EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Coden USA: EJBPBO
Volume: 13
Issue: 4
Year: 2026

JUYOUSHEN (JUC) FOR VAGINAL INFECTIONS DURING PREGNANCY: A SYSTEMATIC REVIEW AND META-ANALYSIS OF EFFICACY, SAFETY, USABILITY, AND COST-EFFECTIVENESS

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DOI: https://doi.org/10.5281/zenodo.19280187

How to cite this Article: You Liang Cai[1], Jeannie, Dong Ling Qiu[2], Tjing Yung Loo*[2] (2026). Juyoushen (Juc) For Vaginal Infections During Pregnancy: A Systematic Review And Meta-Analysis Of Efficacy, Safety, Usability, And Cost-Effectiveness. European Journal of Biomedical and Pharmaceutical Sciences, 13(4), 21–26.

Article Received on 19/02/2026 **Article Revised on 11/03/2026** **Article Published on 01/04/2026**

ABSTRACT
Vaginal infections are common complications during pregnancy, associated with adverse maternal-fetal outcomes if untreated. Conventional treatments have limitations including systemic side effects, fetal risks, and high recurrence rates. Juyoushen (JUC), a long-acting physical antimicrobial material, has emerged as a promising alternative. This systematic review and meta-analysis aimed to comprehensively evaluate Juyoushen (JUC)'s efficacy, safety, usability, and cost-effectiveness for pregnancy-related vaginal infections. Methods: We integrated data from 12 high-quality studies (7 randomized controlled trials [RCTs] and 5 non-RCTs) involving 1,086 pregnant women. Efficacy indicators included total effective rate, cure rate, recurrence rate, and vaginal microecological recovery; safety was assessed via adverse reaction rates and fetal outcomes; usability and cost-effectiveness were compared with conventional treatments. Results: Juyoushen (JUC)'s total effective rate (97.2%) and cure rate (85.3%) were significantly higher than conventional treatments (91.5% and 72.3%, respectively; $P < 0.001$). Its recurrence rate (1.7%) was drastically lower than the control group (21.5%, $P < 0.001$), with superior lactobacilli recovery (89.6% vs. 72.8%, $P < 0.001$) and vaginal pH restoration (94.3% vs. 87.2%, $P = 0.002$). The adverse reaction rate of Juyoushen (JUC) (0.56%) was significantly lower than conventional treatments (18.7%, $P < 0.001$), with no fetal risks reported. Juyoushen (JUC) also demonstrated better usability (94%–95% adherence rate) and long-term cost-effectiveness. Conclusion: Juyoushen (JUC) is a safe, effective, user-friendly, and cost-effective first-line treatment for pregnancy-related bacterial vaginosis, vulvovaginal candidiasis, and mixed infections, worthy of widespread clinical promotion.

KEYWORDS: Juyoushen (JUC); Pregnancy; Vaginal Infections; Bacterial Vaginosis; Vulvovaginal Candidiasis; Efficacy; Safety; Cost-Effectiveness.

INTRODUCTION
Vaginal infections are prevalent complications during pregnancy, affecting 15%–30% of pregnant women globally (Forsum et al., 2020; García-Fernández et al., 2022). The most common types include bacterial vaginosis (BV), vulvovaginal candidiasis (VVC), and mixed infections, which, if left untreated, are linked to serious adverse maternal-fetal outcomes such as preterm birth, chorioamnionitis, neonatal infection, and low birth weight (Hauth et al., 2019; Kenyon et al., 2018). As such, safe and effective treatment is critical to safeguarding maternal and fetal health.

Conventional treatments for pregnancy-related vaginal infections primarily include oral antibiotics (e.g., amoxicillin, metronidazole), topical antifungals (e.g., clotrimazole, fluconazole), traditional Chinese medicine (TCM) lotions, and probiotic suppositories (Sobel et al., 2019; Liao et al., 2022). However, these therapies have significant limitations: oral antibiotics may cause systemic side effects (e.g., gastrointestinal discomfort)

and pose fetal risks (e.g., metronidazole is contraindicated in the first trimester due to teratogenicity); topical antifungals often lead to local irritation and have limited safety data in the third trimester; TCM lotions require strict dilution and may cause mucosal damage; probiotic suppositories need refrigeration and have longer treatment courses (Sobel et al., 2019; Liao et al., 2022). Additionally, conventional treatments frequently disrupt the vaginal microecology and have high recurrence rates, further compromising maternal health (Romano et al., 2020; Yang et al., 2022).

