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ShoulderShoulder Dystocia: A Systematic Review on Prevention, Complications, Prognosis, and Management Over the Last 16 Years

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ADMINISTRATIVE INFORMATION

Support - University of Medicine and Pharmacy Iuliu Hatieganu, Cluj-Napoca, Romania.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 17 September 2026 and was last updated on 17 September 2026.

INTRODUCTION

Review question / Objective The primary objective of this systematic review is to comprehensively evaluate the contemporary evidence on the prevention, clinical management, complications, and prognosis of shoulder dystocia during vaginal delivery. The review will assess studies published between January 2010 and January 2026, with particular emphasis on the effectiveness and safety of obstetric maneuvers used for the resolution of shoulder dystocia.

Specifically, the review aims to compare the success rates of external maneuvers, including the McRoberts maneuver and suprapubic pressure, with internal maneuvers, including rotational techniques and posterior arm delivery; to identify maternal, fetal, and intrapartum factors associated with shoulder dystocia and shoulder dystocia-related brachial plexus injury; and to evaluate

maternal and neonatal complications associated with different management strategies.

Secondary objectives are to investigate whether fetal birthweight and parity influence clinical outcomes or maneuver effectiveness; to assess the relationship between the number and sequence of maneuvers, head-to-body delivery interval, and maternal and neonatal morbidity; and to evaluate the impact of multidisciplinary simulation-based training on clinical management and neonatal outcomes.

The review will also examine contemporary strategies for antenatal prediction and prevention of shoulder dystocia, including clinical and sonographic risk assessment, prediction models, and the role of elective cesarean delivery in pregnancies at increased risk.

The overarching review question is: What does the contemporary evidence demonstrate regarding the

prediction, prevention, optimal management, maternal and neonatal complications, and prognosis of shoulder dystocia, and which clinical strategies are associated with the most favorable maternal and neonatal outcomes?

Rationale Shoulder dystocia is an unpredictable and potentially severe obstetric emergency that requires prompt recognition and coordinated clinical management. Although several maternal, fetal, and intrapartum risk factors have been identified, including fetal macrosomia, maternal obesity, diabetes mellitus, previous shoulder dystocia, and operative vaginal delivery, a substantial proportion of cases occur without recognizable antecedent risk factors. Consequently, accurate antenatal prediction remains challenging, limiting the effectiveness of preventive strategies.

Shoulder dystocia is associated with clinically important maternal and neonatal morbidity. Maternal complications include postpartum hemorrhage, cervical and vaginal lacerations, severe perineal trauma, and, rarely, symphyseal injury. Neonatal complications include brachial plexus injury, clavicular and humeral fractures, hypoxic-ischemic injury, and, in severe cases, neonatal death. Although most brachial plexus injuries are transient, persistent neurological impairment may occur and represents an important source of long-term morbidity. Shoulder dystocia also has substantial medico-legal implications, particularly when associated with permanent brachial plexus injury.

Clinical management relies on a sequence of external and internal obstetric maneuvers. However, the comparative effectiveness and safety of individual maneuvers remain incompletely defined. Differences in clinical definitions, maneuver sequencing, operator experience, documentation, institutional protocols, and severity of individual cases have contributed to considerable heterogeneity across published studies. Moreover, internal maneuvers are frequently performed only after external techniques have failed, creating potential confounding by indication when their outcomes are compared.

During the last 16 years, several important developments have changed the evidence base surrounding shoulder dystocia. These include studies evaluating the biomechanics and clinical effectiveness of individual maneuvers, increasing implementation of multidisciplinary simulation-based training, investigation of the relationship between maneuver sequence and maternal or

neonatal morbidity, and the development of clinical, ultrasonographic, and machine-learning models for antenatal prediction.

A contemporary synthesis of this evidence is therefore warranted to clarify the relative effectiveness and safety of available management strategies, identify factors associated with adverse maternal and neonatal outcomes, evaluate current approaches to prediction and prevention, and assess the impact of simulation-based training. By systematically reviewing evidence published between January 2010 and January 2026, this review aims to provide an updated and clinically relevant synthesis that may support evidence-based decision-making, professional training, and future research in the prevention and management of shoulder dystocia.

