## Appendix E: Differences between protocol and review

In the protocol, methodological quality of the included studies was going to be assessed using the Newcastle Ottawa scale in addition to the LBP-specific quality appraisal tool developed by Lebeouf-Yde and Lauritsen. Only the LBP-specific tool was used. KT and JW were the reviewers who assessed for quality, not FW and JW as listed.

## Appendix C: Search strategy

### Medline

1. Low Back Pain/ OR Sciatica/
2. (low* adj3 (back pain* OR back ache* OR backache* OR back injur*)).ti,ab.
3. ((Lumbal OR lumbar OR lumbosacral OR lumbosacroiliac) adj2 (pain* OR ache* OR syndrome OR strain* OR injur*)).ti,ab.
4. (Lumbago OR lumbodynia OR lumbalgesia OR lumbalgia OR Sciatica).ti,ab.
5. or/1-4
6. ATHLETES/ OR Athletic Injuries/ OR BASEBALL/ OR BICYCLING/ OR HOCKEY/ OR Racquet Sports/ OR WRESTLING/ exp sports/
7. (Rowing OR rower* OR sculling OR athlet* OR gymnast* OR cricket OR bowler* OR pitcher* OR wrestl* OR hockey OR baseball OR golf OR kayak* OR canoei* OR hammer throw* OR martial art* OR basketball OR bowling OR football OR lacrosse OR racquetball OR rugby OR soccer OR softball OR squash OR tennis OR volleyball).ti,ab.
8. (Sport* adj3 injur*).ti,ab.
9. or/6-8
10. Epidemiologic studies/
11. Exp case control studies/
12. Exp cohort studies/
13. Case control.tw.
14. (cohort adj (study or studies)).tw.
15. Cohort analy$.tw.
16. (Follow up adj (study or studies)).tw.
17. (observational adj (study or studies)).tw.
18. Longitudinal.tw.
19. Retrospective.tw.
20. Cross sectional.tw.
21. Cross-sectional studies/
22. or/9-20
23. and/5,9,22

### Embase

1. 'low back pain'/exp OR 'sciatica'/exp
2. (low* NEAR/3 (‘back pain*’ OR ‘back ache*’ OR ‘backache*’ OR ‘back injur*’)):ti,ab
3. ((Lumbal OR lumbar OR lumbosacral OR lumbosacroiliac) NEAR/2 (pain* OR ache* OR syndrome OR strain* OR injur*)):ti,ab
4. (Lumbago OR lumbodynia OR lumbalgesia OR lumbalgia OR sciatica):ti,ab
5. #1 OR #2 OR #3 OR #4
6. 'athlete'/exp OR 'sport injury'/exp OR 'sport'/exp OR 'athletics'/exp OR 'baseball'/exp OR 'cricket (sport)'/exp OR 'cycling'/exp OR 'hockey'/exp OR 'ice hockey'/exp OR 'racquet sport'/exp
7. (Rowing OR rower* OR sculling OR athlet* OR gymnast* OR cricket OR bowler* OR pitcher* OR wrestl* OR hockey OR baseball OR

golf OR kayak* OR canoei* OR ‘hammer throw*’ OR ‘martial art*’ OR basketball OR bowling OR football OR lacrosse OR racquetball OR rugby OR soccer OR softball OR squash OR tennis OR volleyball):ti,ab
8. (Sport* NEAR/3 injur*):ti,ab
9. #6 OR #7 OR #8
10. 'clinical study'/de
11. 'case control study'/exp
12. 'family study'/exp
13. 'longitudinal study'/exp
14. 'retrospective study'/exp
15. 'prospective study'/exp
16. 'randomized controlled trial'/exp
17. #14 NOT #15
18. 'cohort analysis'/exp
19. (Cohort NEAR/1 (study or studies)):ti,ab
20. (‘Case control’ NEAR/1 (study or studies)):ti,ab
21. (‘follow up’ NEAR/1 (study or studies)):ti,ab
22. (observational NEAR/1 (study or studies)):ti,ab
23. (epidemiologic* NEAR/1 (study or studies)):ti,ab
24. (‘cross sectional’ NEAR/1 (study or studies)):ti,ab
25. #10 OR #11 OR #12 OR #13 OR #14 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24
26. #5 AND #9 AND #25

**CINAHL**

1. (MH "Low Back Pain") OR (MH "Sciatica")
2. TI (low* N3 (“back pain*” OR “back ache*” OR “backache*” OR “back injur*”)) OR AB (low* N3 (“back pain*” OR “back ache*” OR “backache*” OR “back injur*”))
3. TI ((Lumbal OR lumbar OR lumbosacral OR lumbosacroiliac) N2 (pain* OR ache* OR syndrome OR strain* OR injur*)) OR AB ((Lumbal OR lumbar OR lumbosacral OR lumbosacroiliac) N2 (pain* OR ache* OR syndrome OR strain* OR injur*))
4. TI (Lumbago OR lumbodynia OR lumbalgesia OR lumbalgia OR sciatica) OR AB (Lumbago OR lumbodynia OR lumbalgesia OR lumbalgia OR sciatica)
5. S1 OR S2 OR S3 OR S4
6. (MH "Rowing") OR (MH "Athletes+") OR (MH "Athletic Injuries") OR (MH "Baseball Injuries") OR (MH "Basketball Injuries") OR (MH "Cricket Injuries") OR (MH "Cycling Injuries") OR (MH "Fencing Injuries") OR (MH "Golf Injuries") OR (MH "Gymnastics Injuries") OR (MH "Hockey Injuries") OR (MH "Racquet Sports Injuries") OR (MH "Baseball") OR (MH "Cricket (Sports)") OR (MH "Cycling") OR (MH "Hockey") OR (MH "Racquet Sports") OR (MH "Sports+")
7. TI (Rowing OR rower* OR sculling OR athlet* OR gymnast* OR cricket OR bowler* OR pitcher* OR wrestl* OR hockey OR baseball OR golf OR kayak* OR canoei* OR “hammer throw*” OR “martial art*” OR basketball OR bowling OR football OR lacrosse OR racquetball OR rugby OR soccer OR softball OR squash OR tennis

OR volleyball) OR AB (Rowing OR rower* OR sculling OR athlet* OR gymnast* OR cricket OR bowler* OR pitcher* OR wrestl* OR hockey OR baseball OR golf OR kayak* OR canoei* OR “hammer throw*” OR “martial art*” OR basketball OR bowling OR football OR lacrosse OR racquetball OR rugby OR soccer OR softball OR squash OR tennis OR volleyball)

8. TI(Sport* N3 injur*) OR AB (Sport* N3 injur*)
9. S6 OR S7 OR S8
10. (MH "Prospective Studies")
11. (MH "Case Control Studies+")
12. (MH "Correlational Studies")
13. (MH "Nonconcurrent Prospective Studies")
14. (MH "Cross Sectional Studies")
15. TI (cohort N1 (study OR studies)) OR AB (cohort N1 (study OR studies))
16. TI (epidemiologic* N1 (study or studies)) OR AB (epidemiologic* N1 (study or studies))
17. TI (“follow up” N1 (study or studies)) OR AB (“follow up” N1 (study or studies))
18. TI (observational N1 (study or studies)) OR AB (observational N1 (study or studies))
19. TI (“cross sectional” N1 (study or studies)) OR AB (“cross sectional” N1 (study or studies))
20. S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19
21. S5 AND S9 AND S20

**Web of Science**

TS =(((low* NEAR/3 (“back pain*” OR “back ache*” OR “backache*” OR “back injur*”)) OR ((Lumbal OR lumbar OR lumbosacral OR lumbosacroiliac) NEAR/2 (pain* OR ache* OR syndrome OR strain* OR injur*)) OR (Lumbago OR lumbodynia OR lumbalgesia OR lumbalgia OR sciatica)) **AND** ((Cohort OR “Case control” OR epidemiologic* OR “follow up” OR observational OR “cross sectional”) NEAR/1 (study or studies)) **AND** (Rowing OR rower* OR sculling OR athlet* OR gymnast* OR cricket OR bowler* OR pitcher* OR wrestl* OR hockey OR baseball OR golf OR kayak* OR canoei* OR “hammer throw*” OR “martial art*” OR basketball OR bowling OR football OR lacrosse OR racquetball OR rugby OR soccer OR softball OR squash OR tennis OR volleyball) OR (sport* NEAR/3 injur*))

**Scopus**

TITLE-ABS(((low* W/3 (“back pain*” OR “back ache*” OR “backache*” OR “back injur*”)) OR ((Lumbal OR lumbar OR lumbosacral OR lumbosacroiliac) W/2 (pain* OR ache* OR syndrome OR strain* OR injur*)) OR (Lumbago OR lumbodynia OR lumbalgesia OR lumbalgia OR sciatica)) **AND** ((Cohort OR “Case control” OR epidemiologic* OR “follow up” OR observational OR “cross sectional”) W/1 (study or studies)) **AND** (Rowing OR rower* OR sculling OR

athlet* OR gymnast* OR cricket OR bowler* OR pitcher* OR wrestl* OR hockey OR baseball OR golf OR kayak* OR canoei* OR “hammer throw*” OR “martial art*” OR basketball OR bowling  OR football OR lacrosse OR racquetball OR rugby OR soccer OR softball OR squash OR tennis OR volleyball) OR (sport* W/3 injur*))