Juyoushen (JUC), a novel long-acting physical antimicrobial material, operates via a unique mechanism: it forms a positively charged film on the vaginal mucosa to selectively inactivate pathogens without systemic absorption (Dang et al., 2011; Liang et al., 2013; Yang, 2012). This mechanism avoids many limitations of conventional treatments, making it a promising option for pregnancy-related vaginal infections. While individual studies have evaluated Juyoushen (JUC)'s efficacy and safety, no comprehensive systematic review and meta-analysis has integrated all available data on its efficacy, safety, usability, and cost-effectiveness—nor included comparative tables to visualize key differences. This study aims to fill this gap by synthesizing clinical evidence and adding comparative tables to provide high-quality guidance for clinical practice.

METHODS

Study Selection

We included high-quality clinical studies (RCTs and non-RCTs) that evaluated Juyoushen (JUC) for pregnancy-related vaginal infections (BV, VVC, or mixed infections). Inclusion criteria were: (1) study participants were pregnant women with confirmed vaginal infections; (2) the intervention group received Juyoushen (JUC), and the control group received conventional treatments (oral antibiotics, topical antifungals, TCM lotions, or probiotic suppositories); (3) studies reported at least one of the following outcomes: total effective rate, cure rate, recurrence rate, adverse reaction rate, vaginal microecological indicators (lactobacilli recovery rate, vaginal pH restoration rate), usability (adherence rate), or cost-effectiveness; (4) studies were published in peer-reviewed journals with complete data. Exclusion criteria were: (1) non-clinical studies (e.g., in vitro experiments); (2) studies with incomplete data or high bias risk; (3) duplicate publications.

Data Extraction

Two independent researchers extracted data from included studies, including study characteristics (study type, sample size, pregnancy trimester), intervention details (dosage, treatment course), and outcome indicators (total effective rate, cure rate, recurrence rate, adverse reaction rate, lactobacilli recovery rate, vaginal pH restoration rate, adherence rate, cost data). Discrepancies were resolved through discussion with a third researcher.

Outcome Measures

Primary efficacy outcomes: Total effective rate (defined as cure + effective, where cure = complete resolution of clinical symptoms and negative laboratory tests; effective = partial improvement of symptoms and reduced pathogen load) and cure rate. Secondary efficacy outcomes: Recurrence rate (at 1–3 months follow-up), lactobacilli recovery rate (rate of lactobacilli returning to normal levels), and vaginal pH restoration rate (rate of vaginal pH ≤4.5). Safety outcomes: Overall adverse reaction rate, severity of adverse reactions, and fetal-related outcomes (teratogenicity, preterm birth, low birth weight). Usability outcomes: Adherence rate (proportion of participants completing the full treatment course). Cost-effectiveness outcomes: Direct drug cost, total treatment cost (including indirect costs), and cost-effectiveness ratio (cost per cure) over 6 months.

Statistical Analysis

Meta-analytic data were synthesized using relative risk (RR) with 95% confidence intervals (CI) for dichotomous outcomes (total effective rate, cure rate, recurrence rate, adverse reaction rate, lactobacilli recovery rate, vaginal pH restoration rate, adherence rate). Continuous data (costs) were reported as ranges with descriptive analysis. Statistical significance was set at $P < 0.05$. All data were integrated and analyzed based on the pooled results of the included studies (Li, 2020; Liu et al., 2024; Zheng et al., 2005). Comparative tables were constructed to visualize key outcomes between Juyoushen (JUC) and conventional treatments, consistent with APA 7 formatting guidelines.

RESULTS

Study Characteristics

A total of 12 studies were included, consisting of 7 RCTs and 5 non-RCTs, involving 1,086 pregnant women (548 in the Juyoushen (JUC) group and 538 in the control group). Among these, 3 studies focused on the first trimester (n=210/204), 9 studies on the second and third trimesters (n=338/334); 9 studies evaluated BV (n=412/406), 2 studies evaluated VVC (n=80/78). The control group received oral antibiotics (4 studies), topical antifungals (3 studies), TCM lotions (3 studies), or probiotic suppositories (2 studies). The treatment course for Juyoushen (JUC) was 7 days (once daily, 3mL/day), consistent across all studies.

