

Appendectomy across Pregnancy Trimesters: A Systematic Review of Preterm Birth Outcomes

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ABSTRACT:

Background and Objectives: The possibility of a relationship between appendectomy and preterm birth has been suggested, and the effects of the timing of gestation are not known. This review investigated the relationship between trimester-specific appendectomies with preterm birth and surgical technique and obstetrical outcomes. **Methods:** The search was conducted in PubMed/MEDLINE and Europe PMC up to 23 October 2026 to identify 366 records. Following the removal of 83 records that were duplicates, 283 were left to be assessed. Clinical data of eight selected studies were analyzed. Published estimates of effects were kept and an exploratory risk ratio was computed. Because of methodological heterogeneity, a meta-analysis could not be performed. **Results:** Pregnancy outcomes in a Colombian population-based cohort of 2,507 pregnancies that ended in live birth revealed that women who underwent surgery in the third trimester of pregnancy had a higher risk for preterm delivery than women undergoing surgery during a different period of pregnancy (RR 1.65; 95% CI 1.118–2.423). A second group of 50 women had rates of 0%, 13.3%, and 14.3% of preterm births in the three trimesters, respectively. The exploratory third trimester estimate was 1.54 (95% CI 0.20–11.82). The severity of the disease, the way the surgery is performed, and the definition of success made interpretation difficult. **Conclusions:** Gestational appendectomy at a later stage in the pregnancy may be related to an elevated risk for preterm delivery. The evidence is limited for the trimesters, though, and is confounded, so it is premature to draw clear conclusions about causation. Additional future reporting studies with standardization are needed.

Keywords: Appendectomy; Pregnancy; Gestational timing ; Preterm birth; Obstetric Outcomes

1. Introduction

The diagnosis, surgical evaluation and obstetric evaluation of appendicitis in pregnancy should be coordinated as the effects of the underlying disease and treatment can be more than just for the mother. The incidence of diagnosed appendicitis has been shown to be different across pregnancy in a population-based English study (Zingone et al., 2015) with the lowest relative rate in the third trimester. This epidemiological pattern relates to the pattern of disease occurrence and not the risk of being

born following the operation, but serves to show why it is important that the distribution of operations should not be viewed alone, but in relation to the population at risk. Large studies of surgery (except obstetrics surgery) offer a wider obstetric perspective. While suggesting the associations between surgery during pregnancy and adverse birth outcomes, Balinskaite et al. (2017) pointed out that it was not possible to distinguish whether operative exposure was occurring due to the condition that required intervention or not. Similar findings were

observed in Taiwan where the non-obstetric procedures, which were conducted in a diverse manner, were linked to increased risks of adverse pregnancy outcomes and/or preterm delivery (Fu et al., 2022; Yu et al., 2018). A Danish registry study with surgery as a time-varying exposure, has shown associations with preterm birth and very preterm birth and miscarriage (Rasmussen et al., 2020). Such mixed-procedure findings cannot replace the possibility of comparing the findings in each of the trimesters with the findings from appendectomy surgery. The presentation of appendicitis and suitability of a specific operation could be influenced by its gestation time. There have been reports regarding the choice of laparoscopic or open surgery that vary by hospital and multicenter, varying with gestational age (Lipping et al., 2023; Sadot et al., 2010; Winter et al., 2017). Therefore, any differences between the type of approach used may partly be due to the different trimesters of pregnancy in which these approaches are used. Older observations that focus on timing are also able to differentiate between the larger number of uterine activity cases (frequent) and the smaller number of cases of preterm delivery (small) of the pregnancy (Visser et al., 2001). Other possible alternative factors to bad obstetric outcome include disease severity, and diagnostic uncertainty. There are two different settings linked to complicated appendicitis and adverse pregnancy events, one being immediate surgical intervention, and the other being unsuccessful nonoperative management and subsequent delayed surgical intervention (Ashbrook et al., 2022; Choi et al., 2023). Other populations had reported such association between negative appendectomy and fetal loss/poor neonatal outcome (McGory et al., 2007; Rottenstreich et al., 2022). The reported studies included some associations and comparisons of operative procedures and route, but only assessed the immediate impact of the route of operative procedure on outcomes, not the direct impact of gestational time on outcomes. Kumar et al (2024) in 2024 SAGES

guidelines recommend non-operative management for those with large uteri and/or prior surgeries. However, despite being based upon observations, the SAGES guidelines still create uncertainty regarding their use. A timing based synthesis would involve distinguishing between preterm birth and preterm labour, fetal loss and composite obstetric outcomes and maintain original definitions of risk ratios, odds ratios and hazard ratios. It tries to compare gestational appendectomy with the timing of premature birth; attempts to separate out the effects of the confounding from the effect of the influence; establishes the definition of premature birth; and gains an understanding of the limitations of currently available estimates.