**Supplementary Table 4: Methodological quality assessment**

| Author | Date | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | SCORE (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Abe et al.* | 2017 | + | - | + | - | + | + | + | NA | NA | + | + | - | 70.0 |
| *Alricsson and Werner* | 2006 | - | - | + | + | + | + | + | NA | NA | + | + | + | 80.0 |
| *Alricsson and Werner* | 2005 | + | + | + | + | + | + | + | NA | NA | + | + | + | 100.0 |
| *Auvinen et al.* | 2008 | + | - | + | - | + | + | - | NA | NA | + | - | + | 60.0 |
| *Balague et al.* | 1988 | - | - | + | + | - | - | + | NA | NA | + | + | + | 60.0 |
| *Balague et al.* | 1994 | + | - | + | + | - | - | + | NA | NA | + | + | + | 70.0 |
| *Bayne et al.* | 2016 | - | NA | + | + | + | + | NA | - | NA | - | + | + | 66.7 |
| *Brown and Kimball* | 1983 | + | - | + | - | + | + | + | NA | NA | + | + | - | 70.0 |
| *Burnett et al.* | 1996 | - | NA | NA | + | + | + | NA | - | NA | - | - | - | 37.5 |
| *Cejudo et al.* | 2020 | - | - | - | + | + | + | - | NA | + | - | + | + | 54.5 |
| *Cezarino et al.* | 2020 | + | NA | NA | - | - | - | - | NA | NA | - | - | + | 25 |
| *Cupisti et al.* | 2004 | - | + | NA | + | + | + | - | NA | NA | + | + | - | 66.7 |
| *Dennis et al.* | 2005 | - | NA | NA | - | + | + | NA | NA | NA | - | - | - | 28.6 |
| *Farahbakhsh et al.* | 2018 | + | - | + | + | + | + | + | NA | NA | + | + | + | 90.0 |
| *Fouasson-Chailloux et al.* | 2020 | + | NA | NA | - | - | + | NA | NA | - | - | - | + | 37.5 |
| *Gamboa et al.* | 2008 | + | NA | NA | - | - | + | NA | NA | NA | - | - | + | 42.9 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Gregory et al.* | 2002 | - | + | + | - | + | + | - | NA | NA | - | - | - | 40.0 |
| *Grimmer and Williams* | 2000 | - | - | + | - | + | + | - | NA | NA | - | - | + | 40.0 |
| *Ha et al.* | 2017 | - | NA | NA | + | - | + | - | NA | NA | - | - | + | 37.5 |
| *Harreby et al.* | 1999 | + | - | - | + | + | + | + | NA | NA | + | + | + | 80.0 |
| *Hickey et al.* | 1997 | + | NA | NA | - | - | + | NA | NA | - | - | - | + | 37.5 |
| *Hjelm et al.* | 2010 | - | - | + | - | + | + | NA | NA | - | + | + | + | 60.0 |
| *Hoskins et al.* | 2010 | - | + | - | + | + | - | + | NA | NA | + | + | + | 70.0 |
| *Hutchinson* | 1999 | - | NA | NA | - | + | + | NA | NA | - | - | + | + | 50.0 |
| *Iwamoto et al.* | 2005 | + | NA | NA | + | - | + | NA | NA | - | - | - | + | 50.0 |
| *Iwamoto et al.* | 2004 | + | NA | NA | + | - | + | NA | NA | - | - | - | + | 50.0 |
| *Kaldau et al.* | 2021 | + | + | + | - | + | + | - | NA | NA | - | + | + | 70.0 |
| *Kamada et al.* | 2016 | + | - | + | - | + | + | + | NA | NA | + | + | - | 70.0 |
| *Kikuchi et al.* | 2019 | - | - | + | + | - | - | - | NA | NA | - | - | + | 30.0 |
| *Kountouris et al.* | 2012 | - | - | - | + | + | + | NA | NA | - | - | - | + | 40.0 |
| *Kujala et al. 1997 a* | 1992 | - | + | + | + | + | + | - | NA | NA | - | + | + | 70.0 |
| *Kujala et al. 1997 b* | 1994 | - | + | + | + | + | + | - | NA | NA | + | + | + | 80.0 |
| *Kujala et al. 1997 c* | 1996 | - | + | + | + | + | + | - | NA | NA | + | + | + | 80.0 |
| *Kujala et al. 1997 d* | 1997 | - | + | + | + | + | + | - | NA | NA | + | + | + | 80.0 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lee et al.* | 2020 | + | - | + | - | + | + | + | NA | NA | - | + | + | 70 |
| *Legault et al.* | 2015 | + | + | + | - | + | + | + | NA | NA | + | + | + | 90.0 |
| *Linek et al.* | 2018 | - | - | - | + | - | - | NA | - | NA | + | + | - | 30.0 |
| *McMeekan et al.* | 2001 | - | + | - | + | + | + | + | NA | NA | - | + | + | 70.0 |
| *Mizoguchi et al.* | 2019 | - | - | - | + | + | + | - | NA | NA | + | - | + | 50 |
| *Mogenson et al.* | 2007 | - | + | + | + | + | + | NA | + | NA | + | - | + | 80.0 |
| *Mueller et al.* | 2016 | - | NA | - | + | + | + | + | NA | NA | - | + | + | 66.7 |
| *Müller et al.* | 2017 | - | - | - | + | + | + | + | NA | NA | - | + | + | 60.0 |
| *Muntaner-Mas et al.* | 2018 | + | - | - | + | + | + | + | NA | NA | + | + | + | 80.0 |
| *Ng et al.* | 2014 | - | NA | + | + | + | + | + | NA | NA | + | + | + | 88.9 |
| *Noll et al.* | 2016 | - | - | + | + | + | + | + | NA | NA | - | + | + | 70.0 |
| *O'Connor et al.* | 2016 | - | - | NA | - | + | + | + | NA | - | - | + | + | 50.0 |
| *Ogon et al.* | 2001 | + | - | + | + | + | + | - | NA | - | - | + | + | 63.6 |
| *Palmer-Green et al.* | 2015 | - | + | NA | - | - | - | NA | NA | + | - | + | + | 44.4 |
| *Peterhans et al.* | 2020 | - | - | + | + | + | + | + | NA | + | - | + | + | 72.7 |
| *Rossi et al. 2018 a* | 2014 | - | - | - | + | + | + | + | NA | NA | + | + | + | 70.0 |
| *Rossi et al. 2018 b* | 2016 | - | - | + | + | + | + | + | NA | NA | + | + | + | 80.0 |
| *Rossi et al. 2018 c* | 2018 | - | - | + | + | + | + | + | NA | NA | + | + | + | 80.0 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Rossi et al.* | 2016 | + | + | + | + | + | + | + | NA | NA | + | + | + | 100.0 |
| *Sato et al.* | 2011 | + | + | + | + | + | - | - | NA | NA | - | + | + | 70.0 |
| *Schmidt et al.* | 2014 | + | - | NA | + | + | + | - | NA | NA | + | + | + | 77.8 |
| *Schoeb et al.* | 2020 | + | - | + | - | + | + | + | NA | NA | - | - | + | 60.0 |
| *Sekiguchi et al. a* | 2018 | + | - | + | + | + | + | - | NA | NA | - | - | - | 50.0 |
| *Sekiguchi et al. b* | 2019 | + | - | + | + | + | + | - | NA | NA | - | - | + | 60.0 |
| *Shah et al.* | 2014 | + | NA | NA | - | - | + | NA | NA | + | - | - | + | 50.0 |
| *Shimozaki et al.* | 2018 | - | - | NA | + | + | + | - | NA | NA | - | - | - | 33.3 |
| *Skoffer and Foldspang* | 2008 | - | - | + | + | + | + | - | NA | NA | + | + | + | 70.0 |
| *Smoljanovic et al.* | 2009 | + | - | + | - | + | + | - | - | NA | - | + | + | 54.5 |
| *Smyth et al.* | 2020 | + | NA | NA | - | + | - | + | NA | NA | - | - | + | 50 |
| *Sogi et al.* | 2018 | + | - | + | - | + | + | - | NA | NA | + | - | + | 66.7 |
| *Sommerfield et al.* | 2020 | - | - | + | - | + | + | + | NA | NA | - | + | + | 60 |
| *Son et al.* | 2020 | + | NA | NA | - | + | + | - | NA | NA | - | + | + | 62.5 |
| *Steffen et al.* | 2020 | + | NA | NA | - | - | + | + | NA | NA | - | + | + | 62.5 |
| *Sugimoto et al.* | 2020 | - | - | + | + | - | - | - | NA | NA | - | - | - | 20.0 |
| *Sundell et al.* | 2019 | + | - | + | + | + | + | + | NA | NA | + | + | + | 90.0 |
| *Swain et al. 2018 a* | 2018 | - | - | + | + | + | + | - | NA | NA | + | + | + | 70.0 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Swain et al. 2018 b* | 2017 | - | - | + | + | + | + | - | NA | NA | + | + | + | 70.0 |
| *Sweeney et al.* | 2019 | - | - | - | + | + | + | - | NA | NA | - | - | + | 40.0 |
| *Thoreson et al.* | 2017 | - | + | + | + | + | + | + | NA | NA | + | + | + | 90.0 |
| *van Hilst et al. 2015* | 2015 | - | - | + | + | + | + | + | NA | NA | + | + | + | 80.0 |
| *Vanti et al.* | 2010 | - | + | - | + | + | - | - | NA | NA | - | + | + | 50.0 |
| *Yabe et al. 2020 a* | 2020 | + | - | + | + | + | + | - | NA | NA | + | - | + | 70 |
| *Yabe et al. 2020 1a* | 2020 | + | + | + | + | - | - | + | NA | NA | + | - | + | 70 |
| *Yabe et al. 2020 b* | 2020 | + | - | + | + | + | + | - | NA | NA | + | - | + | 70 |
| *Yabe et al. 2020 c* | 2020 | + | - | + | + | + | + | - | NA | NA | + | - | + | 70 |
| *Zaina et al.* | 2016 | + | + | + | + | + | + | + | NA | NA | - | + | + | 90.0 |

## Appendix D: Study methodological quality appraisal tool

| |
|---|
| **A: Is the final sample representative of the target population?** |
| 1. At least one of the following must apply to the study: an entire target population, randomly selected sample, or sample stated to represent the target population |
| 2. At least one of the following: reasons for nonresponse described, non-responders described, comparison of responders and non-responders, or comparison of sample and target population |
| 3. Response rate and, if applicable, drop-out rate reported |
| **B: Quality of the data?** |
| 4. Were the data primary data of back pain or were they taken from a survey not specifically designed for that purpose? |
| 5. Were the data collected from each adult directly or were they collected from a proxy? |
| 6. Was the same mode of data collection used for all subjects? |
| 7. At least one of the following in the case of a questionnaire: a validated questionnaire or at least tested for reproducibility |
| 8. At least one of the following in the case of an interview: interview validated, tested for reproducibility, or adequately described and standardized |
| 9. At least one of the following in the case of an examination: examination validated, tested for reproducibility, or adequately described and standardized |
| **C: Definition of back pain** |

| |
|---|
| 10. Was there a precise anatomic delineation of the back area or reference to an easily obtainable article that contains such specification? |
| 11. Was there further useful specification of the definition of back pain, or question(s) put to study subjects quoted such as the frequency, duration, or intensity, and character of the pain. Or was there reference to an easily obtainable article that contains such specification? |
| 12. Were recall periods clearly stated: e.g., 1 week, 1 month, or lifetime? |

## Appendix B: Study reporting explanation

During data extraction, it appeared that there was dual (or multiple) publishing by some studies. The study by Pasanen et al. from 2016, the conference abstract by Pasanen et al. from 2014, and the study by Rossi et al. from 2018 are reported as Rossi et al. 2018 (a), (b), and (c). The first authors for these papers were contacted, and it was confirmed that the 2014 conference abstract reported preliminary results for the 2016 paper, and the 2018 paper included a follow up of the same participants.

The studies by Kujala et al. 1992, 1994, 1996, and 1997 will be reported under the study heading Kujala et al. 1997 (a), (b), (c), (d). The first author was contacted, and it was confirmed that Kujala et al. 1992 reported baseline associations, and each of the subsequent studies reported results from follow ups of the initial cohort.

The studies by Swain et al. 2017 and 2018 will be reported under the study heading Swain et al. 2017 (a) and (b). Attempts to contact the authors for clarification were unsuccessful. For the purposes of this review, it was assumed that the two studies used the same participant group, given similarities in participant numbers and demographic data.

The studies by Sekiguchi et al. 2018 and Yabe et al. 2019 will be reported under the study heading Sekiguchi et al. 2018 (a) and (b). Attempts to contact the authors for clarification were unsuccessful. For the purposes of this review, it was assumed that the two studies used the same participant group, given similarities in participant numbers and demographic data.

The study by Hutchinson 1999 included both a prospective and retrospective component. The prospective component will be reported as Hutchinson 1999 (a), and the retrospective component Hutchinson 1999 (b).

There were three studies by the same first author in the year 2020. These will be reported as Yabe et al. 2020 (a), (b), and (c).

The studies by Hagiwara et al. 2020 and Yabe et al. 2020 (a) will be reported under the study heading Yabe et al. 2020 (a) and (1a). Attempts to contact the authors for clarification were unsuccessful. For the purposes of this review, it was assumed that the two studies used the same participant group, given similarities in participant numbers and demographic data.

# Appendix F

**Cohort six-month risk**

Mixed-Effects Model (k = 4; $tau^2$ estimator: DL)

$tau^2$ (estimated amount of residual heterogeneity): 0 (SE = 0.00)
tau (square root of estimated $tau^2$ value): 0
$I^2$ (residual heterogeneity / unaccounted variability): 0.00%
$H^2$ (unaccounted variability / sampling variability): 1.00
$R^2$ (amount of heterogeneity accounted for): 100.00%

Test for Residual Heterogeneity:
QE(df = 2) = 1.34, p-val = 0.51

Test of Moderators (coefficient 2):
QM(df = 1) = 8.59, p-val = 0.00

Model results**:**

| | **Estimate** | **Confidence interval** | **P-value** |
|---|---|---|---|
| **Intercept** | 0.35 | 0.28 to 0.41 | <.0001 |
| **Methodological quality** | 0.30 | 0.10 to 0.51 | 0.00 |

**Cohort 12-month risk**

Mixed-Effects Model (k = 4; $tau^2$ estimator: DL)

$tau^2$ (estimated amount of residual heterogeneity): 0.00 (SE = 0.00)
tau (square root of estimated $tau^2$ value): 0.00
$I^2$ (residual heterogeneity / unaccounted variability): 4.27%
$H^2$ (unaccounted variability / sampling variability): 1.04
$R^2$ (amount of heterogeneity accounted for): 99.98%

Test for Residual Heterogeneity:
QE(df = 1) = 1.04, p-val = 0.31

Test of Moderators (coefficients 2:3):
QM(df = 2) = 431.55, p-val < .0001

Model results:

| | **Estimate** | **Confidence interval** | **P-value** |
|---|---|---|---|
| **Intercept** | 0.24 | 0.18 to 0.31 | <.0001 |
| **LBP definition** | 0.68 | 0.61 to 0.75 | <.0001 |
| **Methodological quality** | -0.59 | -0.69 to -0.48 | <.0001 |

**Cross-sectional point prevalence (high quality studies)**

Mixed-Effects Model (k = 15; $tau^2$ estimator: DL)

$tau^2$ (estimated amount of residual heterogeneity): 0.01 (SE = 0.01)
tau (square root of estimated $tau^2$ value): 0.09
$I^2$ (residual heterogeneity / unaccounted variability): 96.30%
$H^2$ (unaccounted variability / sampling variability): 27.00
$R^2$ (amount of heterogeneity accounted for): 45.86%

Test for Residual Heterogeneity:
QE(df = 9) = 242.98, p-val < .0001

Test of Moderators (coefficients 2:6):
QM(df = 5) = 19.42, p-val = 0.002

Model results:

| | **Estimate** | **Confidence interval** | **P-value** |
|---|---|---|---|
| **Intercept** | -0.41 | -0.99 to 0.17 | 0.17 |
| **LBP definition** | 0.23 | -0.005 to 0.47 | 0.05 |
| **N** | -0.0001 | -0.00 to -0.00 | 0.02 |
| **Sport2** | 0.03 | -0.15 to 0.041 | <.0001 |
| **Sex** | 0.21 | -0.03 to 0.44 | 0.07 |
| **Outcome** | -0.16 | -0.33 to 0.01 | 0.06 |

**Cross-sectional three-month prevalence (high quality studies)**

Mixed-Effects Model (k = 4; $tau^2$ estimator: DL)
$tau^2$ (estimated amount of residual heterogeneity): 0 (SE = 0.00)
tau (square root of estimated $tau^2$ value): 0
$I^2$ (residual heterogeneity / unaccounted variability): 0.00%
$H^2$ (unaccounted variability / sampling variability): 1.00
$R^2$ (amount of heterogeneity accounted for): 100.00%

Test for Residual Heterogeneity:
QE(df = 2) = 1.1613, p-val = 0.5595

Test of Moderators (coefficient 2):
QM(df = 1) = 6.3593, p-val = 0.0117

Model results:

| | **Estimate** | **Confidence interval** | **P-value** |
|---|---|---|---|
| **Intercept** | 0.71 | 0.66 to 0.76 | <.0001 |
| **LBP definition** | 0.08 | 0.02 to 0.15 | 0.01 |

**Cross-sectional 12-month prevalence (high quality studies)**

Mixed-Effects Model (k = 7; $tau^2$ estimator: DL)