Condition being studied Shoulder dystocia is an acute obstetric emergency occurring during vaginal cephalic delivery in which, after delivery of the fetal head, additional obstetric maneuvers are required to achieve delivery of the shoulders when gentle downward traction is unsuccessful. It most commonly results from impaction of the anterior fetal shoulder behind the maternal pubic symphysis and, less frequently, from impaction of the posterior shoulder against the sacral promontory.

Shoulder dystocia is characterized by considerable clinical unpredictability. Recognized risk factors include fetal macrosomia, maternal diabetes mellitus, maternal obesity, previous shoulder dystocia, and operative vaginal delivery; however, a substantial proportion of cases occur in the absence of identifiable antenatal risk factors. This limits the accuracy of antenatal prediction and makes timely recognition and effective intrapartum management essential.

Management involves a sequence of obstetric maneuvers intended to release the impacted shoulder while minimizing maternal and neonatal injury. These include external techniques, such as the McRoberts maneuver and suprapubic pressure, internal rotational maneuvers, posterior arm delivery, positional techniques, and, in refractory cases, rescue procedures.

The condition is associated with significant maternal and neonatal morbidity. Maternal complications may include postpartum hemorrhage, cervical or vaginal lacerations, third- and fourth-degree perineal trauma, and symphyseal injury. Neonatal complications include brachial plexus injury, clavicular or humeral

fractures, hypoxic-ischemic encephalopathy, and, rarely, neonatal death. Although most neonatal brachial plexus injuries resolve spontaneously, persistent neurological impairment may occur.

The condition evaluated in this systematic review therefore encompasses shoulder dystocia during vaginal delivery, its antenatal risk factors and prediction, preventive strategies, obstetric management and maneuver effectiveness, associated maternal and neonatal complications, and short- and long-term neonatal prognosis.

METHODS

Search strategy A comprehensive systematic literature search will be conducted in five electronic databases: PubMed/MEDLINE, Embase, Scopus, Web of Science, and the Cochrane Library. The search will cover publications from January 1, 2010 to January 31, 2026.

The search strategy will combine controlled vocabulary terms (MeSH in PubMed/MEDLINE and Emtree terms in Embase, where applicable) with free-text keywords related to shoulder dystocia, obstetric maneuvers, maternal and neonatal complications, risk factors, prediction, prevention, and simulation-based training.

The principal search concepts will include: “shoulder dystocia”, “shoulder dystocia management”, “obstetric maneuvers”, “McRoberts maneuver”, “suprapubic pressure”, “posterior arm delivery”, “posterior arm”, “internal rotation”, “rotational maneuver”, “Rubin maneuver”, “Woods screw maneuver”, “Gaskin maneuver”, “brachial plexus injury”, “brachial plexus palsy”, “Erb palsy”, “neonatal injury”, “maternal morbidity”, “perineal trauma”, “postpartum hemorrhage”, “macrosomia”, “fetal macrosomia”, “birthweight”, “maternal diabetes”, “operative vaginal delivery”, “risk factors”, “prediction”, “prevention”, “simulation training”, and “obstetric emergency training”.

The core PubMed/MEDLINE search strategy will be:

(“Shoulder Dystocia”[MeSH] OR “shoulder dystocia”[Title/Abstract]) AND (“Obstetric Labor Complications”[MeSH] OR “obstetric maneuver”[Title/Abstract] OR “McRoberts”[Title/Abstract] OR “suprapubic pressure”[Title/Abstract] OR “posterior arm”[Title/Abstract] OR “internal rotation”[Title/Abstract] OR “rotational maneuver”[Title/Abstract] OR “Rubin maneuver”[Title/Abstract] OR “Woods screw”[Title/Abstract] OR

“Gaskin maneuver”[Title/Abstract] OR “brachial plexus injur”[Title/Abstract] OR “brachial plexus pals”[Title/Abstract] OR “Erb pals”[Title/Abstract] OR macrosomia[Title/Abstract] OR birthweight[Title/Abstract] OR “maternal diabetes”[Title/Abstract] OR “operative vaginal delivery”[Title/Abstract] OR “risk factor”[Title/Abstract] OR predict*[Title/Abstract] OR prevent*[Title/Abstract] OR “simulation training”[Title/Abstract]).