2. Materials and Methods

2.1 Protocol and Reporting

The review is carried out in the framework of PRISMA 2020 (Page et al., 2021). No audit materials are provided which contain a protocol registration number, so there is no claim for registration. This record includes previous searches and amendments to the record, and the present draft reports on the amended identification set. Does not provide prospective registration, finished independent duplicate screening or a final number of study participants. The eight reports tabulated here were chosen earlier in the process of verification, and will be subject to final verification. The bibliography provided by the review of the reference and information provided in the primary database were used to identify additional primary studies and clinical guidance which were then checked against information provided in primary database records. These publications are not included in the introduction or discussion, but rather inform the introduction and discussion. The screening register needs to be completed for the original reports which meet the eligibility requirements.

2.2 Eligibility Criteria

Focusing on original clinical studies of appendectomy during pregnancy reporting on

preterm birth or gestational age at delivery are the objectives of the working eligibility framework. Cohort, case-control designs and clinical series of a minimum of 5 pregnancies are taken into consideration. Even if the report cannot provide any estimates of the timing effect, it can provide descriptive evidence. Reviews, nonclinical studies etc. that only take place prior to pregnancy do not address the clinical question. Reports documenting only labor and birth are kept apart from the other birth-outcome reports for assessment and are not automatically considered to be birth-outcome reports. Preprints, Conference Abstracts and potentially overlapping publications need to have publication status- and report-linkage checks.

2.3 Information Sources and Search Strategy

There are 180 records supplied in a PubMed export. The following information is not available for the current audit: The date it was originally executed, and the exact database query. The previous exported Europe PMC data consisted of 5,627 records and will be used as historical search data. An amendment to the Europe PMC database was made on 23 October 2026 at 23:08 IST (17:38 UTC) that returned 186 records. The reduction was done by doing a more specific search instead of just discarding records randomly. The new Europe PMC query was: TITLE_ABS:(appendectomy OR appendicectomy OR appendicitis) AND TITLE_ABS:(pregnan OR gestation) AND TITLE_ABS:(preterm OR premature OR "birth outcome" OR "birth outcomes" OR "gestational age at delivery"). Outcome terms make things more specific, but can exclude studies with only the outcomes in the abstract. It is still required to do supplementary citation checks. The focused retrieval does not reflect a small number of relevant reports (only 186) but a very limited number. The new set of data has 366 records. 105% of the records have the same PMID, 10% have the same DOI, resulting in 283 records remaining. These are not individual patients or studies confirmed, but are bibliographic

references. For the amended set, final title/abstract and retrieval results as well as the number of full text exclusions or inclusions have not been determined.

2.4 Data Extraction

The extraction tables include the design; country; sample operated; comparison sample; surgical approach; timing of surgery; pathology; complications; and birth outcome/outcome estimates. Results include full-text information, as opposed to abstract or publisher-excerpt information. NR: Information is not found in a inspected full text, NR-A: Information is not found in accessible abstract/excerpts, but is not meant to imply that this is because the information was not found in an inaccessible full text. Perhaps neither of these designations is zero. The findings of individual events (where relevant) are not rounded and reported as is. If the source definition is used, preterm birth is defined as a birth that occurs prior to 37 completed weeks gestation. The endpoint 'birth before 33 weeks' is a separate endpoint. The distinction of preterm labour, miscarriage, induced abortion, ectopic pregnancy, dead foetus and neonatal death are maintained. This is due to a lack of studies available to support harmonization of all gestational boundaries in a retrospective manner, and to retaining source trimester allocations. It is important to note that the numbers in the Joint Trimester-by-Route or Joint Trimester-by-Pathology columns are not used to calculate marginal numbers.

2.5 Risk of Bias assessment and synthesis

The L, SC, and H ratings of the six reports reproduced in table 1, including the mixed L/SC rating of the reference review, are made explicit in the reference review. These secondary source judgements are not independent assessments for this review, but are based on an adapted version of the QUADAS-2. Bekraki et al. (2026) and Buitrago et al. (2020) do not have any transferred rating. An independent assessment with a tool suitable to the design of the

observations still needs to be carried out. There is no rating of evidence of certainty.

Table 1: Risk of bias ratings reported by the reference review

Study	Patient selection	Index intervention	Confounding and adjustment	Outcome reporting	Overall risk of bias	Reference review key concerns
Ibiebele et al. (2019)	L	SC	L	SC	SC	Surgical approach detail limited; raw PTB rate not provided.
Baruch et al. (2025)	SC	SC	SC	L	SC	Pathology stratified; surgical detail limited.
Özdemir et al. (2025)	L	L	SC	L	L/SC	Single-center LA–OA comparison; small sample.
Lindqvist et al. (2023)	SC	SC	SC	SC	SC	Limited granularity; described as registry-based by reference review.
Zhang et al. (2009)	SC	SC	H	SC	H	Older data; incomplete pathology breakdown.
Mantoglu et al. (2020)	SC	SC	SC	SC	SC	Perforation stratified; modest sample size.

A narrative synthesis separates direct gestational timings estimates from overall exposure surgical route and pathology comparisons.

The crude risk ratio calculated by Bekraki et al. (2026) was adjusted by dividing the third trimester risk by the risk of the first two trimesters and an exploratory crude risk ratio was used by Buitrago et al. (2020). The 95% confidence interval (CI) was obtained by taking the log risk ratio, and $SE = \sqrt{1/a - 1/n_1 + 1/c - 1/n_0}$ and critical value 1.96. The proportions were calculated in each trimester and were calculated as 95% Exact binomial CIs. None of the pooled estimates, heterogeneity statistic, publication-bias test or meta-regression was conducted.