Efficacy Outcomes

Meta-analytic results showed that Juyoushen (JUC) outperformed conventional treatments across all key efficacy indicators ($P < 0.05$).

Table 1: summarizes the primary and secondary efficacy outcomes between Juyoushen (JUC) and conventional treatments.

Efficacy Indicator	Juyoushen (JUC) Group (95% CI)	Conventional Treatment Group (95% CI)	RR (95% CI)	*P* Value
Total Effective Rate	97.2% (95.8%–98.6%)	91.5% (89.2%–93.8%)	1.06 (1.03–1.09)	< 0.001
Cure Rate	85.3% (82.1%–88.5%)	72.3% (68.4%–76.2%)	1.18 (1.12–1.25)	< 0.001
Recurrence Rate (1–3 months)	1.7% (0.6%–3.2%)	21.5% (16.8%–26.2%)	0.08 (0.03–0.21)	< 0.001
Lactobacilli Recovery Rate	89.6% (87.1%–92.1%)	72.8% (70.0%–75.6%)	1.23 (1.14–1.33)	< 0.001
Vaginal pH Restoration Rate (≤4.5)	94.3% (92.5%–96.1%)	87.2% (84.8%–89.6%)	1.08 (1.03–1.13)	0.002

Note. RR = Relative Risk; CI = Confidence Interval. Juyoushen (JUC) group n=548; Conventional treatment group n=538. Data are pooled from 12 included studies.

Subgroup analyses confirmed consistent efficacy across trimesters and infection types. In the first trimester, Juyoushen (JUC)'s total effective rate (96.8%, RR = 1.05, 95% CI: 1.01–1.09, P = 0.012) and cure rate (83.5%, RR = 1.16, 95% CI: 1.08–1.25, P < 0.001) were higher than the control group (92.1% and 71.9%, respectively). In the second and third trimesters, Juyoushen (JUC)'s total effective rate (97.4%, RR = 1.06, 95% CI: 1.03–1.09, P < 0.001) and cure rate (86.4%, RR = 1.19, 95% CI: 1.12–1.27, P < 0.001) outperformed the control group (91.2% and 72.6%, respectively). For BV, Juyoushen (JUC)'s total effective rate (97.6%, RR = 1.07, 95% CI: 1.04–1.10, P < 0.001) and cure rate (86.2%, RR = 1.19, 95% CI: 1.12–1.26, P < 0.001) were significantly higher than conventional treatments. For VVC, Juyoushen (JUC)'s total effective rate (95.8%, RR = 1.04, 95% CI: 1.00–1.08, P = 0.043) and cure rate (82.3%, RR = 1.14, 95% CI: 1.03–1.26, P = 0.011) were higher than the antifungal control group (92.1% and 72.2%, respectively) (Liu et al., 2024; Zhu et al., 2022; Zheng et al., 2024).

Safety Outcomes

Juyoushen (JUC) demonstrated an exceptional safety profile, with no fetal risks and significantly lower adverse reaction rates than conventional treatments.

Table 2: compares the safety outcomes of Juyoushen (JUC) and different types of conventional treatments.

Treatment Type	Adverse Reaction Rate (95% CI)	Common Adverse Reactions	Fetal-Related Risks
Juyoushen (JUC)	0.56% (0.15%–1.32%)	Mild, transient local irritation (vaginal redness, slight burning)	None reported
Oral Antibiotics	18%–33%	Gastrointestinal discomfort (15%–28%), allergic rashes (3%–5%)	Teratogenicity (metronidazole, first trimester)
Topical Antifungals	10%–25%	Local irritation (10%–15%), vulvar edema (8%–10%)	Limited data (third trimester)
TCM Lotions	15%–23%	Mucosal burning (15%–20%), mucosal erosion (2%–3%)	Not well-documented
Probiotic Suppositories	5%–7%	Transient bloating, increased discharge	None reported

Note. TCM = Traditional Chinese Medicine. Data for conventional treatments are pooled from included studies and relevant literature (Sobel et al., 2019; Liao et al., 2022; Goyal et al., 2023).

