Year 3 SSC Coversheet

Title of your project	Spinal disorders in elite swimmers
Student Number	23001487
Project Description and Aims: Please describe in brief what the broad purpose of your SSC project is. (please also note if there were any changes from your original proposal)	• Elite swimmers are thought to be at an increased risk of injury due to high a intensity and volume of training that involves repetitive motions. Spinal injuries are one of the most common types of injury in swimmers. This is thought to be due to repetitive stress on the back, especially in strokes such as butterfly and breaststroke. • This project aims to investigate, through a systematic review, if swimmers are at an elevated risk of spinal disorders and which spinal disorders (e.g. spondylolysis, spondylolisthesis, any spinal deformities (e.g. Scheuermann's kyphosis, scoliosis etc.), any back or neck muscle sprain etc.) are swimmers more at risk of developing. This will be compared to the general population and other elite athletes within the same age category. • This project will also explore which factors may be causative or protective of any back injury in elite swimmers. • This systematic review will be carried out with an agreed upon search strategy and protocol searching multiple databases. Screening will then be carried out, results synthesised and written up. The final product will then be made into an abstract and poster ready for presentation
Educational Objectives: What did you intend to achieve from your project?	1. To reinforce knowledge of spinal disorders such as spondylolysis, spondylolisthesis, any spinal deformities (e.g. Scheuermann's kyphosis, scoliosis etc.), back or neck muscle sprain, acute nerve compression and degenerative disc disease, their mechanisms of injury and possible treatments.

	2. To gain a deeper understanding of the biomechanics involved in swimming, especially looking at spinal movement in breaststroke and butterfly. 3. To effectively critically appraise and evaluate the quality of evidence when performing a literature search using the appropriate checklists and methods (e.g. CASP checklist). 4. To gain a deeper understanding of study methods and the hierarchy of evidence when searching literature. 5. To gain a full understanding of what is required in a systematic review by reading pre-existing systematic reviews and using resources such as a PRISMA checklist.
SSC Logistics: Describe here the activities you have undertaken during your SSC placement.	Prior to starting the SSC period, background reading will be undertaken, and a search strategy will be created, including which databases will be targeted, with tutor approval at each necessary step. During the SSC period, the tutor and I have agreed that this project can be carried out independently, with their support online or in person as and when needed. I will be executing the search strategy and screening literature during this period to then review along with my tutor. I will aim to have the completed review written up and sent to my tutor by the end of week 5, with any corrections being made during week 6. My abstract and poster will also be made during week 6.
Was Ethics Approval required?	No
Word Count (for abstract and poster)	Abstract: 460 Poster: 765
AI declaration	I declare that I have used Generative AI software to support me in producing parts of this work. I have used Gen AI in line with the usage defined by the assessment guidance and have maintained academic integrity throughout my work. I have validated any Gen AI content through using reliable independent sources. I acknowledge my use of AI tools to (insert as appropriate): 1. Generate initial ideas or structures, to help understand core concepts or other preparatory activities:

	Microsoft copilot was used to help format search strategies for use in search databases, such as pubmed and ovid. 2. Write, rewrite, or paraphrase part of this submission Microsoft copilot was used to help spell check and correct grammar in the abstract and poster text. 3. Generate other aspect(s) of the assignment Google Gemini was used in order to assist with some of the statistics used by giving step by step instructions to the student on how to perform statistical analysis in excel.

ABSTRACT

The Swimmers Spine: A Systematic Review of the Literature

James F. Cummings-Candal, Michael J.H. McCarthy

Objective

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

Design

A systematic search of PubMed, Ovid Medline, Ovid Embase and Scopus identified studies published between 2000 and 2025. After screening 589 titles and abstracts, 94 full-text articles were access and 11 met inclusion criteria. Eligible studies were included if they were level four or higher evidence and reported data on the epidemiology of specific spinal conditions in competitive swimmers. Risk of bias was assessed using the Newcastle-Ottawa scale. Studies were grouped by type of condition and were classified by if the study had any comparative cohorts. Incidence was calculated to compare the prevalence of each condition within swimmers, and where data was available, comparisons were made between swimmers and other athletes using risk ratios (RR), generated using a inverse-variance weighted meta-analysis of risk ratios

Setting:

Studies published between 2000 and 2025 were eligible.

Population/Participants:

Competitive swimmers were the primary population studied and were compared with other completive athletes and non-athletes when available.