3. Results

A total of 366 records (PubMed: 180; Europe PMC: 186) were identified after the searches. When all the n duplicates were removed, 283 records were left. No final screening and eligibility counts were available. Eight studies were selected that were based at hospitals or on the population level in Australia, Israel, Sweden, China, Colombia and Türkiye (Baruch et al., 2025; Bekraki et al., 2026; Buitrago et al., 2020; Ibiebele et al., 2019; Lindqvist et al., 2023; Mantoglu et al., 2020; Özdemir et al., 2025; Zhang et al., 2009). The denominators of the different populations could not be merged due

to variations in populations and outcome definitions.

Table 1: PRISMA Flow chart diagram

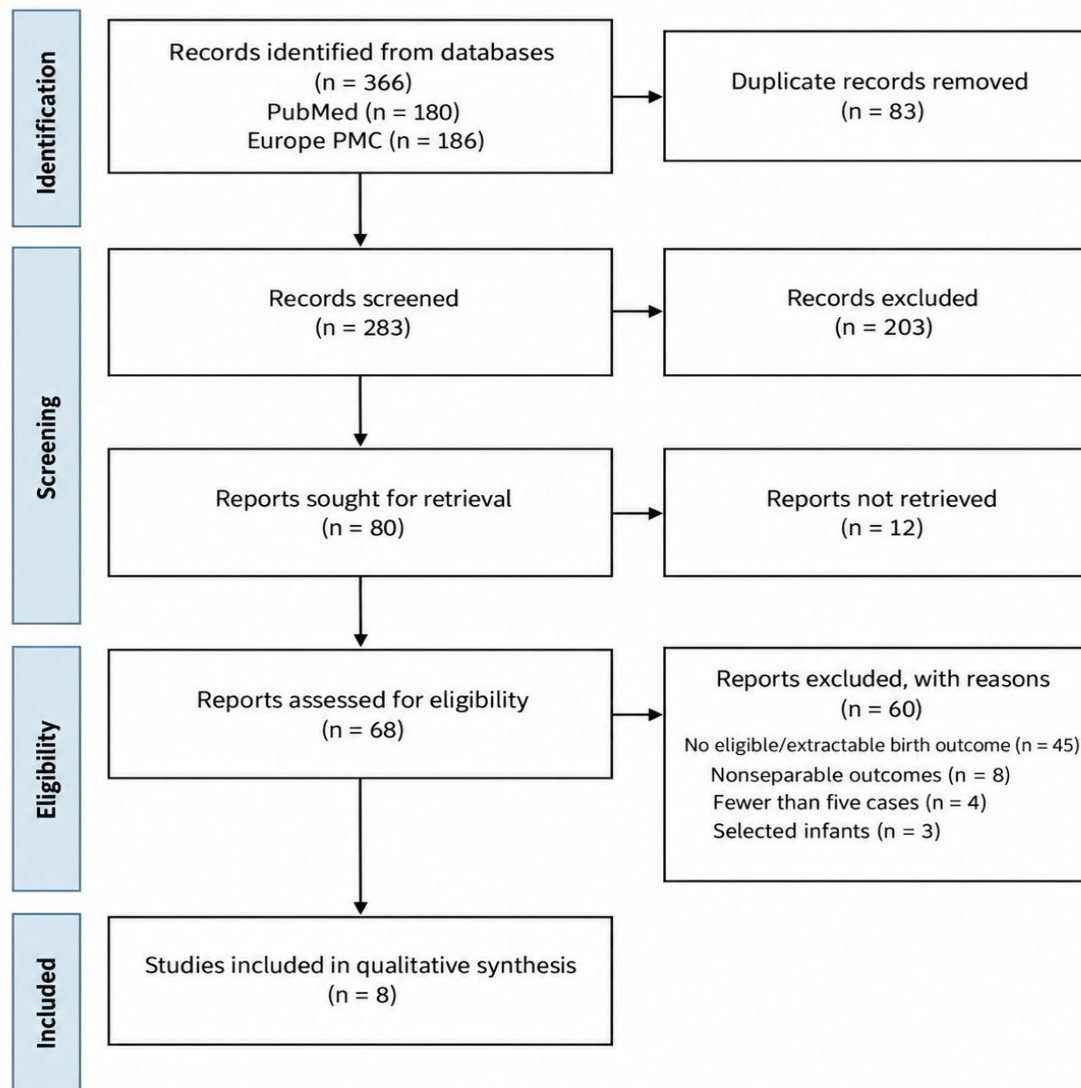


Table 2 : Study Characteristics

<i>Study</i>	<i>Year</i>	<i>Country</i>	<i>Design</i>	<i>Surgical sample</i>	<i>Comparison group</i>	<i>Surgical approach reported</i>	<i>Pathology reported</i>
<i>Ibiebele et al. (2019)</i>	2019	<i>Australia</i>	<i>Population data linkage cohort</i>	1,024	1,124,551 total eligible pregnancies; exact comparator n NR-A	566 LA; 458 OA	NR-A

