Epidemiology of low back pain in rowers

A systematic review examined the prevalence of and risk factors for LBP in the general sports population to provide context for rowing.[1] The following question regarding rowing-related LBP was addressed:

"What is the current epidemiological evidence for prevalence of LBP in rowers and what are the associated risk factors?"

In 86 studies in all sports, the mean LBP point prevalence was 33%; lifetime prevalence was 63%; 12-month prevalence was 51%. Comparison across sports was limited by participant numbers, study quality and methodologies, and varying LBP definitions. Risk factors for LBP included history of a previous episode, and statistically significant associations were reported for high training volume, periods of load increase, and years of exposure to the sport.

There were 11 studies (1695 participants) that specifically examined LBP in rowers.[2-12] Six studies (667 participants) were high quality.[2 4 7 8 11 12] The most common LBP prevalence estimate for rowing studies was 12 months. The mean 12-month prevalence of LBP for rowers was 48% (range 32% - 95%). When only high-quality studies were pooled, the 12-month prevalence was **61%** (95% CI: 42-78%, I^2 95%). Data are summarised in Table A1

Author, year of publication	Country	No. of participants (M/F)	Mean participant Age (years) (SD)	Type of participants	Variables of interest	Data collection mode	LBP prevalence	Risk factors
Bahr et al. 2004	Norway	N=199, 131(M), 68(F)	M:21(6) F:22 (5)	Elite rowers	LBP prevalence and time loss (training and competition)	Questionnaire	1) LIFETIME: 63.3%; control 51% 2) 12 MONTH (retro) 55.5% rowers; 47.5% control 3) 7 DAYS (retro) 25.3% rowers; 19.6% control	Periods of increased training or competition load p<0.05
Clay, Mansell and Tierney 2016	USA	N=37(F)	N/R	College Division 1 rowers.	LBP prevalence, history of LBP, LBP associated disability	Clinical examination & questionnaire	1) 12 MONTH (retro): 68%	1) Increased years of rowing, 58% greater years in LBP group, p=0.008 2) Previous history of LBP, p=0.27,
Fett, Trompeter and Platen 2017	USA	N=83	21.1	Elite rowers	LBP prevalence	Questionnaire	1) LIFETIME: 96.4%; 2) 12 MONTH (retro): 95.2%; 3) 7 day (retro): 67.5%	1) Training volume, p<0.05 2) Increased age, p<0.001 3) Rowing participation OR 6.4 (95% CI 1.9-21.5)
Gonzalez et al. 2018	USA	N=31(F)	19.9(1.4)	National Collegiate Athletic Association Division I, open-weight rowers	LBP prevalence, FMS and SEBT performance	Clinical examination	1) One season (pros): 58% 2) 12 MONTH (retro): 54%	1) FMS score of <16 increased risk of LBP; RR=0.0667, 95% CI 0.9-2.11
Hickey, Fricker and McDonald 1997	Australia	N=172 88(M), 84(F)	F:20.1 M:21.3	Elite rowers	All injuries: type, region and prevalence	Retrospective analysis of medical database (10 years)	15.2% female and 25% male had LBP over 10 years	Weight training self-reported as most common 'mechanism of injury' (no data provided)
Maselli et al. 2015	Italy	N=133 107(M) 26(F)	19	National Championship rowers	LBP prevalence duration, severity and frequency of symptoms, time loss from work and training	Questionnaire	1) LIFETIME: 64.7%; 2) 12 MONTH (retro): 40.6%; 3) 1 MONTH (retro):19.5%	1) Type of rowing: a) Sculling + sweep; OR 4.43, p<0.001, 95% CI 1.87-10.48 b) Sweep only; OR= 3.32, p=0.03, 95% CI 1.16-6.27. Both higher risk than sculling only 2) Male sex; OR=2.62, p=0.03, 95% CI 1.16-6.27
Newlands, Reid and Parmar 2015	New Zealand	N=76, 46(M), 30(F)	M:23(4) F:21(4)	International rowers	LBP prevalence, previous history, movement competency screen	Questionnaire	1) 12 MONTH (pros): 52.6 % 2) incidence: 1.67	1) Increasing age;OR=1.08, p=0.02, 95% CI 1.01-1.15 2) Previous LBP history; OR=1.58, 95% CI 0.9-2.65

