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Sex and race disparities in pediatric hydrocephalus shunt outcomes: protocol for a systematic review (retrospective registration)

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ADMINISTRATIVE INFORMATION

Support - None. This review received no funding.

Review stage at the time of initial registration - Completed but not published.

Conflicts of interest - The authors declare no conflicts of interest.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 23 November 2026 and was last updated on 23 November 2026.

INTRODUCTION

Review question / Objective To summarize the existing literature on the association of race and sex with cerebrospinal fluid shunt infection, failure, and revision in pediatric patients with shunted hydrocephalus in the United States. Population: pediatric patients with shunted hydrocephalus. Exposure: race, ethnicity, and sex. Comparator: other racial/ethnic groups and the opposite sex. Outcomes: shunt infection, shunt failure, and shunt revision. Study designs: randomized controlled trials, cohort, case-control, and other observational studies, systematic reviews, meta-analyses, case series, and conference abstracts.

Rationale Hydrocephalus is the most common neurological condition requiring surgery in children, and shunt failure and infection drive substantial morbidity, mortality, and repeat surgery. Comorbidities and surgical factors are well-described predictors of shunt complications, but few studies directly examine demographic variables. Several studies have reported racial disparities in mortality and shunt outcomes in pediatric hydrocephalus, while findings on sex are inconsistent. A systematic synthesis of the US literature is needed to clarify these associations and identify gaps for future research.

Condition being studied Pediatric hydrocephalus treated with a cerebrospinal fluid shunt. Hydrocephalus is an abnormal accumulation of cerebrospinal fluid within the cerebral ventricles, most commonly treated with ventriculoperitoneal shunt placement. Shunts frequently fail or become infected, requiring revision surgery.

METHODS

Search strategy PubMed, Embase, Scopus, and Web of Science were searched for records published through March 2024. Search strategies

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were developed with a medical librarian and combined controlled vocabulary (MeSH/Emtree) and free-text terms for three concepts: (1) hydrocephalus (e.g., hydrocephalus, Dandy-Walker, aqueductal stenosis, ventriculomegaly); (2) cerebrospinal fluid shunts and complications (e.g., shunt, ventriculoperitoneal, failure, malfunction, revision, reoperation, complication); and (3) pediatric populations (e.g., child, infant, neonate, pediatric, adolescent). Results were limited to English. Full database-specific search strings, including any date limits applied, are reported in the published manuscript.

PubMed, Embase, Scopus, and Web of Science were searched from inception through March 2024. Search strategies were developed with a medical librarian and combined controlled vocabulary (MeSH/Emtree) and free-text terms for three concepts: (1) hydrocephalus (e.g., hydrocephalus, Dandy-Walker, aqueductal stenosis, ventriculomegaly); (2) cerebrospinal fluid shunts and complications (e.g., shunt, ventriculoperitoneal, failure, malfunction, revision, reoperation, complication); and (3) pediatric populations (e.g., child, infant, neonate, pediatric, adolescent). Results were limited to English. Full database-specific search strings are reported in the published manuscript.

Participant or population Pediatric patients (under 18 years) with shunted hydrocephalus of any etiology, treated in the United States (studies with approximately 85% or more of data from US institutions).

Intervention Not applicable. This review examines demographic exposures (race, ethnicity, and sex) rather than an intervention.

Comparator Not applicable as an intervention comparator. Outcomes were compared across racial and ethnic groups and between male and female patients.

Study designs to be included Randomized controlled trials, cohort, case-control, and other observational studies, systematic reviews, meta-analyses, case series, and conference abstracts. Letters and case reports were excluded.

Eligibility criteria Inclusion: (1) pediatric patients with shunted hydrocephalus; (2) shunt infection, revision, or failure reported as an endpoint; (3) eligible study design; (4) factors associated with shunt outcomes analyzed by sex and/or race. Exclusion: (1) letters and case reports; (2) no data available for analysis; (3) not available in English; (4) studies conducted outside the US (less than approximately 85% of data from US institutions); (5) outcomes not separated by race or sex.

Information sources PubMed, Embase, Scopus, and Web of Science, searched for records published through March 2024. Records were imported into Covidence for deduplication and screening.

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Main outcome(s) Shunt revision or failure and shunt infection, as defined by each included study, analyzed by race/ethnicity and by sex. Effect measures were extracted as reported (odds ratios, hazard ratios, risk ratios, incidence, and p values). Follow-up periods were recorded as reported by each study.

Additional outcome(s) Study characteristics (design, data source, sample size, follow-up period, outcome definitions) and participant characteristics (age, sex, race, ethnicity, shunt type).

Data management Records were managed in Covidence. Duplicates were removed automatically. Each record was screened by two independent reviewers at title/abstract and full-text stages, with discrepancies resolved by a third reviewer. Data were extracted in duplicate using a standardized form, and the final dataset was verified by an additional reviewer with senior author confirmation.

Quality assessment / Risk of bias analysis Certainty of evidence for each included study was assessed using the GRADE approach (risk of bias, inconsistency, indirectness, imprecision, and publication bias) per the Cochrane Handbook, by two independent reviewers with discrepancies resolved by a third.

Strategy of data synthesis A meta-analysis was planned a priori. Because of substantial heterogeneity in outcome definitions, follow-up time points, and racial categorization across studies, quantitative pooling was not performed. Results are synthesized narratively with descriptive summary statistics for each included study.

Subgroup analysis Studies were grouped by primary outcome (shunt infection; shunt revision/failure; both) and by demographic variable

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reported (race only, sex only, or both). No statistical subgroup analysis was performed.

Sensitivity analysis None. No quantitative pooling was performed.

Language restriction English only.

Country(ies) involved United States.

Other relevant information This review was registered retrospectively. It began in 2020, before the target journal required prospective registration, and screening, data extraction, and analysis were complete at the time of registration. This record describes the methods as they were conducted. The only deviation from the original plan was that a planned meta-analysis was not performed because of heterogeneity in outcome definitions and follow-up periods; results are reported narratively instead. Current review status: Completed but not published.

Keywords hydrocephalus; cerebrospinal fluid shunt; shunt failure; shunt infection; race; sex; health disparities; pediatrics.

Dissemination plans Publication in a peer-reviewed journal.

Contributions of each author

Author 1 - Hunter Caroline Davies. screening, data extraction, GRADE assessment, analysis, drafted the manuscript.
Author 2 - Jana Badrani. screening, data extraction, GRADE assessment, analysis, drafted the manuscript.
Author 3 - Abhishek Kamath. screening, data extraction, GRADE assessment, analysis, drafted the manuscript.
Author 4 - Abdulraheem Kaimari. screening, data extraction, GRADE assessment, critical revision.
Author 5 - Ali Hassan Fathallah-Shaykh. critical revision of the manuscript.
Author 6 - Anna Rowell. title and abstract screening, critical revision.
Author 7 - Jessica Thrower. title and abstract screening, critical revision.
Author 8 - Addison Stewart. title and abstract screening, critical revision.
Author 9 - Katelin Baird. critical revision of the manuscript.
Author 10 - Caroline T. Caudill. verification of the final dataset, critical revision.
Author 11 - Anastasia Arynchyna-Smith. project administration, critical revision.
Author 12 - Emma C. O'Hagan. developed and executed the search strategy, drafted the manuscript.
Author 13 - Lauren N. Simpson. critical revision of the manuscript.
Author 14 - Brandon G. Rocque. conception and design, adjudication of screening discrepancies, supervision, critical revision.

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