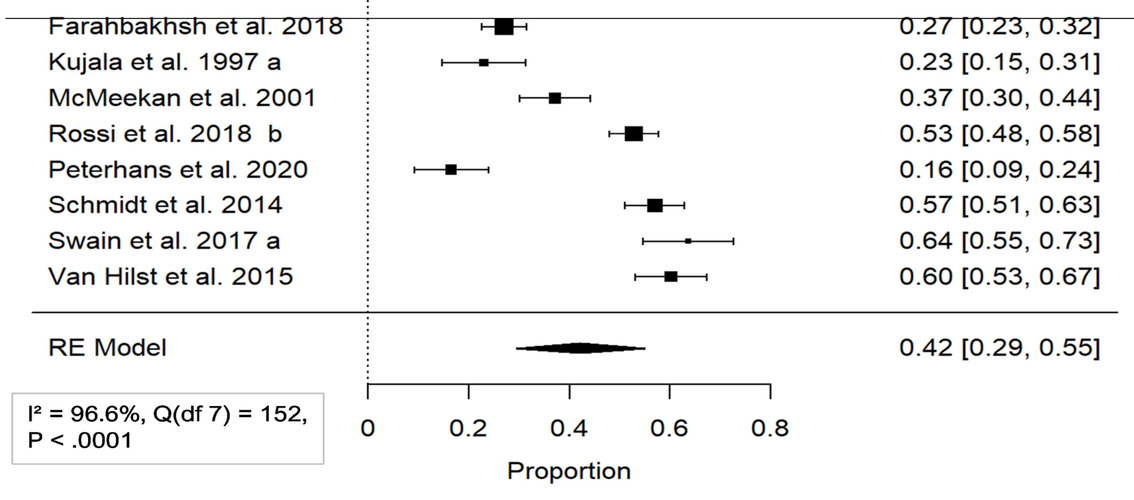
$tau^2$ (estimated amount of residual heterogeneity): 0.10 (SE = 0.15)
tau (square root of estimated $tau^2$ value): 0.32
$I^2$ (residual heterogeneity / unaccounted variability): 98.23%
$H^2$ (unaccounted variability / sampling variability): 56.37
$R^2$ (amount of heterogeneity accounted for): 0.00%

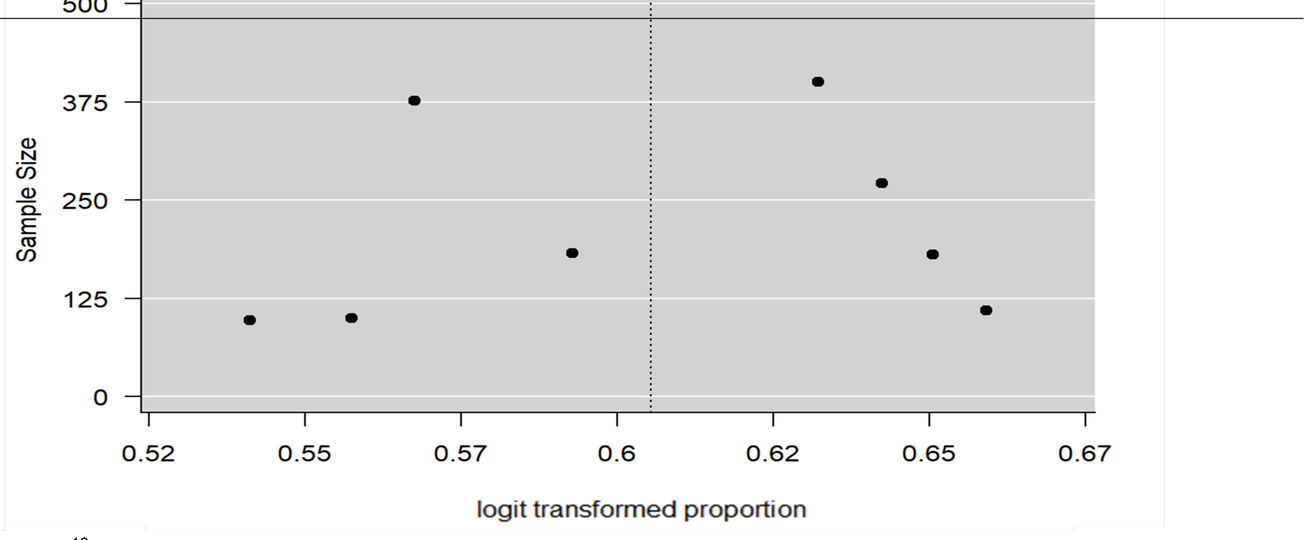
Test for Residual Heterogeneity:
QE(df = 1) = 56.37, p-val < .0001

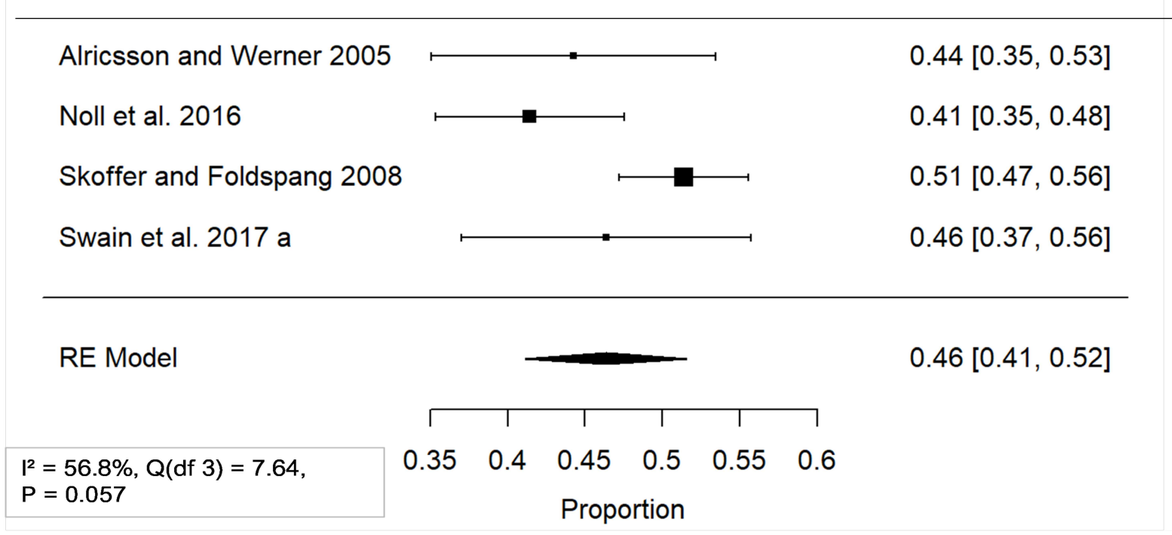
Test of Moderators (coefficients 2:6):
QM(df = 5) = 1.15, p-val = 0.95

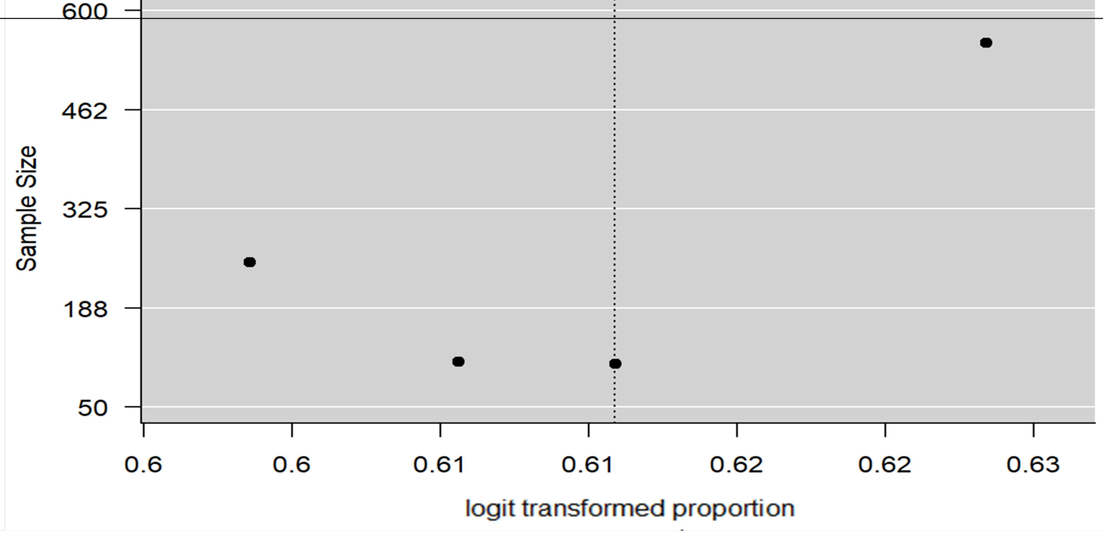
Model results:

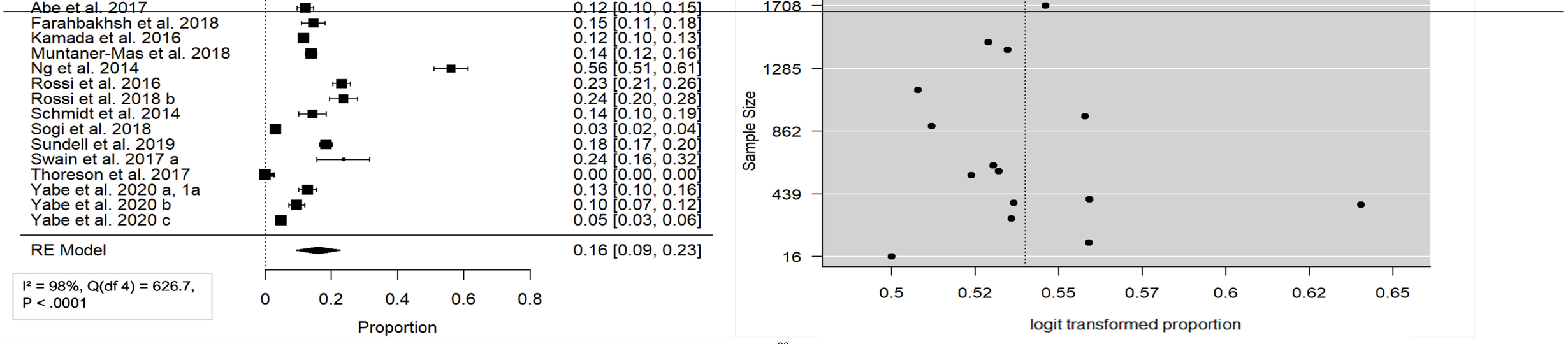
| | **Estimate** | **Confidence interval** | **P-value** |
|---|---|---|---|
| **Intercept** | -0.08 | -2.02 to 1.87 | 0.94 |
| **LBP definition** | 0.31 | -0.69 to 1.32 | 0.54 |
| **Number of participants** | 0.00 | -0.00 to .00 | 0.96 |
| **Sport** | 0.01 | -0.07 to 0.09 | 0.77 |
| **Sex** | 0.30 | -0.54 to 1.13 | 0.49 |
| **Data collection mode** | -0.07 | -0.48 to 0.31 | 0.71 |


Farahbakhsh et al. 2018
Kujala et al. 1997 a
McMeekan et al. 2001
Rossi et al. 2018 b
Peterhans et al. 2020
Schmidt et al. 2014
Swain et al. 2017 a
Van Hilst et al. 2015
RE Model
0.27 [0.23, 0.32]
0.23 [0.15, 0.31]
0.37 [0.30, 0.44]
0.53 [0.48, 0.58]
0.16 [0.09, 0.24]
0.57 [0.51, 0.63]
0.64 [0.55, 0.73]
0.60 [0.53, 0.67]
0.42 [0.29, 0.55]
I² = 96.6%, Q(df 7) = 152, P < .0001
0
0.2
0.4
0.6
0.8
Proportion


500
375
250
125
0
Sample Size
0.52
0.55
0.57
0.6
0.62
0.65
0.67
logit transformed proportion


Alricsson and Werner 2005
0.44 [0.35, 0.53]
Noll et al. 2016
0.41 [0.35, 0.48]
Skoffer and Foldspang 2008
0.51 [0.47, 0.56]
Swain et al. 2017 a
0.46 [0.37, 0.56]
RE Model
0.46 [0.41, 0.52]
I² = 56.8%, Q(df 3) = 7.64,
P = 0.057
0.35
0.4
0.45
0.5
0.55
0.6
Proportion


600
462
325
188
50
Sample Size
0.6
0.6
0.61
0.61
0.62
0.62
0.63
logit transformed proportion


Abe et al. 2017 0.12 [0.10, 0.15]
Farahbakhsh et al. 2018 0.15 [0.11, 0.18]
Kamada et al. 2016 0.12 [0.10, 0.13]
Muntaner-Mas et al. 2018 0.14 [0.12, 0.16]
Ng et al. 2014 0.56 [0.51, 0.61]
Rossi et al. 2016 0.23 [0.21, 0.26]
Rossi et al. 2018 b 0.24 [0.20, 0.28]
Schmidt et al. 2014 0.14 [0.10, 0.19]
Sogi et al. 2018 0.03 [0.02, 0.04]
Sundell et al. 2019 0.18 [0.17, 0.20]
Swain et al. 2017 a 0.24 [0.16, 0.32]
Thoreson et al. 2017 0.00 [0.00, 0.00]
Yabe et al. 2020 a, 1a 0.13 [0.10, 0.16]
Yabe et al. 2020 b 0.10 [0.07, 0.12]
Yabe et al. 2020 c 0.05 [0.03, 0.06]
RE Model 0.16 [0.09, 0.23]
I² = 98%, Q(df 4) = 626.7, P < .0001
0 0.2 0.4 0.6 0.8
Proportion
1708
1285
862
439
16
Sample Size
0.5 0.52 0.55 0.57 0.6 0.62 0.65
logit transformed proportion

**Interpretation of in-text funnel plots**

**Figure 2**: There is one outlier in this funnel plot which reported a higher incidence proportion. The remaining three studies are clustered around the midline. The outlier had 50% lower study numbers than the other three. All studies had similar definitions of injury. It is not possible to comment if there was recruitment bias in the outlying study.