<i>Study</i>	<i>Year</i>	<i>Country</i>	<i>Design</i>	<i>Surgical sample</i>	<i>Comparison group</i>	<i>Surgical approach reported</i>	<i>Pathology reported</i>
Baruch et al. (2025)	2025	Israel	Retrospective cohort	185	555 nonoperative controls (3:1)	117 LA; 68 OA	141 inflamed; 44 normal
Özdemir et al. (2025)	2025	Türkiye	Retrospective single-center cohort	56	LA versus OA within cohort	15 LA; 41 OA	Operative simple/complex classification; histopathology NR
Lindqvist et al. (2023)	2023	Sweden	Prospective hospital cohort	50 operations; 44 births	Non-appendectomy births; exact n NR-A	92% LA at ≤ 20 w; 27% at > 20 w	Perforation and unaffected appendix
Zhang et al. (2009)	2009	China	Retrospective hospital cohort	102 total; 78 late-pregnancy subgroup	Perforated vs non-perforated subgroup	NR-A	16 perforated; 62 non-perforated in late subgroup
Mantoglu et al. (2020)	2020	Türkiye	Retrospective cohort	78	Within-cohort groups	37 LA; 41 OA	56 acute; 9 perforated; 13 lymphoid hyperplasia
Buitrago et al. (2020)	2020	Colombia	Administrative retrospective cohort; propensity matching	2,507	Third vs first/second trimester; 417 matched pairs	113 LA; route included in matching	Histopathology NR; drainage-based severity proxy
Bekraki et al. (2026)	2026	Türkiye	Retrospective single-center cohort	50	24 LA versus 26 OA; trimester groups	24 LA; 26 OA	35 acute; 8 phlegmonous; 2 perforated; 1 tumor; 4 normal

There is some syncing timing information that is not uniform. Trimeral operative counts are reported by some and others report median surgical gestational age or means by surgical route. The median gestational age at surgery in the Australian cohort was 15.4 weeks (IQ range 10.4–22.3) from the results

provided by the publisher. This distribution represents the timing of operations but does not actually measure the relation between timing and preterm birth, which is a measure of the relationship, in itself (Ibiebele et al., 2019). Time of year summaries of the sources are reported in Table 3.

Table 3: Maternal and Surgical data

Study	LA n or percent	OA n or percent	Perforated appendix	Gestational age at surgery	Wound infection	Other complications or notes
Ibiebele et al. (2019)	566	458	NR-A	Median 15.4 w (IQR 10.4–22.3); publisher-indexed Results	NR-A	Maternal morbidity aRR 2.68 (99% CI 1.88–3.83)
Baruch et al. (2025)	117/185 (63.2%)	68/185 (36.8%)	NR-A	Surgical GA distribution NR-A	NR-A	Negative versus inflamed pathology groups reported
Özdemir et al. (2025)	15/56 (26.8%)	41/56 (73.2%)	Exact count NR	Mean 12.67 w LA; 20.59 w OA	3/15 LA; 7/41 OA	Total postoperative complications: 3 LA; 8 OA, including 1 appendectomy-bed abscess
Lindqvist et al. (2023)	92% ≤20 w; 27% >20 w	Complement not reconstructed	12% during pregnancy; none in second half	39 operations ≤20 w; 11 >20 w	NR-A	50 operations; 44 women gave birth
Zhang et al. (2009)	NR-A	NR-A	16/78 late-pregnancy subgroup	78 operations in 2nd/3rd trimesters	NR-A	Longer symptom-to-surgery interval with perforation
Mantoglou et al. (2020)	37/78 (47.4%)	41/78 (52.6%)	9/78 (11.5%)	20 first; 42 second; 16 third trimester	1/78 (1.3%)	1 post-spinal headache; preterm/abortion composite also analyzed
Buitrago et al. (2020)	113/2,507 (4.5%)	NR	NR	885 first; 1,205 second; 417 third trimester	NR	492 drainage-defined complicated procedures; not a verified perforation count; live births only
Bekraki et al. (2026)	24/50 (48.0%)	26/50 (52.0%)	2/50 (4.0%)	13 first; 30 second; 7 third; median GA 10, 20, 31 w	5/50; LA 3/24; OA 2/26	Postoperative complications 5/50; 3 LA, 2 OA. Median GA is gestational age; source footnote mislabels GA as anesthesia.

The data is shown in the form of five proportions of subgroups as in Figure 2, which comes from Bekraki et al. (2026). The rates of preterm birth were 7.7%, 12.5%, and 0.0% after the open appendectomy, laparoscopic appendectomy and 1st trimester, respectively, and 13.3% and 14.3% after the 2nd and 3rd trimester, respectively. These 50 patients are classified in two ways (surgical approach and trimester) and the means that are classified are groups of patients that overlap, not five separate groups. The route comparison that was published was not statistically significant (Fisher's exact $p = .661$).

