side (mmHg)	108.0	119.0	0.35
Back extensor muscles strength (kg)	72.0	85.0	0.11
ROM of trunk Flexion (cm)	6.5	6.5	0.86
ROM of trunk extension (cm)	3.2	3.5	0.67
ROM of non-dominant side trunk lateral flexion (cm)	21.2	21.5	0.33
ROM of dominant side trunk lateral flexion (cm)	21.0	21.0	0.44
ROM of non-dominant side trunk rotation (cm)	5.5	6.3	0.54
ROM of dominant side trunk rotation (cm)	6.5	7.1	0.20
Hip internal rotation of non-dominant side (degrees/°)	38.0	36.0	0.45
Hip internal rotation of dominant side (degrees/°)	36.0	35.5	0.21
Ankle dorsiflexion of non-dominant side (cm)	13.9	15.2	0.04*
Ankle dorsiflexion of dominant side (cm)	14.9	15.1	0.33
Hamstring flexibility (cm)	32.2	32.3	0.31
p-value: significant level result from Mann Whitney U test; LBP: Low Back Pain; ROM: Range of Motion			
* p < .05: significant			

Association of general characteristics with LBP of the study population was evaluated in Additional file 3: Table S1. There were negative correlations for the age, body mass index and training period and a positive correlation for the bowling experience with LBP of the study population which was insignificant.

Table 3 shows the association of intrinsic factors with the LBP of the study population. Quadriceps strength of dominant side, hamstring strength and ankle dorsiflexion of non- dominant side was significantly negatively correlated with the LBP (p<0.05). Hip internal rotation of dominant and non-

dominant sides, ankle dorsiflexion of dominant side, hamstring flexibility were insignificant positively correlated with the LBP ($p>0.05$). Quadriceps strength of non-dominant side, hamstring strength of dominant side, ROM of trunk flexion, extension, rotations and non-dominant side lateral flexion were negatively correlated with the LBP, while ROM of dominant side lateral flexion was positively correlated with the LBP. However, none of the parameters were not significantly associated with the LBP ($p>0.05$).

Table 3
Association of intrinsic factors with Low Back Pain of the study population

Variable	r_{sp}	p-value
Quadriceps strength of non-dominant side (mmHg)	-0.18	0.11
Quadriceps strength of dominant side (mmHg)	-0.34*	0.01*
Hamstring strength of non-dominant side (mmHg)	-0.28*	0.01*
Hamstring strength of dominant side (mmHg)	-0.15	0.17
Back extensor muscles strength (kg)	-0.20	0.06
ROM of trunk Flexion (cm)	-0.01	0.91
ROM of trunk extension (cm)	-0.09	0.42
ROM of non-dominant side trunk lateral flexion (cm)	-0.05	0.64
ROM of dominant side trunk lateral flexion (cm)	0.09	0.41
ROM of non-dominant side trunk rotation (cm)	-0.07	0.51
ROM of dominant side trunk rotation (cm)	-0.18	0.11
Hip internal rotation of non-dominant side (degrees/°)	0.08	0.46
Hip internal rotation of dominant side (degrees/°)	0.14	0.21
Ankle dorsiflexion of non-dominant side (cm)	0.26*	0.02*
Ankle dorsiflexion of dominant side (cm)	0.13	0.25
Hamstring flexibility (cm)	0.11	0.31
r_{sp} : Spearman's correlation coefficient; p-value: significant level result from Spearman's correlation test; ROM: Range of Motion		
* $p < .05$: significant		

Discussion

This study describes the associated intrinsic factors and how it relates to the prevalence of non-contact LBP in adolescent male fast bowlers playing for division 1 Colombo schools aged between 15-19 years. Previously some studies had been conducted, but focusing only one or two intrinsic factors related to this

topic. This is the first research study presenting associated intrinsic factors to fast bowlers' low back pain in Sri Lankan region.

Similar to present study, Foster et al. [11] also explained that the age of adolescent the fast bowlers might be susceptible for high incidence of lower back injuries (LBI) due to incomplete ossification of neural arches of lumbar vertebrae. A study of three dimensional measurement of lumbar spine kinematics in fast bowlers emphasized that there was no significant relationship between lumbar injuries and all the lower lumbar movements [12]. With regards to that, excessive trunk lateral flexion has been identified by analyzing dynamic biomechanics, as a risk factor of low back injuries in adolescent cricket pace bowlers [7].