					(MCS) score,training volume		episodes per 1000 h of rowing exposure.	(logistic regression) 3) Total training hours/month; r=0.83, p<0.01 4) Ergometer hours/month; r=0.8, p<0.01 5) Average training hours/month; r=0.73, p<0.01 6) Average Km rowed/month; r=0.71, p=0.01
Schultz, Lenz and Buttner-Janz 2016b	Germany	N=45 29(M) 16(F)	22	Elite Rowers	1. Prevalence of LBP. 2. Pain intensity (VAS)	Questionnaire	1) 12 MONTH (retro): 31.5%	N/R
Smoljanović et al. 2018	Croatia	N=743, 475(M) 268(F)	50	Masters rowers	All injuries sustained during a 12-month period	Questionnaire	1) 12 MONTH (retro): 32.6%	1) Ergometer training >30 minutes in rowers age 60+years; x^2 4.114, p=0.043 2) Scullers higher risk than sweep rowers; x^2 4.973, p=0.026
Trompeter, Fett and Platen 2019	Germany	N=156 57.1%M, 41.7%F	22.2 (5.1)	Elite and no-elite rowers	Prevalence and severity of LBP.	Questionnaire	1) 12 MONTH (retro): 75% rowers, 58% controls. 2) 7 DAY (retro): 40% rowers, 29% controls. 3) LIFETIME: 84% rowers, 71% controls.	Training volume (12 month LBP); p=0.022, r=0.184
Wilson et al. 2010	Ireland	N=20 12(M) 8(F)	26.3 (4.2)	International rowers	1. Incidence of all injuries 2. training and competition exposure 3. type of injury	Questionnaire	1) 12 MONTH (pros): 31.8%	1) Ergometer training (more than 30 mins); r=0.75, p=0.01 2) Heavy weight training; r=0.66; p=0.02 3) Increased core stability training; r=0.68, p=0.01

Table A1: Studies examining epidemiology of low back pain in rowers

Summary statements from the Delphi process are in Table A2

Summary statements & recommendations: Epidemiology of low back pain in athletes with a rowing subgroup analysis
Exercise caution when comparing results of studies with different definitions of LBP. A standardised definition of athlete LBP is needed.
Prevalence varies widely among studies as a result of different methodologies and definitions of LBP. More research is needed, using gold standard prospective data collection, to estimate more precisely the prevalence of LBP in athletes.
Risk factors for LBP in athletes are: history of LBP; rapid increase in training or competition load; higher volume and intensity of training/competition; Increased years of exposure to the sport (career length)
Rowing-specific risk factors are: all of above + ergometer training greater than 30 minutes/session.
Radiological abnormalities should be considered in relation to symptom presentation and not in isolation. The significance of radiological abnormalities in the absence of symptoms is unclear.
Pre-season screening does not predict within-season onset of LBP in athletes.
Technical issues/biomechanics are likely to be a risk factor for LBP in some sports, but there is insufficient evidence to identify those and more research is needed to confirm this.

Table A2: Summary statements and recommendations from epidemiology of LBP in athletes review.

Definition of rowing-related low back pain

Fourteen experts (FW, KW, JT, KA, CG, JH, LT, AV, SJM, JPC, AMcG, MW, JAH, JS) rated nine initial statements proposed by the experts from standard, widely used LBP definitions and from those contained in the athlete LBP epidemiology studies. A decision was made following a four-round Delphi process. The consensus definition is described in **Box 1** (main document).

Relationship between biomechanics and rowing-related low back pain

A systematic review examined the relationship between rowing-related LBP and rowing biomechanics.[13] The following question regarding rowing-related LBP was raised:

"What are the spine, pelvis and hip biomechanics of rowing and how do they influence the risk of low back pain in rowers?"

Thirteen studies investigated spine kinematics during rowing and nine studies investigated muscle activity. One study compared the ergometer to rowing in a boat and all other studies were conducted on an ergometer. Rowing activity was associated with in an increased sagittal flexion range in the lumbar spine over time (spinal creep), which increased as rowers fatigued.

Studies that specifically examined LBP reported conflicting results regarding the influence of LBP on kinematics; some demonstrated that rowers with LBP history move more through their lumbar spine than their hips and other studies found no difference between groups.

Muscle activity during rowing is dominated by the extensor group of the trunk with trunk flexor activity focused on the transition from the drive to recovery phase. One study compared fixed and dynamic ergometers and found no difference in trunk muscle activity. One cross sectional, injury surveillance study (not included in the biomechanics review) reported a reduction in LBP prevalence when fixed ergometers were replaced by dynamic ergometers but no biomechanical factors were explored.[14] No studies examined trunk muscle function in a boat. Fatigue altered muscle recruitment. Rowers with LBP history had less efficient erector spinae recruitment compared to those without a history of LBP.