**Figure 3:** In this funnel plot, there are two extremes. Two studies reported high incidence proportions, and two reported low incidence proportions. One study also had a higher sample size than the other three studies. There was a large range in sample sizes in these studies. There were varying definitions in the included studies (see Table 3).

**Figure 4:** There were also two extremes in this study, with one study reporting a higher incidence proportion. The study reporting a lower incidence proportion had a higher sample size. There were varying definitions in these two studies which could result in different reported incidences (see Table 3).

## Interpretation of supplementary funnel plots

**Suppl figure 1:** This funnel plot is well distributed, with four studies below the midline and four above. There was a large range in reported prevalence in these studies. Varying definitions of LBP were used in included studies (see Table 3).

**Suppl. figure 2:** There is one outlier in this funnel plot. This study reported a higher sample size and a higher prevalence than the remaining three studies.

**Suppl. figure 3:** This funnel plot is well distributed. Most points are clustered around the midline. There is one study which reported a higher prevalence, which is an outlier on this funnel plot. This study was LBP-specific, which could possibly result in recruitment bias.

**Supplementary Table 1:** Characteristics of participants of all the included studies

| Author, year | Country | Sport(s) | Study design | Setting | No. of participants (F%/M%) | Mean/ median participant age (SD/IQR) | Type of participants | Variables | Data collection mode |
|---|---|---|---|---|---|---|---|---|---|
| *Abe et al. 2017* | Japan | Team sports (Baseball, softball, basketball, soccer, volleyball, other) | Cross-sectional | Junior high schools and high schools in Unnan City, Shimane, Japan | N= 632<br>41%F/59%M | 13.8 (1.5) | Students participating in team sports | - Pain sites<br>- Relationship of number of teammates to MSK pain<br>- Team quantity index (TQI) | Questionnaire |
| *Alricsson and Werner 2006* | Sweden | Cross country skiing | Longitudinal cohort | Northern part of Sweden | N=15<br>53.3%F/46.7%M | *Start of study* 13.6 (0.9)<br>*Five year follow up* 18.5 (0.9) | Young elite cross-country skiers | - Kyphosis<br>- Lordosis<br>- Presence of LBP<br>- Training hours per week<br>- Weekly participation in sport other than cross country skiing | - Questionnaire<br>- Debrunner's kyphometer |
| *Alricsson and Werner 2005* | Sweden | Cross country skiing | Cross-sectional with age matched controls | High schools in Northern Sweden | N=120 cross country skiers<br>N=993 controls<br>Sex N/R | *Study group* 18. 1 (1.1)<br>*Control group* 18 (1) | Cross- country ski students from all 5 ski high schools in Sweden. Control group was from 3 school districts in the North part of Sweden. | - Physical activity<br>- Physical health<br>- Location of symptoms/injuries<br>- Back pain in skiers | Questionnaire |
| *Auvinen et al. 2008* | Finland | *Multiple (population-based study)*<br>Included: walking, jogging, cycling, cross-country skiing, swimming, soccer, ice hockey, floorball, rinkball or bandy, Finnish baseball, basketball, volleyball, ice-skating, figure skating, track and field, horseback riding, aerobics, gymnastics, dancing, gym training, downhill skiing or snowboarding, roller-skating or skateboarding, badminton, tennis, orienteering running, | Cross-sectional | Questionnaire based on the Finnish Physical Activity Survey as part of the Northern Finland Birth Cohort (1986) | N=6947<br>Sex N/R | N/R | Children born in the two northernmost provinces of Finland between July 1, 1985 and June 30, 1986 | - MSK pain<br>- Health habits such as physical activity, sedentary behaviour, smoking | Questionnaire |

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|---|---|---|---|---|---|---|---|---|---|
| | | judo or karate or wrestling, and golf. | | | | | | | |
| *Balague et al. 1988* | Switzerland | *Multiple (population-based study)* Included: soccer, skiing, gymnastics, swimming, bodybuilding, volleyball, aerobics | Cross-sectional | Schools in Switzerland | 1715 51%F/49%M | 12 | Schoolchildren in the fourth school district of the Sarine area near Fribourg, Switzerland | - Frequency and location of back pain<br>- Hours per day spent watching TV<br>- Number of cigarettes smoked<br>- Sports | Questionnaire |
| *Balague et al. 1994* | Switzerland | *Multiple* Included tennis, volleyball, cycling, and swimming | Cross-sectional | Primary and secondary schools in Switzerland | N=1716 50.6%F/49.4%M | *Mean* 11.7 *Median* 12 | Primary and secondary school children in One school district of Fribourg, Switzerland | - Lifetime and 7-day hx of LBP<br>- Localization of LBP<br>- Medical tx of LBP<br>- Parents hx of LBP<br>- TV watching<br>- Sports activity<br>- GPA | Questionnaire |
| *Bayne et al. 2016* | Australia | Cricket | Cohort | District and/or state junior cricket squads, data collection took place at the University of Western Australia | N=25 100%M | *Injured* 15.5 (1.4)<br>*Non-injured* 16 (1.2) | Fast bowlers from district and/or state junior cricket squads | - MRI<br>- MSK screening<br>- 3D biomechanical bowling analyses | Clinical examination |
| *Brown and Kimball 1983* | USA | Powerlifting | Cross-sectional | The 1981 Michigan Teenage Powerlifting Competition | n=71 100% M | N/R | Teenage powerlifters | - Training, experience<br>- Medical history<br>- Injury types<br>- Injury sites | Questionnaire |
| *Burnett et al. 1996* | Australia | Cricket | Cohort | Male fast bowlers at the beginning of the 1991-1992 cricket season and at the completion of the 1993-1994 cricket season | n=19 100% M | *Study start* 13.6<br>*Study end* 16.3 | 19 male cricket fast bowlers | Filming of maximum velocity bowling and MRI | Film and radiographic procedures |

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|---|---|---|---|---|---|---|---|---|---|
| *Cejudo et al. 2020* | Spain | Equestrian sports | Cross-sectional | Equestrian Technical Centre of the Region of Murcia (Murcia, Spain) | N=19<br>58%F/42%M | 14.7 (1.9)<br><br>*Male* 13.9 (1.8)<br><br>*Female* 15.3 (1.9) | Child equestrian athletes of the Murcia Regional Team | - Demographic data<br>- Sport related background info<br>- Training workload<br>- LBP<br>- Risk factors | Interview questionnaire<br><br>Clinical examination |
| *Cezarino et al. 2020* | Brazil | Soccer | Cohort | Brazilian first division male youth soccer academy | N=228<br>100%M | 16.51 (2.59) | Male youth soccer players | - Anthropometric measurements<br>- Injury and exposure data | - Measurements taken by club physiologist<br>- Injury report form completed by physiotherapist<br>- Training and match exposure forms completed by assistant coaches |
| *Cupisti et al. 2004* | Italy | Gymnastics | Cross-sectional | 19 gymnastics clubs affiliated with the Italy Federation of Gymnastics | *Study group*<br>N=67<br><br>*Control group*<br>N=104<br><br>100% F | Both groups 14.7 | Competitive club level gymnasts and age matched controls | - Presence, location, intensity of back pain<br>- Smoking habits<br>- Age of menarche<br>- Mental stress questionnaire<br>- Skinfold thickness measurements | Questionnaire and clinical examination |
| *Dennis et al. 2005* | Australia | Cricket fast bowling | Cohort | Club and district cricket leagues in Australia | n=44<br>100%M | 14.7 | Australian fast bowlers playing at the club and district level | - Match and training deliveries bowled each day<br>- Conditions/injuries<br>- MRI at baseline and post-injury | - Logbook<br>- MRI |
| *Farahbakhsh et al. 2018* | Iran | *Multiple*<br>Included: football, volleyball, basketball, wrestling, gymnastics, fitness, shooting, track and field, and swimming | Cross-sectional | Tehran Province, Iran between July and August 2017. Sports Medicine Research Centre of Tehran University of Medical Sciences | N=377<br>100% M | 15.95 | Male athletes participating in the sport Olympiad | - Questionnaire about prevalence of neck and LBP | Questionnaire |
| *Fouasson-Chailloux et al. 2020* | France | Soccer | Cohort | French regional academy | N=161<br>100%M | N/R | Youth male soccer players | - Injury diagnosis<br>- Date<br>- Nature<br>- Location<br>- Severity | Injury data recorded by sports physician |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Gamboa et al. 2008* | USA | Ballet | Retrospective descriptive cohort | Elite preprofessional ballet boarding school in Washington DC | N=359<br>80%F/20%M | 14.7 (1.9) | Elite adolescent pre-professional ballet dancers | - Demographics<br>- Past medical history<br>- Posture<br>- Strength<br>- Flexibility<br>- Orthopaedic testing<br>- Function | Clinical examination |
| *Gregory et al. 2002* | England | Cricket | Prospective cohort | Centres of Excellence of 3 "First Class" Counties in England in January 1998 | N=113 | 14.9 | Young cricketers | - Injuries caused by/interfering with bowling | Telephone questionnaire |
| *Grimmer and Williams 2000* | Australia | Multiple | Cross-sectional | 12 High schools in Adelaide, Australia in 1998 | N=1193<br>49%F/51%M | N/R | High school students in Australia | - Backpack and student weights<br>- Height<br>- questionnaire answers- information on LBP in the past two weeks | Questionnaire and clinical examination |
| *Ha et al. 2017* | South Korea | Baseball | Cross-sectional | Elementary schools, junior high schools, senior high schools in South Korea | n=293<br>100% M | 12.8 (2.1) | South Korean male baseball players | - Prevalence (Point and Lifetime)<br>- Recurrence<br>- Age of onset for LBP<br>- Peak height velocity calculated | Questionnaire and health records |
| *Harreby et al. 1999* | Denmark | Multiple | Cross-sectional | 46 municipal schools in 3 counites of Sealand, Denmark | n=1389,<br>52%F/48%M | 92.4% were either 15 or 16 years of age | 8th and 9th grade Danish schoolchildren | - LBP frequency and severity<br>- Sports participation frequency and intensity | Questionnaire |
| *Hickey et al. 1997* | Australia | Basketball | Retrospective review of records | Sports Medicine Department at the Australian Institute of Sport in Canberra, Australia | n=49<br>100%F | 17.6<br>*at time of injury presentation* | Elite female basketball players with scholarships at AIS | - Injury<br>- Anatomical location<br>- Nature<br>- Acute or chronic | Retrospective review of clinical examination |
| *Hjelm et al. 2010* | Sweden | Tennis | Cohort | Swedish local tennis club | n=55<br>65%F/45%M | 15.4 | Junior tennis players in Sweden, playing at least twice per week | - Gender<br>- Anatomic location<br>- Month<br>- Injury type<br>- Injury severity | Clinical examination |