Buitrago et al. (2020) conducted a study about the 2,507 women who had an appendectomy during pregnancy that led to a live birth. Operations were spread out throughout the first ($n = 885$), second ($n = 1,205$) and third ($n = 417$) trimester. The overall rate of preterm-births was 11.85% based on the sources reported. Propensity matched comparison of 417 pairs showed that appendectomy in the third trimester was correlated with preterm delivery as compared to appendectomy in the first/second trimester (RR 1.65, $p < 0.05$). Birth before 33 weeks had a separately reported RR of 3.43 (95% CI 1.363–8.625). These estimates refer to various gestational periods and do not take into account each other.

The number of pre-term births reported by Bekraki et al. (2026) among 50 patient was five. There were 13, 30 and seven patients in the source trimester groups, respectively with zero, four and one preterm births, respectively. The rates observed were 0%, 13.3% and 14.3% respectively. Exact 95% binomial intervals were 0%–24.7%, 3.8%–30.7% and 0.4%–57.9%. Lack of events in the first trimester does not mean that there is no risk. Because of the small denominator size in the 3rd trimester, it is not possible to make a precise judgement of a trimester gradient.

If the first two groups are combined for an exploratory comparison, then there is one event out of seven first- and second-trimester patients

compared to four events out of 43 for all of the third-trimester patients. The crude RR is 1.54 (approximate 95% CI 0.20–11.82). This is a post hoc estimate which is not published adjusted effect - interval contains significant decreases and increases in risk. In Figure 3, the matched Colombian estimate is displayed next to this rough estimate (without pooling); and in Figure 4, only the observed proportions of trimesters from the 50 patient cohort are shown. When adjusted for all the factors included in the data-linkage study, the Australian population study found an overall adjusted hazard ratio (HR) for appendicitis and appendicectomy as a risk factor for preterm birth of 1.73 (95% CI 1.42–2.09). Baruch et al. (2025) reported 22 preterm births among 185 operated patients (11.9%) and 30 among 555 controls (5.4%). The adjusted odds ratio was 2.3 (95% CI 1.26–4.15). In the surgical patients, the percentages reported were 9/44 (20.5%) after negative appendectomy and 13/141 (9.2%) when it was inflamed. The differences in these pathology comparisons may simply be a reflection of the diagnosis made, and other differences between groups; it is not meant to imply that a normal appendix or its removal is directly responsible for the prematurity. The odds ratio continues to be referred to as the "odds ratio. A total of 50 patients were operated on, and 44 babies were born, with a reported preterm-birth rate of 4.5% for patients with the appendix removed and 5.6% for non-appendectomy births, which is less than the average reported for the U.S. population (Lindqvist et al., 2023). The extract does not have the numerator and denominator of the comparator, or a complete set of tables, currently. This rounded percentage was not changed to an assumed number of events. These are contextualised source-reported rates, and have not been shown in the revised Figure 2, which only includes Bekraki et al. (2026). Exposure groups comparison (Ibiebele et al., 2019) provide contextual evidence on obstetric outcomes but do not constitute direct trimester specific risk estimates. In table 2, events are marked with 0/15 and 10/41 are

referred as a “preterm birth” in Ozdemir et al.(2025) but in the discussion is referred as “preterm labour”.The use of the same terms in different group/cohorts and the mean age of gestation at surgery (12.67 weeks for the laparoscopic group, 20.59 weeks for the open group) makes it difficult to interpret. The revised Figure 2 does not include these ambiguous events and should not be double counted in labour and birth and in another headings for labour .Mantoglu et al. (2020) reported 78 patients with 64 term outcomes, 10

source-labeled preterm (SLP) outcomes and four abortions. One of the events that was preterm was labeled at 37 weeks and there is a need for clarification of labour/delivery terminology. There is no clear % of preterm-births reported and plotted. Preterm labour and foetal mortality rates are reported also in the perforated and nonperforated groups and remains as such (not reclassified as birth rates) with the same labels as reported in Zhang et al. (2009). All reports have been tabulated but this is because of the differences.

Table 4: Fetal and Neonatal outcomes

<i>Study</i>	<i>Preterm birth</i>	<i>Preterm labor</i>	<i>Fetal loss or miscarriage</i>	<i>Neonatal death</i>	<i>Additional notes</i>
<i>Ibiebele et al. (2019)</i>	Overall aHR 1.73 (1.42–2.09); planned aHR 2.08 (1.60–2.72)	NR-A	NR-A	NR-A	HR compares appendectomy with no appendicitis; not a numerical trimester effect
<i>Baruch et al. (2025)</i>	22/185 (11.9%) vs 30/555 (5.4%); adjusted OR 2.3 (1.26–4.15)	NR-A	NR-A	NR-A	Negative 9/44 (20.5%); inflamed 13/141 (9.2%); OR is not RR
<i>Özdemir et al. (2025)</i>	Table 2: LA 0/15; OA 10/41 (24.4%)	Discussion calls the same events preterm labor	0 fetal deaths in either group (Discussion)	NR	Birth/ labor terminology inconsistent; do not count as separate endpoints. GA differs by route.
<i>Lindqvist et al. (2023)</i>	4.5% vs 5.6% without appendectomy	NR-A	1 miscarriage; 1 ectopic; 1 induced abortion; 2 fetal deaths before surgery*	NR-A	44 births. Loss details from publisher-indexed Results; do not attribute preoperative deaths to surgery.
<i>Zhang et al. (2009)</i>	Not verified as PTB	5.1% vs 1.3%, perforated vs non-perforated	Fetal mortality 25% vs 1.7%	NR-A	Source-reported percentages; denominator interpretation unresolved; no PTB plot
<i>Mantoglu et al. (2020)</i>	10 source-labeled preterm outcomes / 78; definition unresolved	Terminology overlaps delivery	4 abortions/ 78 (5.1%)	NR	64 term; one preterm-labeled event at 37 w; no verified PTB percentage plotted
<i>Buitrago et al. (2020)</i>	11.85% overall; matched RR 1.65 (1.118–2.423), third vs earlier	NR	Not estimable from live-birth selected cohort	NR	Birth <33 w RR 3.43 (1.363–8.625); distinct from PTB <37 w