Equivalent search strategies will be adapted to the syntax and controlled vocabulary of Embase, Scopus, Web of Science, and the Cochrane Library. Within each concept, synonyms and related terms will be combined using the Boolean operator OR, while the shoulder dystocia concept will be combined with management, outcome, risk-factor, prevention, and training concepts using AND. Truncation and database-specific field tags will be applied where appropriate.

Searches will be restricted to studies involving human participants, published in English between January 2010 and January 2026. No restriction based on geographical location will be applied.

In addition to electronic database searching, the reference lists of all eligible full-text articles and relevant reviews will be manually screened to identify additional studies not retrieved by the electronic searches. Duplicate records will be removed before title and abstract screening. Two reviewers will independently screen titles and abstracts, followed by full-text assessment of potentially eligible studies. Any disagreement will be resolved through discussion and consensus or, when necessary, consultation with a third reviewer.

Participant or population The population of interest will include women undergoing vaginal cephalic delivery complicated by shoulder dystocia and their newborns. Shoulder dystocia will be defined according to the criteria used in the individual studies, generally as a vaginal cephalic birth requiring additional obstetric maneuvers to achieve delivery of the shoulders after delivery of the fetal head when gentle downward traction is unsuccessful.

Studies involving women of any maternal age, parity, ethnicity, or geographical location will be eligible. Both women with and without recognized risk factors for shoulder dystocia will be considered, including maternal diabetes, obesity, previous shoulder dystocia, suspected fetal macrosomia, prolonged labor, and operative vaginal delivery.

Neonatal populations will include infants delivered following an episode of shoulder dystocia, irrespective of gestational age or birthweight, where relevant maternal, obstetric, or neonatal outcome data are available.

The review will include populations from hospital-based cohorts, population-based registries, prospective or retrospective observational studies, case-control studies, and eligible interventional or simulation-related studies relevant to the management of shoulder dystocia.

Studies not involving human participants, case reports or very small case series with fewer than five cases, and studies without quantitative data relevant to shoulder dystocia management or outcomes will be excluded.

Intervention The interventions of interest will include obstetric maneuvers and management strategies used for the resolution of shoulder dystocia, as well as simulation-based training interventions designed to improve shoulder dystocia management.

Obstetric interventions will include external maneuvers, such as the McRoberts maneuver and suprapubic pressure; internal rotational maneuvers, including the Rubin and Woods screw maneuvers; posterior arm delivery; positional techniques such as the Gaskin/all-fours maneuver; and, where reported, rescue procedures used for refractory shoulder dystocia, including the Zavanelli maneuver and symphysiotomy.

Studies evaluating individual maneuvers, combinations of maneuvers, different maneuver sequences, escalation from external to internal techniques, or the number of maneuvers required to achieve successful delivery will be eligible. Variations in the precise technique or sequence of maneuvers will be accepted provided that the intervention is clearly described and quantitative maternal, fetal, neonatal, or maneuver-related outcome data are reported.

The review will also evaluate multidisciplinary and multiprofessional simulation-based shoulder dystocia training programs, including conventional hands-on simulation, team-based emergency training, and technology-assisted or virtual-reality simulation where applicable. These interventions will be considered in relation to changes in clinical management, appropriate maneuver use, excessive traction, brachial plexus injury, and other maternal or neonatal outcomes.

Preventive strategies, including antenatal risk assessment and elective cesarean delivery for pregnancies considered at high risk of shoulder dystocia, will also be examined where relevant to the prevention component of the review.

Comparator Comparators will vary according to the intervention and study design. For studies evaluating obstetric maneuvers, comparisons may include external versus internal maneuvers, individual maneuvers versus alternative maneuvers, or different combinations and sequences of maneuvers. Specific comparisons of interest will include McRoberts maneuver with or without suprapubic pressure versus internal rotational maneuvers or posterior arm delivery.