Summary statements from the Delphi process are in Table A3.

Summary statements & recommendations: Relationship of biomechanics to rowing-related LBP
There is insufficient evidence to recommend one ergometer type (fixed vs dynamic) over the other to avoid LBP
Rowing requires a relatively vertical pelvic position at the catch. If limitations in hip flexion do not allow for a vertical pelvis and increased lumbar flexion results, the risk for LBP may increase
Trunk asymmetries do not appear to be associated with LBP
The muscle activity of the trunk is dominated by the extensor group when rowing; the flexor group is relatively silent. The trunk flexors (abdominals) act as a braking force (eccentrically) at the end of the drive and at the change in direction of the trunk to the recovery.
There is insufficient evidence to confidently define which trunk and hip biomechanics increase risk of LBP in rowers. Future studies should evaluate rower biomechanics as part of a longitudinal LBP risk assessment programme

Table A3: Summary statements and recommendations from relationship of biomechanics to rowing-related LBP

Managing low back pain in athletes

A systematic review examined the management strategies for LBP in athletes and aimed to examine rowing specifically (where possible).[15] The following question was raised:

"*What is the evidence for commonly used treatments for managing LBP in athletes?*"

Thirteen randomised controlled trials (505 participants) examined exercise, biomechanical and activity modifications, and manual therapy. These were included in the review. Studies examining surgery and injection therapies were observational in design and were not included. There was a reduction in pain and disability after any treatment. Exercise was the most frequently investigated treatment, although no return to sport (RTS) data were reported for any exercise intervention. Different treatments for LBP in athletes improved pain, function, and RTS, but it was unclear what the most effective treatments were. All exercise approaches reduced pain and improved function in athletes with LBP. There was insufficient evidence to support activity or biomechanical modifications or manual therapy as stand-alone therapies. There were no studies that specifically examined management strategies in rowers.

Summary statements and recommendations from the Delphi process are shown in Table A4.

Summary statements & recommendations: Managing low back pain in athletes
Until robust evidence is produced for athlete populations, recommendations for LBP management in non-athletic populations should be used to guide management of LBP in athletes, considering the sport-specific circumstances surrounding the athlete while adopting a biopsychosocial approach.
Employ shared decision-making regarding individual treatment goals – consider the athlete's goals, expectations regarding pain, disability, quality of life and return to sport
EXERCISE
Exercise interventions improve pain and function in athletes with LBP.
The effect of exercise interventions on return to sport rates is unknown.
Targeted, dynamic (isotonic rather than isometric), functional (sport-specific) exercise appears to be the most beneficial for athletes with LBP, but there is insufficient evidence to recommend one exercise protocol over another.
BIOMECHANICAL OR ACTIVITY MODIFICATIONS
Biomechanical and activity modifications may result in a reduction of LBP, but there is insufficient evidence to recommend them as stand-alone treatments.
MASSAGE AND MANUAL THERAPY
Massage and manual therapy may improve pain and function in athletes with LBP, but there is insufficient evidence to recommend them as stand-alone treatments.

Table A4: Summary statements and recommendations from managing LBP in athletes.

Rowers' lived experience of rowing-related low back pain

Semi-structured interviews were conducted with 25 rowers in Ireland and Australia.[16] Rowers revealed a culture of openness or concealment that influenced their experience. Rowers' relationships with coaches and peers framed their overall experience, their willingness to reveal their pain, how early they revealed their pain, and the support that they received. The summary recommendations from the Delphi process are shown in Table A5.

Summary recommendations: Rowers' lived experience of rowing-related low back pain
Rowers should be taught about the nature, presentation, and various factors that contribute to LBP.
Rowers should be encouraged to disclose their LBP at an early stage and be informed about the potential negative impacts of concealing their LBP.
Rapid referral pathways to best evidence-based management should be created where possible, so that rowers can access care for LBP.
Rowers should be supported by their coaches, management, and teammates when disclosing LBP.
Rowers feel socially isolated during LBP rehabilitation and supports should be put in place where possible, including peer support (teammates).
There should be a clinical alliance among medical staff to ensure that LBP management strategies and information given to rowers is consistent.
Education regarding best practices should be available to clinicians treating rowing-related LBP.
Medical teams should adopt shared decision-making strategies with the rowers they are treating.
Communication among rowers, coaches and medical staff is important to ensure a uniform narrative with clear and consistent messages around rowing-related LBP.

Table A5: Summary recommendations from the qualitative study of rowing-related LBP

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