<i>Study</i>	<i>Preterm birth</i>	<i>Preterm labor</i>	<i>Fetal loss or miscarriage</i>	<i>Neonatal death</i>	<i>Additional notes</i>
<i>Bekraki et al. (2026)</i>	5/ 50 (10.0%); OA 2/ 26 (7.7%); LA 3/ 24 (12.5%); first 0/ 13; second 4/ 30; third 1/ 7	NR	0 reported	NR	Source trimester allocation retained; wide uncertainty

There is significant variation in pregnancy-loss ascertainment used in different studies. The Colombian live-birth cohort is unable to measure the chance of pregnancy loss. In the Swedish report, excerpts from the reports are published on the basis of the author. This means that extracts from the reports refer to miscarriage, ectopic pregnancy, and induced abortion as well as fetal deaths in the period before surgery, which cannot be combined into one single group and attributed to the exposure in the postoperative period (Lindqvist et al., 2023). The most recent tables keep the explicit fetal-loss (or fetal-death) statements from Bekraki et al. (2026) and Özdemir et al. (2025) and do not add any new statements for neonatal-death. These endpoints are differentiated in Tables 4 and 5 and the limitations of the materials that are available are noted.

Table 5: Reporting of PTB phenotype and fatal loss

<i>Study</i>	<i>PTB subtype: spontaneous or planned/indicated</i>	<i>Fetal loss: miscarriage, IUFD or stillbirth</i>	<i>What was reported</i>
<i>Ibiebele et al. (2019)</i>	Yes: planned and spontaneous analyzed	Exact counts NR-A	Planned PTB aHR 2.08; overall aHR 1.73. Exact timing effect requires full text.
<i>Baruch et al. (2025)</i>	Subtype breakdown NR-A	NR-A	PTB and pathology subgroups reported; fetal loss details require full text.
<i>Özdemir et al. (2025)</i>	Spontaneous vs indicated NR	Yes: 0 fetal deaths reported	Table 2 labels events PTB; Discussion labels same events preterm labor. Fetal death absent in both groups.
<i>Lindqvist et al. (2023)</i>	Subtype breakdown NR-A	1 miscarriage; 1 ectopic; 1 induced abortion; 2 preoperative fetal deaths*	Publisher-indexed Results; these outcomes are distinct. No postoperative loss rate inferred.
<i>Zhang et al. (2009)</i>	Not verified; abstract reports preterm labor	Yes, fetal mortality percentages	Perforated versus non-perforated fetal mortality 25% versus 1.7%; not a PTB effect.
<i>Mantoglu et al. (2020)</i>	Subtype breakdown NR	Yes: 4 abortions	Term/preterm/abortion counts; labor/delivery terminology and composite require resolution.

<i>Study</i>	<i>PTB subtype: spontaneous or planned/indicated</i>	<i>Fetal loss: miscarriage, IUFD or stillbirth</i>	<i>What was reported</i>
<i>Buitrago et al. (2020)</i>	Subtype breakdown NR	Live births selected	Timing-associated PTB estimate; pregnancy loss cannot be inferred from the selected cohort.
<i>Bekraki et al. (2026)</i>	Subtype breakdown NR	Yes: 0 reported fetal losses	PTB counts provided by trimester and route separately; no verified joint trimester-by-route PTB matrix.

The birth proportions of surgical approaches and trimmed birth trimesters are shown in Figures 2 and 3, respectively, while Figure 4 displays the same proportions of birth trimesters as an alternative heatmap.