For studies assessing simulation-based training, outcomes will be compared between pre-training and post-training periods, or between trained and untrained groups where available.

For risk-factor and prognostic analyses, comparator groups may include women or neonates with versus without specific risk factors, including birthweight ≥ 4000 g versus < 4000 g, and nulliparous versus multiparous women, as reported in the included studies.

Where studies do not include a formal comparator group, they may still be eligible if they provide quantitative data relevant to maneuver effectiveness, complications, prevention, or prognosis of shoulder dystocia.

Study designs to be included Original research studies will be included, comprising randomized controlled trials, prospective and retrospective cohort studies, case-control studies, population-based registry studies, and interrupted time-series studies. Eligible simulation-based experimental studies evaluating shoulder dystocia management or training will also be included. Case reports, narrative reviews, editorials, expert opinions, and studies without quantitative outcome data will be excluded.

Eligibility criteria Studies must be peer-reviewed, published in English between January 2010 and January 2026, and involve human participants. Studies must provide quantitative data relevant to shoulder dystocia, including maneuver use or effectiveness, maternal or neonatal complications, prevention, prediction, or prognosis. Case reports or case series with fewer than five cases, non-English publications, studies published before 2010, and studies lacking relevant quantitative outcome data will be excluded.

Information sources The following electronic databases will be systematically searched: PubMed/MEDLINE, Embase, Scopus, Web of Science, and the Cochrane Library. The search will cover studies published between January 2010 and January 2026.

In addition to database searching, the reference lists of all eligible full-text articles and relevant publications identified during the search will be manually screened to identify additional potentially eligible studies.

Only peer-reviewed publications in English will be considered. Grey literature, conference abstracts without sufficient quantitative data, unpublished studies, and non-peer-reviewed sources will not be included. No direct contact with study authors or additional searches of trial registries are planned.

Main outcome(s) The primary outcomes will be successful resolution of shoulder dystocia according to the obstetric maneuver used and the occurrence of maternal and neonatal complications. Maneuver effectiveness will be reported as success/failure rates or proportions, including outcomes for McRoberts maneuver, suprapubic pressure, rotational maneuvers, posterior arm delivery, and combinations or sequences of maneuvers.

Maternal outcomes will include postpartum hemorrhage, cervical or vaginal lacerations, third- or fourth-degree perineal trauma, and other reported maternal injuries. Neonatal outcomes will include brachial plexus injury, persistent brachial plexus injury, clavicular or humeral fracture, low 5-minute Apgar score, hypoxic-ischemic encephalopathy, NICU admission, and neonatal death. Where available, neonatal outcomes will be assessed at birth and during follow-up, including persistent brachial plexus injury at approximately 12 months.

Additional outcomes will include the relationship between head-to-body delivery interval, number and sequence of maneuvers, fetal birthweight and parity, and maternal/neonatal morbidity. The impact of simulation-based training will be evaluated using changes in maneuver use, management practices, brachial plexus injury, and neonatal injury rates.

Outcomes will be expressed as rates/proportions, odds ratios, risk ratios, adjusted odds ratios, and 95% confidence intervals, as available. Where appropriate, pooled risk ratios with 95% confidence intervals will be calculated.

Additional outcome(s) Additional outcomes will include factors associated with the occurrence and severity of shoulder dystocia and shoulder dystocia-related brachial plexus injury, including fetal birthweight, maternal diabetes, maternal body mass index and height, parity, previous shoulder dystocia, prolonged second stage of labor, and operative vaginal delivery.

Subgroup outcomes will include comparisons according to fetal birthweight (≥ 4000 g versus < 4000 g) and parity (nulliparous versus multiparous women). The association between the number and sequence of obstetric maneuvers and maternal or neonatal morbidity will also be evaluated.

Additional outcomes related to prevention and prediction will include the performance of antenatal clinical, ultrasonographic, and machine-learning prediction models, where reported, using measures such as area under the receiver-operating characteristic curve (AUC), sensitivity, specificity, and predictive values.

