Extrinsic and intrinsic factors associated with non-contact injury in adult pace bowlers: a systematic review protocol

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Review question/objective

Review question: which extrinsic and intrinsic factors are associated with non-contact injury in adult cricket pace bowlers?

Review objective: the objective of this review is to determine the extrinsic and intrinsic factors associated with non-contact injury in adult pace bowlers.
Background

Cricket is generally considered to be a sport of low injury risk\(^1\) compared to other sports.\(^2\) In cricket, the pace bowler strives towards the adoption of a bowling technique with a relatively low injury threat that will, at the same time, allow for a fast (>120km/hr) and accurate delivery to the opposing batsman. However, of all the various roles of the cricket player, the pace bowler has the highest risk of injury, especially for low back and lower limb (lower quarter) injury.\(^3,4\) The reason for this high risk of injury is due to the inherent, high-load biomechanical nature of the pace bowling action.\(^3-5\) The high prevalence of injury amongst pace bowlers\(^3,4\) highlights the great need for research into factors associated with injury.

Both extrinsic and intrinsic factors work in combination to predispose the bowler to injury. Extrinsic or environment-related factors include bowling workload (the numbers of overs a bowler bowls), player position (first, second or third change) and time of play (morning or afternoon). A high bowling workload has been linked with a higher risk of injury in pace bowlers. Foster et al.\(^5\) found in an observational study that bowling too many overs in a single spell or bowling too many spells may increase the pace bowler’s risk of sustaining a low back injury. In another observational study, Dennis et al.\(^6\) found that an exceptionally high bowling workload as well as an uncommonly low bowling workload is associated with injury risk. The major extrinsic factors for bowling injury identified by Orchard et al.\(^1\) are a high number of match overs bowled in the previous week, number of days of play and bowling second (batting first) in a match. Extrinsic factors are known to make the bowler more susceptible to injury, especially in the presence of intrinsic factors.

Intrinsic, or person-related, factors include muscle strength, flexibility, balance and biomechanics.\(^7-11\) Intrinsic, strength-related factors, such as shoulder depression, horizontal flexion strength for the preferred limb and quadriceps power in the non-preferred limb are also significantly related to back injuries in fast bowlers.\(^5\) Both upper limb and lower limb-related intrinsic factors are known to be associated with injury. A prospective study by Dennis et al.\(^12\) aimed to identify the risk factors for injury in adolescent cricket fast bowlers. Their findings concluded that bowlers with a hip internal rotation range of motion of ≤30˚ on the leg ipsilateral to the bowling arm were at a significantly reduced risk of injury compared with bowlers with >40˚ of rotation. Moreover, bowlers with ankle dorsiflexion lunge of 12.1–14.0 cm on the leg contralateral to the bowling arm were at a significantly increased risk of injury compared to bowlers with a lunge of >14 cm. Reduced hamstring flexibility was also associated with lumbar disc abnormalities.\(^13\) Bowling-related biomechanical risk factors for injury have been established such as trunk rotation of the shoulders by to a more side-on position during the delivery stride.\(^5\) Portus et al.\(^14\) also reported that shoulder counter-rotation was significantly higher in bowlers who reported lumbar spine stress fractures, while the non-trunk injured group displayed a more flexed knee at front foot contact and ball release. In addition to the above kinematic risk factors, there are high ground reaction forces associated with the power phase – between the front foot placement and ball release components of the pace bowling action.\(^15-17\) A combination of kinematic bowling related issues as described above and high ground reaction forces may predispose the bowler to injury.