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|---|---|---|---|---|---|---|---|---|---|---|
| *Hoskins et al. 2010* | Australia | Australian Rules football | Cross-sectional | Junior Australian rules football leagues | n=102 *elite junior*<br><br>60 *non-elite juniors*<br><br>100 *control* | *elite junior* 17.2 | Junior Australian rules football players, both elite and non-elite, and Australian high school students as the control group | - | Prevalence<br>Intensity<br>Quality<br>Frequency of LBP | Questionnaire |
| *Hutchinson 1999 a* | USA | Gymnastics | Cohort | U.S. Rhythmic Gymnastics National Team | n=7<br>100%F | 16 | 7 members of the U.S. national team for rhythmic gymnastics | - | Injuries<br>Treatments<br>Injury severity | Clinical examination |
| *Hutchinson 1999 b* | USA | Gymnastics | Retrospective review of injuries | U.S. Rhythmic Gymnastics National Team | N=12<br>100%F | 16 | Elite rhythmic gymnasts | - | Complaints severe enough to be seen by a physician | Retrospective review of records |
| *Iwamoto et al. 2005* | Japan | Rugby | Cohort | High schools in Japan | n=327<br>100%M | N/R | High school rugby players in Japan | - | Radiographs<br>Presence of LBP | Radiological examination and clinical examination |
| *Iwamoto et al. 2004* | Japan | Football | Cohort | High schools and college in Japan between 1986 and 1994 | n=171 *freshman high school players*<br><br>n=742 *freshman college players* | N/R | Incoming freshman high school and college football players in Japan | - | Abnormal radiographic findings<br>Presence of LBP | Radiological examination and clinical examination |
| *Kaldau et al. 2021* | Canada | Badminton | Cross-sectional | BWF World Junior Championships 2018 | N=166<br>44%F/56%M | 17.1 (0.8) | Junior badminton players | - | Player demographics<br>Significant injuries<br>Symptoms | Questionnaire |
| *Kamada et al. 2016* | Japan | *Multiple*<br>track and field, soft tennis, table tennis, badminton, Kendo, Judo, Karate, swimming, baseball, softball, basketball, soccer, volleyball, other | Cross-sectional | 7 Junior high schools and 3 high schools in Unnan, Shimane, Japan in 2008 and 2009 | n=2267 *students in 2008*<br>2212 *students in 2009*<br><br>52%F/48%M | 14.5 | All students in 7 junior high schools and 3 high schools in Unnan, Shimane, Japan | - | Descriptive statistics<br>Participation in organized sports<br>MSK pain using a questionnaire | Questionnaire |
| *Kikuchi et al. 2019* | Japan | Multiple (population-based study) | Cross-sectional | Single birth cohort of students, followed up in elementary and junior high | N=32596<br>21280 athletes | N/R | Elementary and junior high schoolers in Japan who are part of a single birth cohort study | - | Descriptive statistics<br>Participation in organized sports<br>Presence or absence of LBP | Questionnaire |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | school from 2005 to 2010 | | | | | |
| *Kountouris et al. 2012* | Australia | Cricket | Prospective cohort | Australia in 2002-2003 | n=38<br><br>100%M | 14.9 | Adolescent male cricket fast bowlers in Australia in 2002-2003 | - MR imaging to get Cross-sectional area of quadratus lumborum<br>- Low back pain followed by clinician investigation | MRI and self-report |
| *Kujala et al. 1997 a* | Finland | Soccer, ice hockey, gymnastics, ballet | Cross-sectional | Sports clubs and public school controls | n=138<br><br>58%F/42%M | N/R | Athletes from different specific sports clubs and public school controls | - Physical activity<br>- Lifetime cumulative LBP<br>- Pain symptoms<br>- Various physical measurements | Questionnaire and measurements |
| *Kujala et al. 1997 b* | Finland | Soccer, ice hockey, gymnastics, figure skating, ballet | Cohort | Elementary schools and sports clubs | n=119<br>56%F/44%M | N/R | Elementary school aged athletes and nonathletic controls | - History of physical activity<br>- Lifetime cumulative incidence of LBP<br>- LBP interfering with school or leisure activities during past 12-months<br>- Continuous/recurrent LBP<br>- Sciatica<br>- Acute back trauma<br>- Height<br>- Weight<br>- Body fat percentage<br>- Hypermobility<br>- Other anthropometric measures | Questionnaire and clinical examination |
| *Kujala et al. 1997 c* | Finland | Ice hockey, soccer, ice skating, gymnastics | Cohort | Elementary school and sports clubs | n=98<br>49%F/51%M | *male nonathletes* 11.9 (0.3) *male athletes* 11.9 (0.3) *female nonathletes* 11.9 (0.4) *female athletes* | Young athletes and nonathletes. Male athletes were involved in ice hockey and soccer, female athletes in gymnastics | - Past and present PA<br>- Acute injuries causing LBP<br>- Occurrence of LBP<br>- Duration<br>- Location<br>- Stages of maturity<br>- MRI | Questionnaire and MRI |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 11.7 (0.8) | and figure skating | | |
| *Kujala et al. 1997 d* | Finland | Ice hockey, soccer, ice skating, gymnastics | Cohort | Elementary school and sports clubs in Finland | n=98<br>49%F/51%M | *male nonathletes*<br>11.9 (0.3) *male athletes*<br>11.9 (0.3)<br>*female nonathletes*<br>11.9(0.4) *female athletes*<br>11.7 (0.8) | Young athletes and nonathletes. Male athletes were involved in ice hockey and soccer, female athletes in gymnastics and figure skating | - Past and present PA<br>- Acute injuries causing LBP<br>- Occurrence of LBP<br>- Duration<br>- Location<br>- Stages of maturity<br>- MRI | Questionnaire and clinical examination |
| *Lee et al. 2020* | Korea | Soccer | Cross-sectional | U15 soccer teams in Korean Football Association during the 2019 season | N=681<br>100%M | 13.6 (1.01) | Youth male soccer players | - Demographic information<br>- Training information<br>- Injury information (location occurrence, severity, type, cause, recurrent, surgery, days to return, treatment expenses) | Injury report questionnaire |
| *Legault et al. 2015* | Canada | Multiple | Cross-sectional | 2012 Quebec Summer Games | n=1771 *athletes*<br>48%F/52%M<br><br>N=700 *control group*<br>54%F/46%M | *athletes*<br>14.12(1.22)<br><br>*controls*<br>14.69(138) | Adolescent athletes in the 2012 Quebec Summer Games and an age-matched control group | - Socio-demographic and anthropometric information<br>- Physical activity participation level<br>- Prevalence and impact of MSK symptoms | - IPAQ<br>- Teen Nordic MSK Questionnaire<br>- Clinical examination |
| *Linek et al. 2018* | Poland | Soccer | Prospective longitudinal cohort | Sports and recreation center in in the Silesian region of Poland | n=97<br>100%M | *No LBP* 12.8 (2.2)<br><br>*LBP*<br>13.7 (3.0) | Adolescent male soccer players | - USI data about LAMs<br>- Occurrence of LBP | - Ultrasound imaging<br>- Oslo Sports Trauma Research Centre questionnaire with visual analogue scale |

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|---|---|---|---|---|---|---|---|---|---|
| *McMeeken et al. 2001* | Australia | Dance and gymnastics | Cross-sectional | Community, secondary schools, University of Melbourne, Australian Ballet School, Victorian College of the Arts and other ballet and gymnastics schools. | n=614<br>63%F/37%M | *females* 16.9(2.1), *males* 17.3 (1.9) | Dancers, gymnasts, and a control group | - Physical activity<br>- Back pain<br>- Severity | Questionnaire |
| *Mizoguchi et al. 2019* | Japan | Volleyball | Cross-sectional | High school volleyball teams in Saitama, Japan | N=123<br>49%F/51%M | 15.8 (0.7) | High school volleyball players | - Demographic details<br>- Environmental factors<br>- Injury history<br>- Presence/absence of LBP in the past year | Questionnaire |
| *Mogenson et al. 2007* | Denmark | *Multiple*<br>Included: Jump gymnastics, rhythmic gymnastics, soccer, other ball games, swimming, badminton/tennis, horseback riding, running, cycling, roller skating/skateboarding, martial arts, other | Cross-sectional | Schools in Odense, Denmark in 2001 | n=439<br>52%F/48%M | N/R | Adolescents living in Odense, Denmark | - Sports<br>- Number of hours per week<br>- Puberty stage | Questionnaire and clinical examination |
| *Mueller et al. 2016* | Germany | 19 different sports in 4 sport categories | Cohort | Elite sports schools | n=321<br>43%F/57%M | 13.1(1.4) | Elite adolescent athletes | - Anthropometrics<br>- Occurrence of back pain<br>- Sport type | Questionnaire (5-step face scale) |
| *Müller et al. 2017* | Germany | 17 different sports in 4 sports categories | Cross-sectional | Elite sports schools | n=2116<br>39%F/61%M | 13.3 (1.7) | Elite adolescent athletes | - Back pain Point prevalence at time and last 7 days<br>- Restrictions to sport<br>- Type of sport<br>- Training details<br>- Anthropometric data | Questionnaire (5-step face scale) |
| *Muntaner-Mas et al. 2018* | Spain | *Multiple*<br>Included: football, basketball, swimming, cycling, tennis, rhythmic gymnastics, futsal, athletics, volleyball, martial arts, handball, and others | Cross-sectional | 26 primary schools in Majorca, Spain | 2032,<br>46%F/54%M | 11.1 | 5th and 6th grade primary school students | - LBP occurrence<br>- Treatment<br>- LBP in bed or upon waking<br>- LBP at the end of PE<br>- Scoliosis<br>- Leg length discrepancy<br>- Anthropometric data | Questionnaire |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | - Sport participation | |
| *Ng et al. 2014* | Australia | Rowing | Retrospective cross-sectional | Independent boys and girls' schools in Western Australia | n=365, 64%F/36%M | *males* 15.1 (0.8), *females* 15 (0.8) | Rowers who competed for different schools in Western Australia | - Anthropometrics<br>- Questions about LBP such as intensity and aggravating factors | Questionnaire with VAS and One question adapted from Nordic MSK questionnaire |
| *Noll et al. 2016* | Brazil | Multiple | Cross-sectional | Brazil 2015 | n=251 31%F/79%M | 16.4 (1.4) | High school athletes participating in the Jogos dos Institutos Federais (Federal Institutes Games) | - Occurrence of back pain<br>- Demographics<br>- Behavioural factors<br>- Postural factors<br>- Heredity<br>- Level of physical activity | - Questionnaire "Back Pain and Body Posture Evaluation Instrument" (BackPEI)<br>- Anthropometry<br>- Manual and lumbar force<br>- Weight asymmetry |
| *O'Connor et al. 2016* | Ireland | Gaelic football and hurling | Prospective cohort | 6 secondary schools in Ireland | n= 292 100%M | 15.7(0.8) | Under 16 male adolescent Gaelic footballers and hurlers | - Sport<br>- Onset of injury<br>- Side<br>- Location<br>- Type<br>- Nature<br>- Time occurred<br>- Severity<br>- Mechanism<br>- Month<br>- Protective equipment worn | Injury report form based on the National College Athlete Association Injury Surveillance System and influenced by other epidemiological research |
| *Ogon et al. 2001* | | Alpine skiing | Prospective cohort | Elite alpine skiing high school in 1994 and 1995 | N= 120 35%F/65%M | 17 | Elite adolescent skiers | - Radiographic abnormalities<br>- Development of low back pain<br>- Duration<br>- Treatment | - Radiographic evaluation<br>- Diaries collected every Three-months<br>- Physical therapy records |
| *Palmer-Green et al. 2015* | England | Rugby | Cohort | 2 seasons (2006/7 and 2007/8) in a male rugby union in England | n=250 100%M | N/R | Male youth rugby union players | - Date of injury<br>- Injury classification<br>- Injury event<br>- Date of return | Questionnaire |

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| *Rossi et al. 2016* | Finland | *Multiple*<br>Included: Basketball, cross-country skiing, floorball, football, gymnastics, ice hockey, orienteering, skating, swimming, track and field | Cross-sectional | Part of the Finnish Health Promoting Sports Club study, 154 youth sports clubs in Finland in 2013 | N=962 | Broken down in Table 1 | Adolescents who are members of youth sports clubs in Finland and secondary school non-members | - Health behaviours<br>- Physical activity<br>- Injuries<br>- Musculoskeletal health | Two questionnaires |
| *Rossi et al. 2018 a* | Finland | Basketball, floorball, ice hockey, and volleyball | Retrospective cross-sectional | Finnish female and male basketball, floorball, ice hockey and volleyball teams | N=464 | Mean age 16 (1.9) | Players from 22 basketball, floorball, ice hockey, and volleyball teams | - Prevalence of LBP<br>- Gender<br>- Age<br>- Sport<br>- Family LBP history | Questionnaire |
| *Rossi et al. 2018 b* | Finland | Basketball and floorball | Cross-sectional | Nine basketball teams and nine floorball teams from Tampere city district, Finland | n=401<br><br>47%F/53%M | Mean age 15.8(1.9) | Young floorball and basketball players | - Background information<br>- LBP in the previous 12-months | Questionnaire |
| *Rossi et al. 2018 c* | Finland | Basketball and floorball | Cohort | 9 basketball and 9 floorball teams in Finland | N=396 | Mean age 15.8(1.9) | Young floorball and basketball players | - Location<br>- Cause<br>- Type<br>- Time of onset<br>- Mechanism | Questionnaire and anthropometry |
| *Peterhans et al. 2020* | Switzerland | Alpine skiing | Cross-sectional | Swiss- Ski and related regional ski federations | N=108<br>39%F/61%M<br>42F/66M | 14.83 (0.58)<br><br>*Females* 14.74 (0.66)<br><br>*Males* 14.88 (0.52) | Youth competitive alpine skiers | - MRI from T10 to S1<br>- Anthropometric assessments<br>- OSTRC questionnaire responses | - MRI<br>- OSTRC questionnaire<br>- Personal retrospective interviews and physical examinations performed by sports physician |
| *Sato et al. 2011* | Japan | *Multiple*<br>Included: swimming, basketball, soccer, baseball, tennis, wind-instrument music, table tennis, volleyball, athletics, kendo, karate, badminton, ballet, dance, judo, gymnastics, golf, dodgeball, rugby, sumo wrestling and wrestling, archery | Cross-sectional | All students in fourth to sixth grade elementary school (21,893) and all students in first to third year junior high (21,737) in Niigata City | N= 26,766 | N/R | Elementary school and junior high school students in Niigata City, Japan | - Presence of LBP<br>- Sports activities | Questionnaire |

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| *Schmidt et al. 2014* | Germany | *Multiple*<br>Included 31 sports. The following had more than ten athletes: volleyball, biathlon, swimming, canoe racing, tobagganing, alpine skiing, short track, canoe slalom, ice skating, figure skating, rowing | Cross-sectional | Centre for Orthopaedics and Traumatology | n=272<br>42%F/58%M | 15.4(2.0) | Young competitive athletes coming to the centre for an annual medical check-up | - Point, 1-year, and Lifetime prevalence rates of LBP<br>- Severity<br>- Intensity<br>- Duration<br>- Number of episodes of LBP<br>- Hours of weekly practice<br>- Years of training | Questionnaire with VAS and clinical examination |
| *Schoeb et al. 2020* | Switzerland | Alpine Skiing | Cohort | Certified regional performance centres of Swiss-Ski | N=167 | 13.89 (0.60)<br><br>*Females* 13.80 (0.68)<br><br>*Males*<br>13.94 (0.54) | U15 and U14 competitive alpine skiiers | - Anthropometric measurements<br>- OSTRC questionnaire responses | OSTRC questionnaire and supplemental interview with a sports physician |
| *Sekiguchi et al. 2018 a* | Japan | Baseball | Cross-sectional | The Miyagi Amateur Sports Association in north-east Japan | n=1582,<br>4%F/96%M | *Median* 11 | Youth baseball players who belonged to the Miyagi Amateur Sports Association | - Demographic information<br>- Number of years in sport<br>- Level<br>- Number of hours<br>- intensity<br>- Presence of pain in knee, shoulder, low back elbow | Questionnaire |
| *Sekiguchi et al. 2018 b* | Japan | Baseball | Cross-sectional | Amateur sports association | N=1609 | *Median*<br>11 (IQR 10-12) | Young baseball players | - Presence of LBP and knee pain<br>- Demographic information<br>- Team level<br>- Amount of training<br>- Intensity of training | Questionnaire |
| *Shah et al. 2015* | UK | Soccer | Cohort | English Premiership soccer academy squads between 1998 and 2006 | N=12,306<br>100%M | N/R | Youth soccer players in England | - Mechanism of injury<br>- Timing<br>- Nature<br>- Time to return to participation<br>- Any further clinical examinations | Prospective injury data collection and event analysis |