There was no significant difference in hip internal or external rotation between adolescent fast bowlers with or without LBP [13]. However, Dennis et al. [14] evaluated that reduction of hip internal rotation of dominant side had significant association with reduction of LBI risk in male adult fast bowlers. Higher peak vertical GRF which is considered as the main contributing factor to the lumbar stress fractures among fast bowlers is associated with a small plantar angle due to increased ankle dorsiflexion and reduced hip flexion [15]. At the delivery stride, a fast bowler has to absorb a maximum GRF of nine times of the body weight during the initial front foot landing [16]. Conversely, restriction in foot and ankle motion can be associated with prevalence of LBP [17].

Weakened quadriceps muscle strength can be lead to LBI [11]. Normally during run up phase, the generated GRF was absorbed by the knee joint and the lumbar spine and the reduction of quadriceps muscle strength resulted reduction of shock absorption on the knee joint and increased the force on the lumbar spine [18]. In contrast, a study interpreted that quadriceps muscle strength of non-dominant side was associated with LBP of young fast bowlers [11]. In fast bowlers, quadriceps and hamstrings muscles are repeatedly contracted eccentrically and concentrically through the run up phase and a peak vertical GRF and a horizontal GRF exert on the dominant side leg on delivery stride [19]. It was evident that reduced hamstring muscle strength cause LBP. When hamstrings weakened than quadriceps muscle, it resulted a downward pull of pelvis that cause hyperextension of lumbar spine. Due to the changed vertebral angle of the spine, the pressure placed on intervertebral discs was increased which would lead to LBI [20].

There were no significant differences existed between strength of back extensor muscles with and without LBP groups in fast bowlers (mean age = 17.9 years) [21]. Some postural deficits caused by genetic factors may predispose an individual to develop the injuries of the lumbar spine, especially when young and playing a high-risk sport like cricket fast bowling [22,23].

Children are more susceptible to overuse injuries than adults due to the effect on their immature growth cartilages and as children become more heavily involved in cricket [24].

LBP is not associated with impaired hamstring flexibility, stiffness [25] or hamstring muscle length [26]. MassoudArab et al. [27] further described that there is no significant difference in hamstring muscle

length with and without sacroiliac joint dysfunction. Some controversial findings stated that lumbar disc abnormalities had an association with reduced hamstring flexibility [8].

Conclusion

The findings of this study revealed that none of the general characteristics which are age, BMI, training period and bowling experience did not contribute to develop LBP symptoms among the adolescent fast bowlers aged between 15-19 years. The higher muscular strength of dominant side quadriceps muscle and non-dominant side hamstring muscle having less probability to develop LBP. Likely, the fast bowlers with higher non-dominant side ankle dorsiflexion are more prone to having LBP.

Limitations

To the best of our knowledge, this was the first study to investigate the associated intrinsic factors to adolescent male fast bowlers' low back pain in Sri Lankan region., however there were a number of limitations. This study was limited to the male population though the game of cricket is now played more commonly by females in Sri Lanka. Further studies should be carried out to cover all areas in Sri Lanka including the Division 02 and Division 03 schools to enhance the sample size.

Abbreviations

BMI – Body Mass Index

GRF – Ground Reaction Force

LBP – Low Back Pain

LBi – Lower Back Injuries

NPRS – Numerical Pain Rating Scale

Declarations

Ethics approval and consent to participate

A written informed consent was obtained from all the participants and their parents and the ethical clearance was obtained from the Ethics Review Committee, Faculty of Medicine, General Sir John Kotelawala Defence University.

Consent for publication

Not applicable.

Availability of data and materials

Since the privacy of research participants may be compromised, we cannot make the information publicly available.

Competing interests

The authors declare that they have no competing interests.

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None

Authors' contributions

USJ and ADPP contributed to manuscript writing, developing study concept and design, data acquisition and data analysis; USJ, IS, DW, DM, SB and KD contributed to data acquisition. All authors read and approved the final manuscript.

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