For simulation-based training, additional outcomes will include changes in shoulder dystocia recognition, appropriate maneuver use, documented excessive traction, and adherence to recommended management practices before and after training.

Where available, effect estimates will be reported as odds ratios, adjusted odds ratios, risk ratios, proportions, or other measures reported by the individual studies, with corresponding 95% confidence intervals.

Data management All records retrieved from the electronic database searches will be exported into a reference management system and duplicates will be identified and removed before screening. The deduplicated records will then undergo title and abstract screening, followed by full-text eligibility assessment.

Two reviewers will independently screen records and assess full-text articles against the predefined eligibility criteria. Disagreements will be resolved through discussion and consensus or, when necessary, by consultation with a third reviewer. Reasons for exclusion at the full-text stage will be recorded and the study selection process will be documented using a PRISMA 2020 flow diagram.

Data from eligible studies will be collected using a standardized extraction form, pilot-tested on five studies before full implementation. Extracted variables will include study characteristics,

population characteristics, sample size, number of shoulder dystocia cases, type and sequence of obstetric maneuvers, maneuver success or failure, maternal and neonatal characteristics, risk factors, and maternal and neonatal outcomes.

Data extraction will be performed by two reviewers and accuracy will be checked through cross-verification. Any discrepancies will be resolved by consensus. Extracted data will be organized in standardized tables for qualitative and, where appropriate, quantitative synthesis.

Quality assessment / Risk of bias analysis The methodological quality and risk of bias of the included primary studies will be assessed independently by two reviewers using validated tools appropriate to each study design.

Cohort and case-control studies will be evaluated using the Newcastle–Ottawa Scale (NOS), which assesses three domains: selection of study groups, comparability of groups, and ascertainment of exposure or outcomes. Studies scoring 7–9 points will be classified as having a low risk of bias, 4–6 points as moderate risk, and 0–3 points as high risk of bias.

Randomized controlled studies, including eligible randomized simulation-based studies, will be assessed using the Cochrane Risk of Bias 2 (RoB 2) tool, evaluating bias arising from the randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of reported results.

Quality assessments will be performed independently by two reviewers. Any disagreements will be resolved through discussion and consensus, with consultation of a third reviewer when necessary. Risk-of-bias assessments will be considered when interpreting the strength and consistency of the findings and will be presented in tabular form.

Strategy of data synthesis Data will be synthesized using narrative and tabular methods. Study characteristics, patient populations, obstetric maneuvers, risk factors, maternal and neonatal complications, and outcomes will be summarized descriptively.

Due to anticipated clinical and methodological heterogeneity across studies, particularly regarding definitions of shoulder dystocia, study populations, maneuver classification and sequencing, and outcome definitions, a formal meta-analysis of all primary outcomes will not be undertaken.

Where studies are sufficiently homogeneous in terms of population, intervention, comparator, and outcome definition, quantitative pooling will be considered. Dichotomous outcomes will be summarized using risk ratios (RRs) or odds ratios (ORs) with 95% confidence intervals (CIs), as appropriate. For simulation-based training studies, pooled risk ratios with 95% CIs will be calculated where sufficient comparable data are available, particularly for brachial plexus injury outcomes before and after training.

Statistical heterogeneity will be assessed using the I^2 statistic. Where substantial heterogeneity or insufficient methodological comparability precludes meaningful pooling, findings will be reported using structured narrative synthesis rather than combined effect estimates.

Prespecified subgroup analyses will compare external versus internal obstetric maneuvers, fetal birthweight ≥ 4000 g versus < 4000 g, and nulliparous versus multiparous women, where sufficient data are available. Additional analyses will examine maneuver sequence and number, head-to-body delivery interval, risk factors for shoulder dystocia-related brachial plexus injury, and the impact of simulation-based training.

Statistical analyses will be performed using Review Manager (RevMan) version 5.4 and R statistical software version 4.3.1.