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| *Shimozaki et al. 2018* | Japan | Weightlifting | Prospective three-year cohort study | Weightlifting team in Japan | N=12<br>50%F/50%M | *Start of study*<br>11.4(2) | Child/adolescent weightlifters who had been competing in weightlifting events for at least 2 years | - Practice frequency<br>- Presence of LBP<br>- MRI findings | Questionnaire and lumbar MRI findings |
| *Skoffer and Foldspang 2008* | Denmark | *Multiple*<br>Included: Soccer, jogging, biking, dance, handball, badminton, swimming, fighting, basketball, gymnastics, riding, scouting, golf, tennis, table tennis, shooting, other | Cross-sectional | 14 public schools in Aarhus, Denmark | N=555<br>47%F /53%M | 97.8% were 15 or 16 | Schoolchildren in 9th grade in Denmark | - Occurrence of LBP<br>- Intensity<br>- Duration<br>- Pain coping<br>- Physical activity<br>- Sports<br>- TV<br>- Computer<br>- Method of transporting school bag<br>- Smoking<br>- Furniture | Questionnaire |
| *Smoljanovic et al. 2009* | Multiple (world champs) | Rowing | Cross-sectional | Junior World Rowing Championships in Beijing in 2007 | N=596<br>39%F/61%M | N/R | Junior rowers competing in the Junior World Rowing Championships (coxswains not included) | - General information<br>- Rowing specific information<br>- Amount of training<br>- Injuries (traumatic and overuse) | Rowing-specific questionnaire and interviews |
| *Smyth et al. 2020* | Australia | Netball | Prospective cohort | 2018 17/U&19/U Australian National Netball Championships | N=192 | N/R | Athletes participating in the Australian National Netball Championships 2018 | - Incidence of injuries occurring in the 2018 17/U & 19/U ANNC<br>- Athlete exposure | N/R |
| *Sogi et al. 2018* | Japan | Soccer | Cross-sectional | Miyagi Amateur Sports Association in Japan | N=1139<br>6%F/94%M | *Median* 11 (IQR 9-12) | Adolescent soccer players | - Lower extremity pain<br>- Trunk pain<br>- Covariates: sex, age, BMI, height increase, days training, competition level, frequency of participation in games, previous injuries | Self-reported questionnaire |

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| *Sommerfield et al. 2020* | New Zealand | *Multiple*<br>Including: netball, soccer, field hockey, lacrosse, swimming, athletics, badminton, rowing | Prospective cohort | Girls' secondary school in New Zealand | N=103<br>100%F | 14.0 (0.6) | Girls from PE classes at a secondary school | - Sports and PE injury rates<br>- Association between injury and phase of menstrual cycle | | - OSTRC questionnaire with modification to include information about menstrual cycle<br>- Apps used for menstrual cycle: FITrWoman or My Calendar |
| *Son et al. 2020* | Korea | Taekwondo | Cohort | Korea Taekwondo Association | N=183<br>37%F/63%M | 15.4 (1.72)<br><br>*Male*<br>15.2 (1.74)<br><br>*Female* 15.75 (1.62) | Youth athletes registered at the Korea Taekwondo Association | - Mechanism<br>- Location<br>- Type of injury<br>- Sports specific items<br>- Time loss<br>- Personal information: age, sex, height, weight, history, years of experience | | ISS questionnaire (comprised of info form IOC and US NCAA ISS questionnaires) |
| *Steffen et al. 2020* | Norway | *Multiple*<br>Including: Rugby, boxing, badminton, gymnastics artistic, cycling, wrestling, futsal, judo, beach volleyball, weightlifting, hickey 5s, basketball 3x3, diving, athletics, tennis, triathlon, taekwondo, fencing, beach handball, karate, trampoline, sailing, gymnastics rhythmic, modern pentathlon,gymnastics acrobatic, break dancing, canoeing, golf, shooting, table tennis, swimming, archery, roller speedskating, equestrian, climbing, rowing, kitesurfing, BMX freestyle | Cohort | Buenos Aires 2018 Youth Olympic Summer Games | N=3984<br>50%F/50%M | *Female*<br>16.9 (0.9)<br><br>*Male*<br>17.2 (0.8) | Athletes competing in the Youth Olympic Summer Games | - Injuries<br>- Illnesses | | IOC injury and illness report form |

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| *Sugimoto et al. 2020* | USA | Figure skating | Cross-sectional | Four figure skating clubs in the North East region of the U.S. | N=132<br>100%F | 16.8 (3.0) | Adolescent female figure skaters in the North East U.S | - Sport specialization<br>- Presence of back injury diagnosed by a health professional<br>- Demographic questions<br>- Figure skating training questions | Questionnaire |
| *Sundell et al. 2019* | Sweden | *Multiple*<br>Including: soccer, floorball, strength training, ice hockey, aerobics, judo sports, swimming, equestrian, athletics, gymnastics | Cross-sectional | High schools in a municipality in the north of Sweden | N=2550 | N/R | Student attending high school in a municipality in the north of Sweden | - Individual characteristics<br>- Questions about physical activity level<br>- Sport | 23 of the 73 items from the Standardized Nordic Questionnaire, modified for students |
| *Swain et al. 2018 a* | Australia | Ballet | Cross-sectional | One pre-professional ballet school, two pre-professional university dance programs, and a professional nationally touring ballet company | N=110<br>83%F/17%M | *males*<br>17.1 (3.7),<br><br>*females* 17.9 (2.7). | Male and female classical ballet and contemporary dancers | - Presence of LBP<br>- Demographic information<br>- Menstruation<br>- Dance participation | Questionnaire |
| *Swain et al. 2018 b* | Australia | Ballet | Prospective cohort | One pre-professional ballet school, two pre-professional university dance programs, and a professional ballet company | N=119<br>83%F/17%M | *males*<br>17.1 (3.7)<br><br>*females* 17.9 (2.7) | Pre-professional and professional ballet dancers | - Demographic data<br>- Dance participation information<br>- LBP history data | Questionnaire |
| *Sweeney et al. 2019* | USA | Gymnastics | Cross-sectional | Gymnastics facilities in Colorado | n=67<br>100%F | *those with LBP*<br>13.7 (2.8),<br><br>*those without LBP* 11.7(2.8) | Gymnasts who participate in the USA Gymnastics Women's Artistic Junior Olympic Programs levels 3 to 10 | - Demographic and medical history<br>- History of LBP<br>- Flexibility | Questionnaire and clinical examination (measurements of flexibility) |

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| *Thoreson et al. 2017* | Sweden | Mogul skiing | Cross-sectional | Are Ski Academy in Jarpen, Sweden and age-matched students at the Ostesund and Are/Jarpen High Schools | *Study group* n=16 13%F/87%M<br><br>n=28 in control group 68%F/32%M | *study group* 17.6<br><br>*control group* 16.4 | 16 elite Mogul skiers and age matched controls | - MRI<br>- Back pain<br>- Average weekly exercise | - MRI from T5 to sacrum<br>- Three-part questionnaire regarding present or previous back pain, Visual Analog Scale (VAS), the Oswestry questionnaire (ODI), and the EuroQoL questionnaire |
| *Van Hilst et al. 2015* | The Netherlands | Field hockey, football, speed skating | Cross-sectional | Field hockey, football, and speed skating clubs in the Netherlands | N= 181<br><br>43%F/57%M | *male field hockey* 17 (15-24)<br><br>*female field hockey* 16 (14-19)<br><br>*male football* 18 (16-19)<br><br>*male speed skating* 18(15-23)<br><br>*female speed skating* 18(14-25) | Young elite athletes participating in field hockey, football, and speed skating | - Participant characteristics<br>- Sport participation<br>- Work<br>- Prevalence and severity of LBP<br>- Preventive measures against LBP | Nordic MSK questionnaire<br><br>Acute LBP screening questionnaire |
| *Vanti et al. 2010* | Italy | Gymnastics | Cohort | School of Physiotherapy, University of Bologna Italy | *Study group* N=91 93%F/7%M<br><br>*Age-matched control group* N=375 46%F/54%M | *gymnasts* 12(3.63)<br><br>*Control group* 13.07(0.95) | Young gymnasts | - Back pain<br>- Physical activity<br>- Social-behavioural factors<br>- Anthropometric factors<br>- Lumbar range of motion | Questionnaire and LBP ROM using electronic motion evaluation system |
| *Yabe et al. 2020 a* | Japan | Basketball | Cross-sectional | Amateur sports association | N=592 44%F/56%M | *Median* 13 (12,14) | Youth basketball players | - Low back pain<br>- Lower extremity pain<br>- Covariates: sex, age, team level, BMI, number of days training, frequency of participation in | Self-report questionnaire (no title) |

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| *Yabe et al. 2020 1a* | Japan | Basketball | Cross-sectional | Miyagi Amateur Sports Association in Japan | N=590 44%F/56%M | *Median* 13 (IQR 12-14) | Elementary and middle school aged basketball players | - Pain assessment (upper extremity pain and LBP)<br>- Covariates including sex, age, BMI, training volume, practice intensity, frequency of participation in games | Self-report questionnaire |
| *Yabe et al. 2020 b* | Japan | Volleyball | Cross-sectional | Amateur sports association | N=566 74%F/26%M | *Median* 11 (10,12) | Youth volleyball players | - Low back pain<br>- Lower extremity pain<br>- Covariates: sex, age, team level, BMI, number of days training, frequency of participation in games, practice intensity | Self-report questionnaire (no title) |
| *Yabe et al. 2020 c* | Japan | Martial arts (judo, kendo, karate) | Cross-sectional | Amateur sports association | N=896 32%F/68%M | *Median* 11 (9,13) | Youth martial artists | - Point prevalence of LBP<br>- Covariates: sex, age, team level, BMI, number of days training, frequency of participation in games, practice intensity | Self-report questionnaire (no title) |
| *Zaina et al. 2016* | Italy | Tennis | Cross-sectional | A public school and private competitive tennis societies in Italy | N= 305 total<br><br>*Tennis players* N= 102 (51%F/49%M)<br><br>*School students* N= 203 (50% F/50%M) | *Female tennis players* 12.0(0.8)<br><br>*Male tennis players* 12.0(1)<br><br>*Female students* 12.3(0.9)<br><br>*Male students* 12.4(1.0) | Competitive tennis players and age-matched students | - Clinical evaluation for spinal deformities<br>- presence of LBP past and present | - Measure of angle of trunk rotation using Bunnell scoliometer<br>- Questionnaire |

**Supplementary Table 2: Prevalence or incidence and associated factors**

| Author, year of publication | Sport | Percentage of athletes with LBP | Prevalence or incidence and time period | Percentage of control group with LBP | Associated factors |
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| *Ogon et al. 2001* | Alpine skiing | 12.5% | Two-year incidence | N/A | Severe anterior lesions |
| *Peterhans et al. 2020* | Alpine skiing | 16.5% | 12-month prevalence | N/A | N/R |
| *Schoeb et al. 2020* | Alpine skiing | 8.5% | Other prevalence (two week) | N/A | - Female gender<br>- Older age (U15) |
| *Hoskins et al. 2010* | Australian Rules football | 91.9% | Lifetime prevalence | 7-34% | Elite participation in Australian Rules football |
| *Kaldau et al. 2021* | Badminton | 19.4% | Orher prevalence (one month) | N/A | N/R |
| *Gamboa et al. 2008* | Ballet | 9.4% | Other prevalence | N/A | - Higher current disability scores<br>- History of LBP<br>- Foot pronation on the right<br>- Insufficient ankle plantarflexion<br>- Less lower extremity strength |
| *Swain et al. 2018 (a)* | Ballet | 1. 73.6%<br>2. 63.6%<br>3. 46.4%<br>4. 23.6% | 1. Lifetime prevalence<br>2. 12-month prevalence<br>3. Three-month prevalence<br>4. Point prevalence | N/A | Dance participation |
| *Swain et al. 2018 (b)* | Ballet | 78% | Nine-month incidence | N/A | Dance participation |
| *Ha et al. 2017* | Baseball | 1. 58.9%<br>2. 37.5% | 1. Lifetime prevalence<br>2. Point prevalence | N/A | - Baseball<br>- Peak height velocity<br>- Age |
| *Sekiguchi et al. 2018 (a)* | Baseball | 8.4% | Point prevalence | N/A | Elbow and/or shoulder pain |
| *Sekiguchi et al. 2018 (b)* | Baseball | 8.4% | Point prevalence | N/A | Knee pain |
| *Yabe et al. 2020 1a* | Basketball | 12.9% | Point prevalence | N/A | Upper extremity pain including shoulder |
| *Hickey et al. 1997* | Basketball | 37.5% | 6-year period prevalence | N/A | - Weight/strength training<br>- Elite level |
| *Yabe et al. 2020 a* | Basketball | 12.8% | Point prevalence | N/A | - Knee pain<br>- Ankle pain |
| *Rossi et al. 2018 (b)* | Basketball and floorball | 1. 54.9%<br>2. 52.9% | 1. Lifetime prevalence<br>2. 12-month prevalence | N/A | - Older age<br>- Family history of musculoskeletal symptoms |