Figure 2: Preterm birth rates by surgical approach and trimester in Bakraki et. al.,(2026)

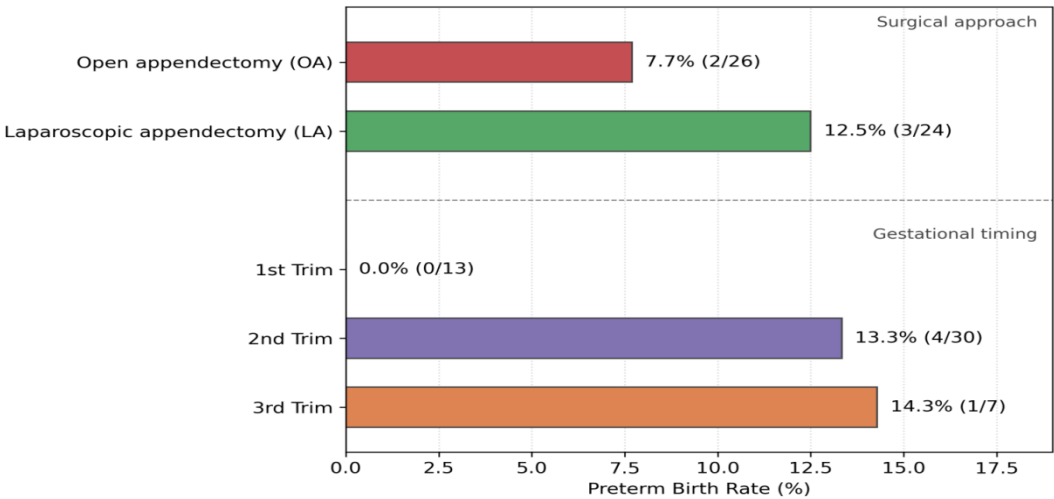


Figure 3: Gestational timing risk ratios without pooling

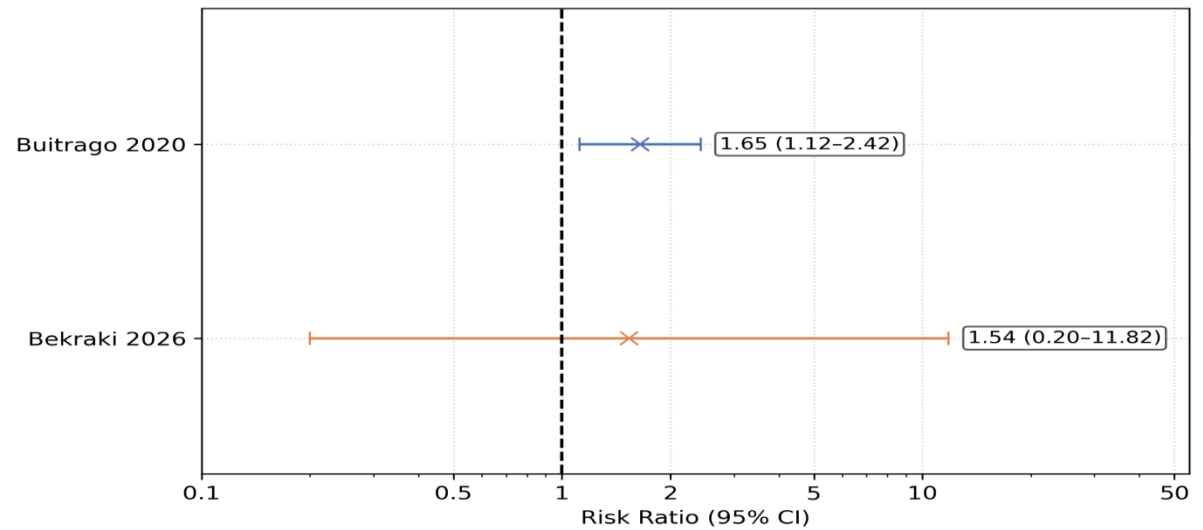
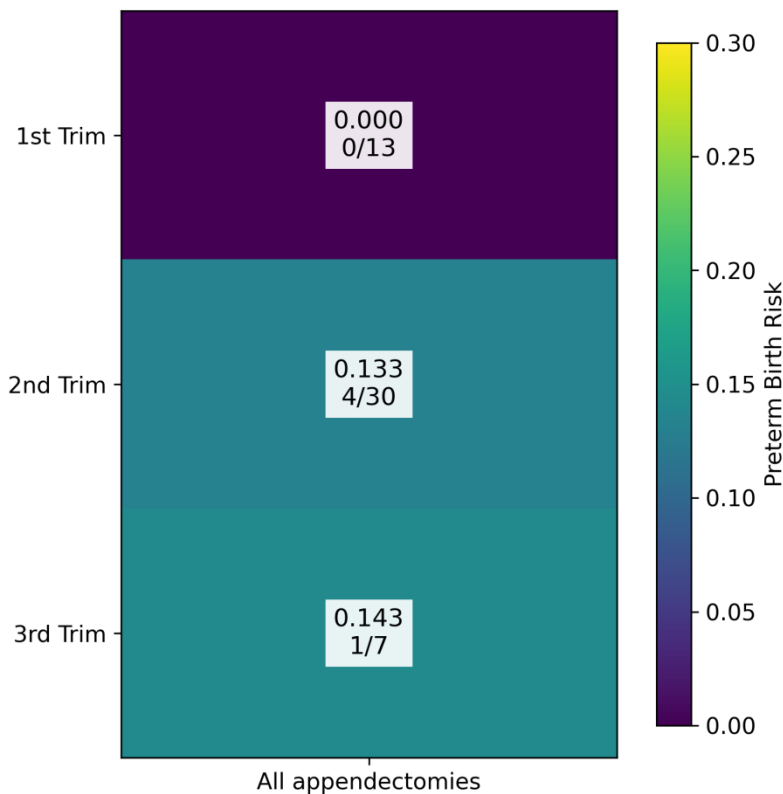