Subgroup analysis Prespecified subgroup analyses will be performed where sufficient and comparable data are available. The main subgroup analyses will include:

1. Type of obstetric maneuver: external maneuvers (including McRoberts maneuver and suprapubic pressure) versus internal maneuvers (including rotational maneuvers and posterior arm delivery). Individual maneuvers will also be compared where sufficient data are available.
2. Fetal birthweight: outcomes will be compared between neonates with a birthweight ≥ 4000 g and < 4000 g, with particular attention to maneuver effectiveness, shoulder dystocia-related brachial plexus injury, and other neonatal complications.
3. Maternal parity: outcomes will be compared between nulliparous and multiparous women, including the occurrence and management of shoulder dystocia and associated maternal and neonatal outcomes.

Where sufficient data are available, additional exploratory subgroup analyses will consider the

number and sequence of maneuvers, maternal diabetes, operative vaginal delivery, and the presence of other recognized maternal or fetal risk factors.

Subgroup findings will be synthesized quantitatively when studies are sufficiently homogeneous; otherwise, they will be presented using structured narrative and tabular synthesis. Differences between subgroups will be interpreted cautiously in view of potential clinical and methodological heterogeneity.

Sensitivity analysis Due to the anticipated clinical and methodological heterogeneity of the included studies and the predominantly observational nature of the available evidence, no formal sensitivity analysis is planned for outcomes synthesized narratively.

For outcomes where quantitative pooling is considered appropriate, sensitivity analyses will be performed, where sufficient data are available, by excluding studies judged to be at high risk of bias and examining whether their removal materially changes the direction or magnitude of the pooled effect estimates.

Where applicable, the robustness of pooled findings will also be explored by considering differences in study design and methodological quality. If the number of studies contributing to a pooled analysis is insufficient to permit meaningful sensitivity analysis, this will be reported and the findings will be interpreted cautiously.

Sensitivity analyses will therefore be restricted to quantitatively pooled outcomes for which adequate comparable data are available and will not be applied to outcomes evaluated exclusively through narrative synthesis.

Language restriction Only studies published in English will be included.

Country(ies) involved Romania.

Other relevant information This systematic review will be conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines.

Study selection will be performed independently by two reviewers at both title/abstract and full-text screening stages. Disagreements will be resolved by consensus or, where necessary, by consultation

with a third reviewer. Inter-rater agreement will be assessed using Cohen's kappa statistic.

Given the anticipated heterogeneity in study populations, definitions of shoulder dystocia, maneuver classifications and sequences, and reported maternal and neonatal outcomes, the evidence will primarily be synthesized narratively and in tabular form. Quantitative pooling will only be undertaken when studies are considered sufficiently comparable.

Particular attention will be given to the clinical effectiveness and safety of different obstetric maneuvers, risk factors for shoulder dystocia-related brachial plexus injury, the relationship between maneuver number and sequence and maternal/neonatal morbidity, the influence of the head-to-body delivery interval on neonatal outcomes, and the impact of multidisciplinary simulation-based training.

The review is intended to provide a contemporary synthesis of evidence published from January 2010 to January 2026 and to identify areas where evidence remains insufficient or heterogeneous, thereby informing future research on prediction, prevention, management, and outcomes of shoulder dystocia.

Keywords shoulder dystocia; obstetric maneuvers; brachial plexus injury; McRoberts maneuver; posterior arm delivery; simulation training; macrosomia; systematic review.

Dissemination plans The findings of this systematic review will be disseminated through publication in a peer-reviewed international scientific journal in the fields of obstetrics, gynecology, and maternal-fetal medicine. The results may also be presented at national and international scientific conferences and professional meetings.

The review is intended to provide clinicians, obstetricians, trainees, and researchers with an updated synthesis of evidence regarding the prediction, prevention, management, complications, and prognosis of shoulder dystocia. Particular emphasis will be placed on the comparative effectiveness of obstetric maneuvers, risk factors for maternal and neonatal morbidity, and the potential impact of multidisciplinary simulation-based training.

The results may also contribute to future educational and simulation-training programs and support the development or refinement of

evidence-based clinical protocols for the management of shoulder dystocia.

Contributions of each author

Author 1 - Carmen Elena Bucuri - conceived the review, designed the methodology and search strategy, coordinated study selection and data extraction, contributed to data analysis and interpretation, and drafted the manuscript.

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