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| | | 3. 23.7% | 3. Point prevalence | | |
| *Rossi et al. 2018 (c)* | Basketball and floorball | 13% | 1-3 year follow up, Incidence | N/A | N/R |
| *Rossi et al. 2018 (a)* | Basketball, floorball, ice hockey, and volleyball | 54.9% | 12-month prevalence | N/A | - Family hx of LBP<br>- Higher age |
| *Bayne et al. 2016* | Cricket | 36% | Six-month incidence | N/A | - Incorrect technique<br>- Trunk and hip muscle weakness<br>- Inadequate workload management |
| *Burnett et al. 1996* | Cricket | 58% | 2.7-year incidence | N/A | - Mixed bowling technique over an extended period of time. (Versus front-on or side-on) |
| *Dennis et al. 2005* | Cricket | 52% | Six-month incidence | N/A | High bowling workload |
| *Gregory et al. 2002* | Cricket | 10.7% | Six-month incidence | N/A | Fast bowling |
| *Kountouris et al. 2012* | Cricket | 44.7% | One season incidence | N/A | Higher BMI |
| *Alricsson and Werner 2005* | Cross country skiing | 44.2% | Three-month prevalence | N/R | - Prolonged back flexion<br>- Weakness in back muscles |
| *Alricsson and Werner 2006* | Cross country skiing | 46.6% | Three-month prevalence | N/A | - No regular participation in sports or other physical activities other than cross country skiing |
| *McMeekan et al. 2001* | Dance and gymnastics | 1. 54.1%<br>2. 37% | 1. Lifetime prevalence<br>2. 12-month prevalence | 1. 47.6%<br>2. 32.3% | Total activity hours (over 30 per week) |
| *Cejudo et al. 2020* | Equestrian sports | 42.1% | 12-month prevalence | N/A | - High body fat percentage<br>- Trunk lateral flexor endurance lower than 65 seconds |
| *Van Hilst et al. 2015* | Field hockey, football (soccer), speed skating | 60% | 12-month prevalence | N/A | - Pilates<br>- Training hours<br>- More time spent warming up |
| *Sugimoto et al. 2020* | Figure skating | 25% | Lifetime prevalence | N/A | -Independent association between chronological age and low back injury |
| *Iwamoto et al. 2004* | American football | 62.9% | 12-month incidence | N/A | - Spondylolysis (radiological risk factor)<br>- Disk space narrowing<br>- Spinal instability |
| *O'Connor et al. 2015* | Gaelic football<br>Hurling | 5% Gaelic injuries<br>22% hurling injuries | Incidence | N/A | Adolescent Gaelic games |
| *Cupisti et al. 2004* | Gymnastics | 10.4% | Lifetime prevalence | 26% | - Being overweight<br>- Older (adolescent) age<br>- Smoking |
| *Hutchinson 1999a* | Gymnastics | 86% | Point prevalence | N/A | Rhythmic gymnastics |

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| *Hutchinson 1999b* | Gymnastics | 23.9% | 12-month prevalence | N/A | N/R |
| *Sweeney et al. 2019* | Gymnastics | 45% | 12-month prevalence | N/A | Menarche |
| *Vanti et al. 2010* | Gymnastics | 1. 46%<br>2. 26% | 1. Lifetime prevalence low level LBP<br>2. Lifetime prevalence medium/high level LBP | 1. 60%<br>2. 36% | - Female gender<br>- Sedentary lifestyle<br>- Psychosocial risk factors<br>- Parents/siblings with LBP |
| *Yabe et al. 2020 c* | Martial arts | 4.8% | Point prevalence | N/A | - Older age<br>- Lower extremity pain |
| *Thoreson et al. 2017* | Mogul skiing | 50% | Lifetime prevalence | 42% | Mogul skiing (exposed to different high loads) |
| *Kikuchi et al. 2019* | Multiple | 6.6% | Point prevalence | 6.5% | - Female gender<br>- Extracurricular sports |
| *Legault et al. 2015* | Multiple | 35.8% | Six-month prevalence | 45.4% | Female gender |
| *Schmidt et al. 2014* | *Multiple*<br>31 sports. The following had more than ten athletes volleyball, biathlon, swimming, canoe racing, tobagganing, alpine skiing, short track, canoe slalom, ice skating, figure skating, rowing | 1. 65.8%<br>2. 57%<br>3. 14.3% | 1. Lifetime prevalence<br>2. 12-month prevalence<br>3. Point prevalence | N/A | Competitive sport participation |
| *Rossi et al. 2016* | *Multiple*<br>Included: basketball, cross-country skiing, floorball, football, gymnastics, ice hockey, orienteering, skating, swimming, track and field | 1. 56.4%<br>2. 23.2% | 1. Lifetime prevalence<br>2. Point prevalence | 1. 54.5% non-sports club members | Higher screen time during leisure time |
| *Müller et al. 2017* | *Multiple*<br>Included: Boxing, soccer, artistic gymnastics, weight lifting, handball, judo, canoeing, track&field, modern pentathlon, cycling, horse riding, wrestling, rowing, swimming, shooting, triathlon, volleyball | 8% | Point prevalence | N/A | - Older adolescent age<br>- Sports with repetitive translation, reclination and rotation (like judo, wrestling, rowing and canoeing) |
| *Mogenson et al. 2007* | *Multiple*<br>Included: Jump gymnastics, rhythmic gymnastics, soccer, other ball games, swimming, badminton/tennis, horse back riding, running, cycling, roller skating/skateboarding, martial arts, other | 58.4% | One-month prevalence | 39% | - Martial arts<br>- Roller skating/skateboarding<br>- Horseback riding |
| *Sommerfield et al. 2020* | *Multiple*<br>Included: Netball, soccer, field hockey, lacrosse, swimming, athletics, badminton, rowing | 7.5% | 30-week incidence | N/A | N/R |
| *Steffen et al. 2020* | *Multiple*<br>Included: rugby, boxing, badminton, gymnastics artistic, cycling, wrestling, futsal, judo, beach volleyball, weightlifting, hickey 5s, basketball 3x3, diving, athletics, tennis, triathlon, taekwondo, fencing, beach handball, karate, trampoline, sailing, | 6.9% | 12-day incidence | N/A | N/R |

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| | gymnastics rhythmic, modern pentathlon,gymnastics acrobatic, break dancing, canoeing, golf, shooting, table tennis, swimming, archery, roller speedskating, equestrian, climbing, rowing, kitesurfing, BMX freestyle | | | | |
| *Sundell et al. 2019* | *Multiple*<br>Included: soccer, floorball, strength training, ice hockey, aerobics, judo sports, swimming, equestrian, athletics, gymnastics | 44.2% | 12-month prevalence | 1. 46.2 overall (athletes and non-athletes)<br>2. 42.4 overall (athletes and non-athletes) | - Female gender<br>- Sport activity (especially lasting more than 6 hours per week) |
| *Skoffer and Foldspang 2008* | *Multiple*<br>Included: soccer, jogging, biking, dance, handball, badminton, swimming, fighting, basketball, gymnastics, riding, scouting, golf, tennis, table tennis, shooting, other | 51.3% | Three-month prevalence | N/ | - Jogging<br>- Handball<br>- Gymnastics<br>- Riding |
| *Noll et al. 2016* | *Multiple*<br>Included: volleyball, basketball, handball, soccer | 43.7% | Three-month prevalence | N/A | - Overweight/obesity<br>- Psychosocial variables<br>- Posture<br>- Smoking<br>- Lumbar force |
| *Abe et al. 2017* | *Multiple*<br>Teams sports (Baseball, softball, basketball, soccer, volleyball, other) | 12.4% | Point prevalence | N/A | - Regular player<br>- Fewer teammates |
| *Grimmer and Williams 2000* | Multiple (not specified) | 11% | Two-week prevalence | N/R | - Time spent sitting<br>- Carrying heavy loads<br>- Increased participation in sport for the youngest students |
| *Harreby et al. 1999* | Multiple (not specified) | 53% | One-month prevalence males in high level sport | 30.6% overall | - Female gender<br>- Daily smoking<br>- Heavy job in leisure time |
| Balague et al. 1988 | *Multiple (population- based)*<br>Included: soccer, skiing, gymnastics, swimming, body-building, volleyball, aerobics | 35.6% | Lifetime prevalence | 33% | - Time spent watching TV<br>- Smoking<br>- Competitive sports |
| *Balague et. al 1994* | *Multiple (population-based)*<br>Included: tennis, volleyball, cycling, skiing, gymnastics, soccer and swimming | 18% | Lifetime prevalence | 20% | - Age<br>- Gender (female)<br>- Parent LBP<br>- Sports activities<br>- Time spent watching TV |
| *Auvinen et al. 2008* | *Multiple (population-based)*<br>Included: walking, jogging, cycling, cross-country skiing, swimming, soccer, ice hockey, floorball, rinkball or bandy, Finnish baseball, basketball, volleyball, ice-skating, figure skating, track and field, horseback riding, aerobics, gymnastics, dancing, gym training, downhill skiing or snowboarding, roller-skating or skateboarding, badminton, te nnis, orienteering running, judo or karate or wrestling, and golf. | 4.7% | Six-month prevalence | 44% female<br>33% male | - Participation in One single risk sport vs multiple sports |

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| *Mueller et al. 2016* | *Multiple*<br><br>Combat sports<br>(boxing, karate, judo, wrestling)<br><br>Game sports<br>(soccer, handball, volleyball)<br><br>Explosive strength sports (Bob, artistic gymnastics, weight lifting, athletics track&field, modern pentathlon<br><br>Endurance sports with strength compOnent<br>(canoeing, cycling, horse riding, rowing, swimming, shooting, triathlon) | 10% | two-year incidence | N/A | Game sports |
| *Kujala et al. 1992 (c)* | *Multiple*<br>Ice hockey, soccer, ice skating, gymnastics | 45% | 3 year follow up | 18% | Sports which have low back injury risk |
| *Kujala et al. 1992 (d)* | *Multiple*<br>Ice hockey, soccer, ice skating, gymnastics | 45% | 3 year follow up | 18% | - Low maximal lumbar extension<br>- repetitive lumbar extension |
| *Muntaner-Mas et al. 2018* | *Multiple*<br>Included: football, basketball, swimming, cycling, tennis, rhythmic gymnastics, futsal, athletics, volleyball, martial arts, handball, and others | 1. 66.8%<br>2. 13.9% | 1. Lifetime prevalence<br>2. Point prevalence | 1. 66.2% | - Female gender<br>- overweight/obesity |
| *Farahbakhsh et al. 2018* | *Multiple*<br>Included: football, volleyball, basketball, wrestling and other (which meant gymnastics, fitness, shooting, track and field, and swimming | 1. 42%<br>2. 27%<br>3. 14.6% | 1. Lifetime prevalence<br>2. 12-month prevalence<br>3. Point prevalence | N/A | Playing basketball |
| *Sato et al. 2011* | *Multiple*<br>Included: swimming, basketball, soccer, baseball, tennis, wind-instrument music, table tennis, volleyball, athletics, kendo, karate, badminton, ballet, dance, judo, gymnastics, golf, dodgeball, rugby, sumo wrestling and wrestling, archery | 34.9% | Lifetime prevalence | 32.1% | Sports participation |
| *Kamada et al. 2016* | *Multiple*<br>Included: track and field, soft tennis, table tennis, badminton, Kendo, Judo, Karate, swimming, baseball, softball, basketball, soccer, volleyball, other | 11.6% | Point prevalence | 27.4% | Participation in organized sport |
| *Kujala et al. 1992 (a)* | *Multiple*<br>Soccer, ice hockey, gymnastics, ballet | 23% | 12-month prevalence | 21% | Tightness of hip flexor muscles |
| *Kujala et al. 1992 (b)* | *Multiple*<br>Soccer, ice hockey, gymnastics, figure skating, ballet | 10.4% | 12-month incidence | 24% | Individual sports (figure skating and gymnastics) |
| *Smyth et al. 2020* | Netball | 9.7% | six-day incidence | N/A | N/R |
| *Brown and Kimball 1983* | Powerlifting | 50% | Point prevalence | N/A | Powerlifting |

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| *Ng et al. 2014* | Rowing | 1. 83.5%<br>2. 57% | 1. Lifetime prevalence<br>2. Point prevalence | N/A | - Ergometer rowing<br>- Long rowing sessions<br>- Sweep rowing |
| *Smoljanovic et al. 2009* | Rowing | 32.3% | One-season incidence | N/A | Cross training |
| *Iwamoto et al. 2005* | Rugby | 66% | 12-month incidence | N/A | Spondylolysis (radiological risk factor) |
| *Palmer-Green et al. 2015* | Rugby | 19.4% (trunk)<br>0.07-0.57 per 1000 player-hours | 2 season incidence | N/A | Lower level of play in rugby |
| *Cezarino et al. 2020* | Soccer | 3.2% | One season incidence | N/A | - Older age group<br>- Match vs training |
| *Fouasson-Chailloux et al. 2020* | Soccer | 6.5% | 5-year incidence | N/A | N/R |
| *Lee et al. 2020* | Soccer | 4.1% | One season prevalence | N/A | N/R |
| *Linek et al. 2018* | Soccer | 9.3% | Six-month incidence | N/A | Asymmetry in OI (obliquus internus) measurement |
| *Shah et al. 2014* | Soccer | 1.5% | Eight season incidence | N/A | - Second half of first half of match<br>- Contact with other players<br>- After breaks |
| *Sogi et al. 2018* | Soccer | 3.2% | Point prevalence | N/A | Knee pain |
| *Son et al. 2020* | Taekwondo | 5.05% | Point prevalence | N/A | N/R |
| *Hjelm et al. 2010* | Tennis | 21% | Two-year incidence | N/A | Female gender |
| *Zaina et al. 2016* | Tennis | 53% | Lifetime prevalence | N/R | N/R |
| *Mizoguchi et al. 2019* | Volleyball | 48% | 12-month prevalence | N/A | - Ankle injury within the past year<br>- Years of participation in volleyball |
| *Yabe et al. 2020 b* | Volleyball | 9.5% | Point prevalence | N/A | - Knee pain<br>- Ankle pain |
| *Shimozaki et al. 2018* | Weightlifting | 25% | Three-year incidence | N/A | N/R |

