

The Swimmers' Spine: A Systematic Review of the Literature

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Objectives

To systematically review the literature surrounding spinal injuries in competitive swimmers, identify the spinal pathologies most frequently reported, and determine whether swimmers are at increased risk compared with other athletes and the general population.

Introduction

- Spinal injuries are considered among the most common musculoskeletal problems affecting competitive swimmers due to repetitive cycles of hyperflexion and hyperextension during training and performance.
- These movements may predispose swimmers to specific spinal conditions, influenced by factors such as stroke specialty, training volume, and equipment use (1).
- Existing studies use differing definitions and diagnostic criteria, making it difficult to determine overall risk or compare swimmers with other populations.
- There has been no comprehensive synthesis of the full range of spinal pathologies reported across the literature.

Methods

A systematic review was carried out using PubMed, Ovid MEDLINE, Ovid Embase and Scopus following PRISMA 2020 guidelines (2).

Inclusion criteria included studies that report on the incidence of specific types of spinal pathology, studies that have a population of competitive swimmers, includes level 4 or greater evidence, includes combinations of search terms within the title and/or abstract, includes studies with full text freely available online published between 2000 and 2025 inclusive.

Exclusion criteria included: studies concerning the use of swimming for managing spinal conditions, studies that do not report on the incidence of specific spinal conditions, studies that do not have any data relating to incidence of spinal disorders, studies that do not specify the number of unique swimmers that participated, grey literature, articles not in English, non-peer reviewed articles. Search results were uploaded to Rayyan (3). Duplicates were removed and abstracts screened prior to full-text selection (Figure 1).

Eleven studies met the inclusion criteria. Risk of bias was assessed using a Newcastle-Ottawa scale. Studies were grouped by the type of condition mentioned and by what cohorts were present in each study. Incidence of different spinal conditions was compared within the swimming group. Where possible, an inverse-variance weighted meta-analysis of risk ratios was used to compare swimmers with other athletes and non-athletes.

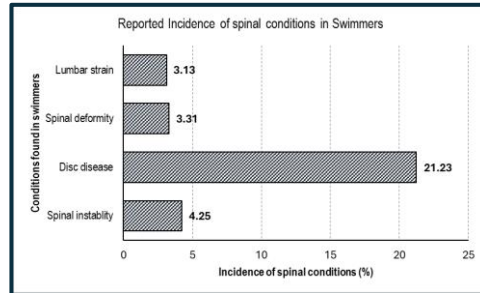


Figure 2 (left): A bar chart showing the reported incidence of spinal conditions in swimmers.

Table 1 (down): A table showing the risk ratios of developing one of the conditions by comparing the swimming cohort to other athlete and non-athlete cohorts.

Condition	Group 1	Group 2	Risk	Risk ratio
Spinal instability	Swimmers	Other Athletes	?	1.166 (CI 0.571-2.379)
Disc disease	Swimmers	Other Athletes	↑	1.474 (CI 1.160-1.874)
Disc disease	Swimmers	Non-Athletes	↑	1.166 (CI 1.015-1.596)

Results

One study examined cervical spine injuries, reporting 88 non-contact and overuse neck injuries among NCAA swimmers over a 5-year period.

Ten studies investigated lumbar spine conditions. Because classification varied, conditions were grouped into four categories: disc disease, spinal instability, spinal deformity and lumbar strain. There were 5 studies that included disc disease, with a pooled incidence of 21.23%, 4 studies that examined spinal instability reporting a pooled incidence of 4.25%, 2 studies that investigated spinal deformity with a pooled incidence of 3.31%, and 3 studies that reported lumbar strain with a pooled incidence of 3.13%. (Figure 2)

We were able to pool data for studies that looked at disc disease and spinal instability and compared the incidence of these conditions, using an inverse-variance weighted meta-analysis to generate risk ratios (RR). Swimmers had a RR of 1.474 (95% CI 1.160–1.874) of having disc disease when compared to other athletes. Swimmers had a RR of 1.273 (95% CI 1.015–1.596) of having disc disease when compared to non-athletes. Swimmers had a RR of 1.166 (95% CI 0.571–2.379) of having spinal instability when compared to other athletes (Table 1). Overall, disc disease was consistently the most frequently reported pathology. Spinal instability, deformity, and muscular strain occurred less commonly but were still present across multiple studies.



Figure 3: An example radiograph of an incidental Scheuermann's kyphosis found in a competitive swimmer

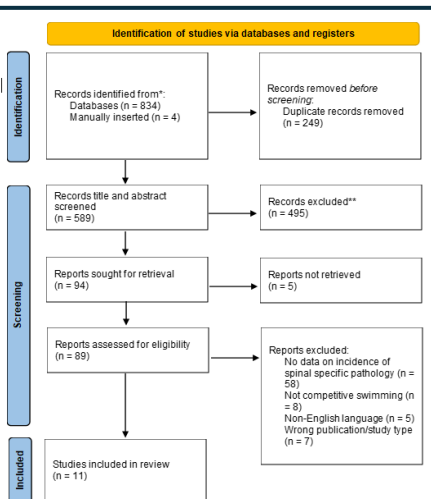


Figure 1: PRISMA for flow of studies across the review

Conclusions

In our review, disc disease was found to be the most common condition in competitive swimmer with an incidence of 21.23%. Disc degeneration in an asymptomatic cohort aged 20-29 years had an incidence of 37% (4). Although it may present asymptotically, disc pathology should remain an important differential diagnosis when assessing swimmers presenting with back pain. Swimming has been associated with spinal deformities (5) such as Scheuermann's kyphosis (Figure 3), but emerging evidence suggests this relationship may not be causal.

This review was limited by the small number of studies reporting condition-specific data, potentially due to conservative management strategies (e.g., physiotherapy, strengthening programmes) reducing the need for diagnostic imaging. This meant that some comparisons in the meta-analysis were comparing populations that were diverse, so further studies reporting on the incidence of these conditions would be necessary to carry out future analysis.

The buoyant aquatic environment may confer a partially protective effect on the spine by reducing axial loading. Further research is required to clarify whether swimming contributes to or protects against the development of various spinal conditions, and to more accurately define the burden of spinal pathology in athletic populations.

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References: 1 Schwartz A, Richard L, Libardo H, Verma R, Benjamin H, Hau C. Lumbar spine injuries among high school and college-aged competitive swimmers associated with various training methods and strokes specialties. *Research in sports medicine* (Print). 2025;1-9. doi: <https://doi.org/10.1080/15438627.2025.2567322>. PT - Article In Press
2 Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. doi: [10.1136/bmj.n71](https://doi.org/10.1136/bmj.n71)
3 Duzzani M, Hamdy H, Fedorowicz Z, Elmaguid A, Rayan -a web and mobile app for systematic reviews. *Systematic Reviews* 2016;5(1):210. doi: [10.1186/s13643-016-0384-4](https://doi.org/10.1186/s13643-016-0384-4)
4 Brinjik W, Luster PH, Comstock B, Beauden BW, Chen LE, Devo RA, et al. Systematic literature review of imaging features of spinal degeneration in asymptomatic populations. *American Journal of Neuroradiology*. 2015 Apr;136:959X (Electronic).
5 Zane F, Donzelli S, Lusi M, Mimali AS, Negrini S. Swimming and Spinal Deformities: A Cross-Sectional Study. *The Journal of Pediatrics*. 2013;164(1):163-7. doi: [10.1016/j.peds.2012.08.024](https://doi.org/10.1016/j.peds.2012.08.024)



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