Figure 4: Observed Trimester- specific preterm birth properties



4. Discussion

The present review evaluated the association between gestational timing of appendectomy and preterm birth, considering surgical approach, appendiceal pathology and maternal characteristics. In this propensity score-matched study, Buitrago et al. (2020) noted that women who had an appendectomy during the third trimester of pregnancy were 14% more likely to have a preterm birth than women who had appendectomies that occurred before or during their second trimester. The same direction of association was reported by Bekraki et al. (2026) but it was not as precise due to a small number of events and a large confidence interval. The results indicate that there may be a gestational time-dependent association with preterm birth but its independent association is unclear. The population-based studies also have shown associations of non-obstetric surgery and poor pregnancy outcomes. Balinskaite et al. (2017), Fu et al. (2022) and Yu et al. (2018) reported obstetric risks associated with surgical interventions during pregnancy; and Rasmussen et al. (2020) highlighted the need of considering

surgical timing. However, these studies were mixed studies, making comparisons of studies limited to appendectomy specific evidence. The choice of surgery and other obstetric outcomes might be affected by gestational age. Laparoscopy was reported as being more frequently used during early pregnancy, and open surgery during late pregnancy by Sadot et al. (2010) and Winter et al. (2017), respectively. While Winter et al. (2017) have found an increased fetal-loss signal after laparoscopy, Yoo et al. (2016) and Lipping et al. (2023) have broadly similar obstetric outcomes of surgical approaches to pregnancy. There is a possibility that these differences may be due to gestational age, severity of disease, patient selection and surgical experience. Bekraki et al. (2026) found that there was no significant difference between the preterm birth rate in those who underwent open appendectomy (7.7%) and those who had undergone laparoscopic appendectomy (12.5%). The rates of the 1st, 2nd, 3rd trimesters were 0%, 13.3% and 14.3% respectively. Due to the few events and large confidence intervals, however, the results are difficult to interpret. These findings are shown in Figures 2–4, which show

that there was some uncertainty in the trimester-specific estimates. Surgical approach and trimesters should not be considered as independent observations as they refer to the same population of patients. Pathology of the appendix and/or the accuracy of the diagnosis can also impact the outcome of pregnancy. McGory et al. (2007) found adverse fetal outcomes with complicated and negative appendectomy and Rottenstreich et al. (2022) explored obstetric outcomes with negative appendectomy with a different surgical comparator. Baruch et al. (2025) gave further proof of the association between preterm birth and appendectomy. The present conclusions emphasize the significance of the severity of the disease, the importance of the correct diagnosis and of suitable indications for surgery. There are other risk factors, such as the progression of the disease and delay of treatment. Choi et al. (2023) reported adverse pregnancy events from complicated appendicitis, while Ashbrook et al. (2022) reported poorer outcomes in those who did not undergo nonoperative management for appendicitis, but instead underwent delayed surgery. Definitions of outcomes did not always differ but these results suggest that early intervention at the right time and when clinically indicated is appropriate. The timing of treatment needs to be differentiated from gestational period, as these are two different exposures.

The current recommendations are to manage the patients surgery on an individual basis. Kumar et al. (2024) advised appendectomy during pregnancy only if the maternal condition calls for it and determined the type of surgery (laparoscopic or open) based on uterine anatomy, gestation, skill of the surgeon and the mother's condition. The multidisciplinary management is still important to achieve the best maternal and fetal outcomes. Care needs to be taken in interpreting outcome definitions as well. Visser et al. (2001) separated out preterm labour from actual preterm delivery and Ibiebele et al. (2019) looked at the differences in obstetric outcomes among delivery subtypes. Likewise, pregnancy loss and stillbirth and

neonatal complications can't be viewed as a type of preterm birth. The exclusion of live births, as done in Buitrago et al. (2020) can impact generalizability as well.

5. Conclusion

The timing of the appendectomy has significance for the outcomes of the mother and child, as does preterm birth when it is associated with an appendectomy during pregnancy. The results of the observed findings indicate that there was an increased risk of preterm delivery after third-trimester appendectomy compared to surgery conducted in earlier gestation. These factors along with the surgical approach, appendiceal inflammation, severity of the disease, and diagnostic delay may also impact obstetric outcomes, highlighting the multifactorial nature of preterm birth after appendectomy. However, surgery for suspected acute appendicitis is warranted during pregnancy and should not be postponed because of the pregnancy status. Optimizing the maternal and neonatal outcome is the primary focus of Individualized operative planning, a proper diagnosis, and coordinated multidisciplinary obstetric care and surgical intervention. The need for future studies is to focus on large prospective cohorts with detailed data of the trimester, standard definitions of preterm, and detailed assessment of surgical and pathological features. There is a tremendous opportunity for refinement of diagnostic pathways and perioperative obstetric management to reduce unnecessary preterm births and safe timely treatment for obstetric acute appendicitis.

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Data Availability: The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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