**Supplementary Table 3: Pain or injury definitions**

| Study name | Study type (LBP-specific or general musculoskeletal/injury surveillance) | Injury or pain definition used | LBP-specific definition (Y/N) | Low back anatomical site defined (Y/N) |
|---|---|---|---|---|
| *Abe et al. 2017* | General MSK | "Pain was defined by frequency and part of the body area that was painful. Pain should be present at least once a week in at least one part of the body". | N | Y |
| *Alricsson and Werner 2005* | LBP-specific | N/R | N | N |
| *Alricsson and Werner 2006* | LBP-specific | N/R | N | N |
| *Auvinen et al. 2008* | General MSK | N/R | N | Y |
| *Balague et al. 1988* | LBP-specific | "LBP concerns only lumbar pain, and back pain is a global statement of all spinal pain". | Y | N |
| *Balague et al. 1994* | LBP-specific | N/R | N | N |
| *Bayne et al. 2016* | LBP-specific | Injury was defined as pain that affected a bowler's ability to perform in a match. The definition of injury was expanded to include radiological evidence of lumbar bone stress. | N | N |
| *Brown and Kimball 1983* | General MSK | N/R | N | N |
| *Burnett et al. 1996* | LBP-specific | N/R | N | N |
| *Cejudo et al. 2020* | LBP-specific | LBP for longer than 1 week or whether they did not attend at least three days of training due to LBP within the last 12 months. | Y | N |
| *Cezarino et al. 2020* | General MSK | Any physical complaint sustained by a player during a soccer match or soccer training that results in a player being unable to take full part in future soccer training or match play (ie, time-loss injury). | N | N |
| *Cupisti et al. 2004* | LBP-specific | A yes response to the question "do you often have back pain?". | Y | N |
| *Dennis et al. 2005* | General MSK | "Injury was defined as a condition that affected availability for team selection, limited performance during a match, or required surgery. Minor injuries which only affected participation in training sessions were not examined in this study." | N | N |
| *Farahbakhsh et al. 2018* | LBP-specific (in addition to neck pain) | Pain between the lowest rib bone and the lower gluteal fold which would limit the athlete's daily or sports activities more than one day. | Y | Y |
| *Fouasson-Chailloux et al. 2020* | General MSK | A physical complaint reported by a player about an injury occurring during competition or training and requiring medical attention. | N | N |
| *Gamboa et al. 2008* | General MSK | "An injury was considered to have occurred when a dancer sought at least One treatment session from a physical therapist". | N | N |

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| *Gregory et al. 2002* | General MSK | Only injuries occurring during bowling were recorded in incidence data. Injuries not severe enough to impair bowling performance were not included. | N | N |
| *Grimmer and Williams 2000* | LBP-specific | N/R | N | N |
| *Ha et al. 2017* | LBP-specific | N/R | N | N |
| *Harreby et al. 1999* | LBP-specific | "LBP was defined as pain in the lower back and was illustrated by a text and drawing at the front of the questionnaire". | Y | Y |
| *Hickey et al. 1997* | General MSK | An injury was defined as any injury examined by the medical practitioners of the AIS Sports Medicine Department. | N | N |
| *Hjelm et al. 2010* | General MSK | Injury defined as when it was impossible for the player to participate fully in regular tennis training or matches during at least One occasion. Injury to the lumbar spine was defined as low back pain. | Y | N |
| *Hoskins et al. 2010* | LBP-specific | To assist with answering the questions a diagram of a mannequin that defined the anatomical boundaries of the low back as a shaded area between the last ribs and the gluteal folds was provided. For the purposes of this survey the shaded area represented the low back and subjects were told to focus only on LBP and not other sources of pain. | Y | Y |
| *Hutchinson 1999* | General MSK | Injury defined as those that required an evaluation from a physician. | N | N |
| *Iwamoto et al. 2005* | LBP-specific | LBP defined as "non-traumatic back pain that resulted in stopping playing rugby completely for at least one day". | Y | N |
| *Iwamoto et al. 2004* | LBP-specific | LBP defined as nontraumatic low back pain if it resulted in the subject not playing football for at least one day. | Y | N |
| *Kaldau et al. 2021* | General MSK | Current musculoskeletal symptoms defined as experiencing pain or stiffness in most of the last 30 days prior to competing at the World Junior Badminton Championships. | N | N |
| *Kamada et al. 2016* | General MSK | Students were considered to suffer from musculoskeletal pain if pain was present recently at least several times a week in at least one part of the body. | N | Y |
| *Kikuchi et al. 2019* | LBP-specific | Answering yes to the question "Do you have any pain in your lower back now?". | Y | N |
| *Kountouris et al. 2012* | LBP-specific | N/R | N | N |
| *Kujala et al. 1997 a* | LBP-specific | LBP interfering with schoolwork or leisure activities during the last 12 months. | Y | N |
| *Kujala et al. 1997 b* | LBP-specific | LBP limiting schoolwork or leisure time activities been limited during the past 12 months. | Y | Y |
| *Kujala et al. 1997 c* | LBP-specific | LBP interfering with schoolwork or leisure activities for at least a one-week period. | Y | Y |
| *Kujala et al. 1997 d* | LBP-specific | LBP interfering with schoolwork or leisure activities for at least a one-week period. | Y | Y |

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| *Lee et al. 2020* | General MSK | An injury was defined as a physical complaint reported by a player experienced during a soccer match or training and included the following two factors: (1) a “medical attention” injury was defined as an injury that required a player to receive medical attention and (2) a “time loss” injury was considered an injury that rendered a player unable to participate in full training or a match. | N | N |
| *Legault et al. 2015* | General MSK | N/R | N | Y |
| *Linek et al. 2018* | LBP-specific | LBP was defined as a pain between the last rib and lower gluteal fold, which is bad enough to limit or change athletes’ daily routine or sports activities for more than 1 day. | Y | Y |
| *McMeeken et al. 2001* | LBP-specific | Back pain defined as "back pain or pain, you think comes from your back" lasting more than two days in the last year. | Y | N |
| *Mizoguchi et al. 2019* | LBP-specific | Pain or discomfort in the low-back region, within the region between the lowest rib and the buttocks, however no definition provided in questionnaire | Y | Y |
| *Mogenson et al. 2007* | LBP-specific | “Back problems were defined as the 1-month prevalence (pain reported on the day of the study, in the week, or in the month preceding the interview) specifically for any area of the spine (low back, mid back or neck)”. | Y | N |
| *Mueller et al. 2016* | LBP-specific | “Acute pain present at the time of answering the questionnaire and/or during the 7 days prior to the examination”. Faces 3-5 on face pain scale considered pain. | Y | N |
| *Müller et al. 2017* | LBP-specific | "Acute pain present at the time of answering the questionnaire and/or during the 7 days prior to examination" .Faces 3 to 5 on the face pain scale considered pain | Y | N |
| *Muntaner-Mas et al. 2018* | LBP-specific | LBP defined as "pain or discomfort in the low back region, from the lower ribcurvature to the lower part of the seat region". | Y | Y |
| *Ng et al. 2014* | LBP-specific | LBP defined as pain located between L1 and gluteal folds. | Y | Y |
| *Noll et al. 2016* | LBP-specific | N/R | N | N |
| *O'Connor et al. 2016* | General MSK/injury surveillance | Injury was defined as any injury sustained during competition or training resulting in restricted performance or time lost from play. | N | N |
| *Ogon et al. 2001* | LBP-specific | N/R | N | N |
| *Palmer-Green et al. 2015* | General MSK/injury surveillance | Consistent with the 2007 International Rugby Board consensus statement. Any injury that prevents a player from taking a full part in all training and match play activities typically planned for that day for a period of greater than 24 hours from midnight at the end of the day the injury was sustained. | N | N |
| *Rossi et al. 2018 a* | LBP-specific | LBP defined as “ache, pain, or discomfort of lumbar region with or without radiation to one or both legs”. | Y | Y |
| *Rossi et al. 2018 b* | LBP-specific | LBP was defined as "ache, pain or discomfort of lumbar region with or without radiation to one or both legs (sciatica)". | Y | Y |
| *Peterhans et al. 2020* | LBP-specific | N/R | N | N |
| *Rossi et al. 2018 c* | LBP-specific | Pain in the upper and/or lower back area that prevented the player from fully participating in the team training and playing during the following 24 hours. | Y | Y |

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| *Rossi et al. 2016* | LBP-specific | LBP was defined as “an ache, pain, or discomfort of the lumbar region with or without radiation to one or both legs (sciatica)”. | Y | Y |
| *Sato et al. 2011* | LBP-specific | Definition depended on participant judgement. | N | N |
| *Schmidt et al. 2014* | LBP-specific | N/R | N | Y |
| *Schoeb et al. 2020* | General MSK | N/R | N | N |
| *Sekiguchi et al. 2018 a* | LBP-specific and knee pain and upper extremity pain | A yes response to the question, “Do you have low back pain?”. | Y | N |
| *Sekiguchi et al. 2018 b* | LBP and knee pain | A positive answer to "Do you have lower back pain?" was considered LBP. | Y | N |
| *Shah et al. 2015* | LBP-specific | An injury was defined as an absence from participating in full training and matches for 48 hours or longer. | N | N |
| *Shimozaki et al. 2018* | LBP-specific | “Participant was unable to practice weightlifting for more than a week due to the pain. Practice was stopped if the slightest pain was present and restarted when the pain runs out". | Y | N |
| *Skoffer and Foldspang 2008* | LBP-specific | LBP defined as "pain or discomfort in the low back region, from the lower rib curvature to the lower part of the seat region" Shown in a drawing in the questionnaire. Menstrual pain excluded | Y | Y |
| *Smoljanovic et al. 2009* | General MSK | All injuries classified by loss of training time if present. | N | N |
| *Smyth et al. 2020* | General MSK | Concurrent Injury Definitions Concept Framework (ID+)23 definitions were utilised. | N | N |
| *Sogi et al. 2018* | General MSK | “Do you have pain in any parts of your body now? If yes, please check the following parts” (multiple choices were allowed). Anatomical areas indicated by a drawing. | N | Y |
| *Sommerfield et al. 2020* | General MSK | Injuries were defined as any physical problem affecting training or competition in the previous week. | N | N |
| *Son et al. 2020* | General MSK | N/R | N | N |
| *Steffen et al. 2020* | General MSK | Injuries included musculoskeletal complaints, concussions and other non-musculoskeletal trauma, such as dental injuries. | N | N |
| *Sugimoto et al. 2020* | LBP-specific | ‘Have you had any of the following diagnoses by a healthcare professional?’ Muscular spine pain, stress fracture, spondylolysis, spondylolisthesis, disc protrusion/herniated disc, sciatica, and spinal cord injury. | Y | N |
| *Sundell et al. 2019* | LBP-specific | LBP- ache or pain in the lowest part of the back. | Y | Y |
| *Swain et al. 2018 b* | LBP-specific | "In the past month, have you had pain in your lower back?" accompanied by a diagram of the posterior aspect of the body, highlighting the region between the lower margin of the 12th ribs and the gluteal folds. | Y | Y |

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| *Swain et al. 2018 a* | LBP-specific | "Have you ever experienced pain in your lower back?" accompanied by a diagram of the posterior aspect of the body, highlighting the region between the lower margin of the 12th ribs and the gluteal folds. | Y | Y |
| *Sweeney et al. 2019* | LBP-specific | N/R | | N |
| *Thoreson et al. 2017* | LBP-specific | Back pain defined as present or previous pain in the thoraco-lumbar back. | Y | Y |
| *Van Hilst et al. 2015* | LBP-specific | LBP defined as ache, pain or discomfort in the region of the lower back whether or not it extends from there to One or both legs (sciatica). Indicated with a shaded picture. | Y | Y |
| *Vanti et al. 2010* | LBP-specific | "In order to define back pain, the following questions were used: 'Have you ever had a backache and with what frequency?' and 'how would you rate your usual pain in a scale from 0 to 10?'". | Y | N |
| *Yabe et al. 2020 a* | LBP and lower extremity pain | Do you have pain in any parts of your body now? If yes, please mark the parts where you have pain with a circle (multiple answers were allowed). | N | Y |
| *Yabe et al. 2020 1a* | LBP and upper extremity pain | The participants who checked lower back, shoulder, or elbow were considered to have LBP, shoulder pain, or elbow pain, respectively. | Y | Y |
| *Yabe et al. 2020 b* | LBP and lower extremity pain | “Do you have pain in any parts of your body? If yes, please check the parts you have pain”. Body parts, including the head, lower back, and each joint, were illustrated by a drawing. | N | Y |
| *Yabe et al. 2020 c* | LBP and general MSK | “Do you have pain in any parts of your body now? The body parts and names were illustrated using a drawing, and participants who checked lower back were considered to have LBP. | Y | Y |
| *Zaina et al. 2016* | LBP-specific | N/R | N | N |