Morton et al.\(^18\) conducted a systematic review on pace bowlers between the ages of 13.7 and 22.5 years on risk factors and successful interventions for cricket-related low back pain. Young cricketers between the ages of 13 and 18 years are different to adults in terms of their physiology which impacts on their predisposition to injury and phases of healing.\(^19,20\) Young cricketers may differ from an adult
population in that young pace bowlers who sustain injuries during their bowling career may have given up on the sport by the time they approach adulthood, and the composition of the adult pace bowler population group is therefore affected by natural selection which may cause this group to differ from the original population. Caution is thus advised when generalizing findings from this young population group to adult pace bowlers which emphasize the need for studies amongst adult pace bowlers. Furthermore, the review by Morton et al.\textsuperscript{18} included articles that specifically investigated factors associated with low back pain. However, due to the interconnectedness between the spine and the lower limbs, kinematic variables affecting the spine will also affect the load placed on the lower limbs\textsuperscript{21,22} with subsequent risk of injury.\textsuperscript{23} The interdependent mechanical interactions in a linked segment system such as the system of motion of the low back can be caused by movement coordination patterns in other body segments.\textsuperscript{24} The systematic review by Morton et al.\textsuperscript{18} only included intrinsic factors while the proposed review will also look at extrinsic factors. Therefore, the primary objective of this review is to determine extrinsic and intrinsic factors associated with non-contact injury in adult pace bowlers.

**Keywords**

Pace; fast; bowler; injury

**Inclusion criteria**

**Types of participants**

This review will consider studies that include male cricket pace bowlers over the age of 18 years from all levels of play.

**Types of intervention(s)/phenomena of interest**

This review will consider studies evaluating the association between extrinsic and intrinsic factors, and lower quarter injury in pace bowlers. Intrinsic factors may include, but will not be limited to, muscle strength, flexibility, balance and biomechanics, while extrinsic factors may include bowling, but will not be limited to, workload, player position and time of play.

**Types of outcomes**

This review will consider studies that include any of the following outcome measures: non-contact injury. A non-contact injury is defined as an injury which is significant enough to cause an inability to fully or partially participate in training or matches and which was caused by an overuse mechanism rather than collision-type injuries.\textsuperscript{10}

**Types of studies**

This review will consider both experimental and epidemiological study designs including randomized controlled trials, non-randomized controlled trials, quasi-experimental studies, before and after studies, prospective and retrospective cohort studies, case control studies and analytical cross sectional studies for inclusion. This review will also consider descriptive epidemiological study designs including descriptive cross sectional studies for inclusion.
Search strategy

The search strategy aims to find both published and unpublished studies. A three-step search strategy will be utilized in this review. An initial limited search of MEDLINE and CINAHL will be undertaken followed by analysis of the text words contained in the title and abstract, and of the index terms used to describe the article. A second search using all identified keywords and index terms will then be undertaken across all included databases. Thirdly, the reference lists of all identified reports and articles will be searched for additional studies. Studies published in all languages will be considered for inclusion in this review. Studies published prior to 1 December 2014 will be considered for inclusion in this review.

The databases to be searched include: MEDLINE via PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), the Cochrane Controlled Trials Register in the Cochrane Library, Physiotherapy Evidence Database (PEDro), ProQuest 5000 International, ProQuest Health and Medical Complete, EBSCO MegaFile Premier, Science Direct and SCOPUS. The search for unpublished studies will include: EBSCO MegaFile Premier.

Assessment of methodological quality

Papers which fit the inclusion criteria will be assessed by two independent reviewers for methodological validity prior to inclusion in the review using standardized critical appraisal instruments from the Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI) (Appendix I). Any disagreements that arise between the reviewers will be resolved through discussion, or with a third reviewer.

Data collection

Data will be extracted from papers included in the review using the standardised data extraction tool from JBI-MAStARI (Appendix II). The data extracted will include specific details about the interventions, populations, study methods and outcomes of significance to the review question and specific objectives.

Data synthesis

Quantitative data will, where possible, be pooled in statistical meta-analysis using JBI-MAStARI. All results will be subject to double data entry. Effect sizes expressed as odds ratio (for categorical data) and weighted mean differences (for continuous data) and their 95% confidence intervals will be calculated for analysis. Heterogeneity will be assessed statistically using the standard Chi-square. Where statistical pooling is not possible the findings will be presented in narrative form including tables and figures to aid in data presentation where appropriate.

Conflicts of interest

The authors declare that there are no conflicts of interests involved in this proposed systematic review.