Results:

Only one study reported on the cervical spine and neck muscles, documenting 88 non-contact and overuse events occurred in NCAA swimmers over a five-year period.

In the lumbar spine, four main categories of conditions were observed. Spinal instability was documented in four studies, with an incidence of 4.25% in swimmers. Disc disease was the most frequently reported condition, observed in 21.23% of swimmers across five studies. Spinal deformity was identified in 3.31% of across two studies. Lumbar strain was reported in 3.13% of swimmers across three studies.

Comparative analysis showed that spinal instability in swimmers versus other athletes had a RR of 1.166 (95% CI 0.571-2.379). Disc disease in swimmers compared with other athletes had a RR of 1.474 (95% CI 1.160-1.874). When compared with two non-athletic populations, disc disease had an RR of 1.273 (95% CI 1.015-1.596).

Conclusions:

Disc disease was the most prevalent lumbar spine condition in competitive swimmers and should be considered a key differential diagnosis in swimmers presenting with low back pain. This review identified several limitations, including that there was generally a lack of available studies providing a condition specific diagnosis. This may reflect the common use of conservative management strategies in swimmers, with physiotherapy and strengthening exercises trialed before further investigations are deemed to be medically necessary. It may also reflect a partially protective effect of swimming, as the lumbar extension posture adopted in the water may reduce mechanical loading on the spine. Further research is required to clarify whether swimming contributes to or protects against the development of spinal conditions, and to determine the true burden of specific spinal conditions in this athletic population.

The Swimmers' Spine: A Systematic Review of the Literature

James F. Cummings-Candal [1], Professor Michael J.H. McCarthy [2,3]
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[2]Consultant Spinal Surgeon, University Hospital of Wales, [3] Honorary Visiting Professor, Cardiff University

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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.

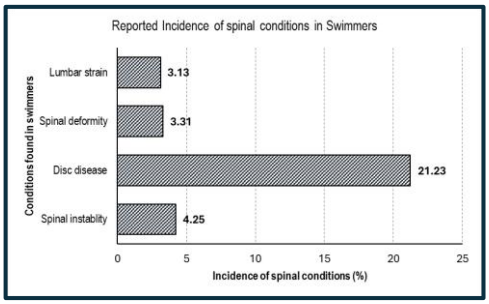

Figure 2 (left): A bar chart showing the reported incidence of spinal conditions in swimmers.

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)

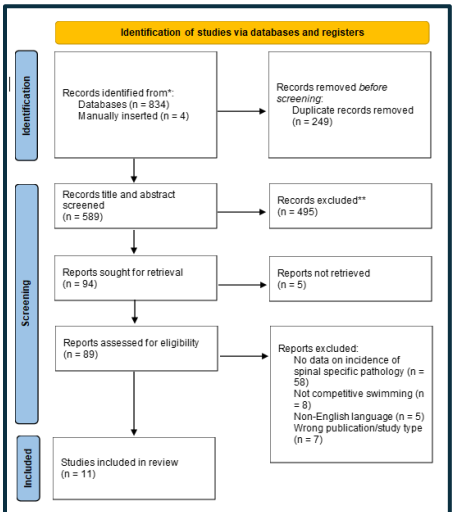

Figure 1: PRISMA for flow of studies across the review

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

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 asymptomatically, 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 ofspinal pathology in athletic populations.

Acknowledgements: I would like to thank Professor McCarthy for his supervision and guidance throughout this project, and the UHW Spinal team for being so welcoming.

References: 1.Schwartz A, Richards L, Labrador H, Verma R, Benjamin H, Hsu C. Lumbar spine injuries among high-school and college-aged competitive swimmers associated with various training methods and stroke specialties. Research in sports medicine (Print). 2025:1–9. doi: https://dx.doi.org/10.1080/15438627.2025.2567352 PT - Article In Press
2.Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71. doi: 10.1136/bmj.n71
3.Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. Systematic Reviews. 2016;5(1):210. doi: 10.1186/s13643-016-0384-4
4.Brinjikji W, Luetmer PH, Comstock B, Bresnahan BW, Chen LE, Deyo RA, et al. Systematic literature review of imaging features of spinal degeneration in asymptomatic populations. American Journal of Neuroradiology. 2015 Apr(1936-959X (Electronic)).
5.Zaina F, Donzelli S, Lusini M, Minnella S, Negrini S. Swimming and Spinal Deformities: A Cross-Sectional Study. The Journal of Pediatrics. 2015;166(1):163–7. doi: 10.1016/j.jpeds.2014.09.024

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