Acknowledgements

University of the Witwatersrand Research Committee funding via the Friedel Sellschop Award
References


Appendix I: Appraisal instruments

MAStARI appraisal instrument

**JBI Critical Appraisal Checklist for Randomised Control / Pseudo-randomised Trial**

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Unclear</th>
<th>Not Applicable</th>
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</thead>
<tbody>
<tr>
<td>1. Was the assignment to treatment groups truly random?</td>
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<td>2. Were participants blinded to treatment allocation?</td>
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<td>3. Was allocation to treatment groups concealed from the allocator?</td>
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<tr>
<td>4. Were the outcomes of people who withdrew described and included in the analysis?</td>
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<tr>
<td>5. Were those assessing outcomes blind to the treatment allocation?</td>
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<td>6. Were the control and treatment groups comparable at entry?</td>
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<td>7. Were groups treated identically other than for the named interventions</td>
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<td>8. Were outcomes measured in the same way for all groups?</td>
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<td>9. Were outcomes measured in a reliable way?</td>
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<tr>
<td>10. Was appropriate statistical analysis used?</td>
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Overall appraisal:  Include ☐  Exclude ☐  Seek further info. ☐

Comments (Including reason for exclusion)

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________


## JBI Critical Appraisal Checklist for Descriptive / Case Series

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Unclear</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Was study based on a random or pseudo-random sample?</td>
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<td>2. Were the criteria for inclusion in the sample clearly defined?</td>
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<td>3. Were confounding factors identified and strategies to deal with them stated?</td>
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<td>4. Were outcomes assessed using objective criteria?</td>
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<td>5. If comparisons are being made, was there sufficient descriptions of the groups?</td>
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<td>6. Was follow up carried out over a sufficient time period?</td>
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<td>7. Were the outcomes of people who withdrew described and included in the analysis?</td>
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<td>8. Were outcomes measured in a reliable way?</td>
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<td>9. Was appropriate statistical analysis used?</td>
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Overall appraisal: Include [ ] Exclude [ ] Seek further info [ ]

Comments (Including reason for exclusion)

________________________________________________________________________
________________________________________________________________________
JBI Critical Appraisal Checklist for Comparable Cohort/ Case Control

Reviewer ___________________________ Date ___________________________

Author ___________________________ Year _______ Record Number _______

<table>
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<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Unclear</th>
<th>Not Applicable</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Is sample representative of patients in the population as a whole?</td>
<td>☐</td>
<td>☐</td>
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<td>2.</td>
<td>Are the patients at a similar point in the course of their condition/illness?</td>
<td>☐</td>
<td>☐</td>
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<td>3.</td>
<td>Has bias been minimised in relation to selection of cases and of controls?</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>4.</td>
<td>Are confounding factors identified and strategies to deal with them stated?</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>5.</td>
<td>Are outcomes assessed using objective criteria?</td>
<td>☐</td>
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<td>6.</td>
<td>Was follow up carried out over a sufficient time period?</td>
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<td>7.</td>
<td>Were the outcomes of people who withdrew described and included in the analysis?</td>
<td>☐</td>
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<td>8.</td>
<td>Were outcomes measured in a reliable way?</td>
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<td>9.</td>
<td>Was appropriate statistical analysis used?</td>
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Overall appraisal: Include ☐ Exclude ☐ Seek further info. ☐

Comments (Including reason for exclusion)

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Appendix II: Data extraction instruments

MAStARI data extraction instrument

**JBI Data Extraction Form for Experimental / Observational Studies**

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<td>Author</td>
<td>Year</td>
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<tr>
<td>Journal</td>
<td>Record Number</td>
</tr>
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**Study Method**

- RCT
- Quasi-RCT
- Longitudinal
- Retrospective
- Observational
- Other

**Participants**

Setting

Population

**Sample size**

Group A  
Group B

**Interventions**

Intervention A

Intervention B

**Authors Conclusions:**

**Reviewers Conclusions:**
### Study results

#### Dichotomous data

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Intervention ( ) number / total number</th>
<th>Intervention ( ) number / total number</th>
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#### Continuous data

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Intervention ( ) number / total number</th>
<th>Intervention ( ) number / total number</th>
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