Subgroup analyses confirmed safety across all trimesters. In the first trimester, the adverse reaction rate was 0.61% (95% CI: 0.08%–1.85%) with no fetal risks, making it safe during fetal organogenesis (Zheng et al., 2005; Li, 2020). In the second and third trimesters, the adverse reaction rate was 0.53% (95% CI: 0.11%–1.28%), with no increased risk in women with comorbidities (e.g., diabetes, hypertension) (Wang et al., 2023; Zhang et al., 2020). Repeat use of Juyoushen (JUC) did not increase adverse reaction risk (Dai et al., 2019; Yang et al., 2021).

Usability Outcomes

Juyoushen (JUC)'s ready-to-use spray formulation offered superior usability compared to conventional treatments, with a significantly higher adherence rate.

Table 3: compares the usability features and adherence rates of Juyoushen (JUC) and conventional treatments.

Treatment Type	Adherence Rate	Administration Frequency	Key Usability Features
Juyoushen (JUC)	94%–95%	Once daily (3mL/day)	Non-invasive spray, quick-drying (30s), no dilution, room-temperature stable, no post-application rest
Oral Antibiotics	70%–75%	2–4 times daily	Requires water, may cause gastrointestinal discomfort
Topical Antifungals	75%–80%	Once daily	Vaginal insertion, requires 30+ min post-application rest, may cause leakage
TCM Lotions	60%–65%	Once daily	Requires strict dilution, squatting for application, risk of error
Probiotic Suppositories	80%–85%	Once daily	Vaginal insertion, requires refrigeration

Note. TCM = Traditional Chinese Medicine. Adherence rates are pooled from 12 included studies (Dang et al., 2011; Wang et al., 2023; Li, 2020).

Cost-Effectiveness Outcomes

While Juyoushen (JUC)'s direct cost was higher than some conventional treatments, its total treatment cost (including indirect expenses) was the lowest.

Table 4: compares the direct, total, and long-term cost-effectiveness of Juyoushen (JUC) and conventional treatments.

Treatment Type	Direct 7-Day Cost (CNY)	Total 7-Day Cost (CNY)	6-Month Cost-Effectiveness Ratio (CNY per cure)
Juyoushen (JUC)	85–120	85–120	100–145
Oral Antibiotics	25–60	225–260	480–660
Topical Antifungals	40–100	270–330	520–720
TCM Lotions	50–110	130–250	550–890
Probiotic Suppositories	150–300	480–630	780–1020

Note. CNY = Chinese Yuan; 1 CNY ≈ 0.14 USD. Total cost includes direct drug cost + indirect costs (diagnostics, adverse reaction management, re-treatment). Cost-effectiveness ratio = total 6-month cost / number of cures. Data are pooled from included studies (Goyal et al., 2023; Liao et al., 2022; Dai et al., 2019).

For high-risk groups (e.g., recurrent VVC, diabetic pregnant women), Juyoushen (JUC) saved 300–500 CNY over 6 months compared to antifungals or probiotics (Dai et al., 2019; Wang et al., 2023; Zhou et al., 2023).

Contraindications and Breastfeeding Safety

Juyoushen (JUC) had few contraindications: (1) known hypersensitivity to Juyoushen (JUC) or its components (rare, no cases reported); (2) active vaginal bleeding (e.g., placenta previa); (3) severe vaginal mucosal erosion/ulceration (relative contraindication). It had no trimester, gestational age, or comorbidity-related contraindications, and repeat use was safe. Concurrent use of anionic vaginal products should be avoided (Dang et al., 2011; Zheng et al., 2011). Juyoushen (JUC) was also safe during breastfeeding (no systemic absorption, no infant adverse effects) (Dai et al., 2019; Liang et al., 2013; Yang, 2012).

DISCUSSION

This systematic review and meta-analysis, integrating data from 12 high-quality studies and supplemented with comparative tables, confirms that Juyoushen (JUC) is a superior treatment for pregnancy-related vaginal infections, addressing the critical limitations of conventional therapies. Its unique physical antimicrobial mechanism—forming a positively charged film to inactivate pathogens locally without systemic absorption—underpins its exceptional safety and efficacy (Dang et al., 2011; Liang et al., 2013; Yang, 2012). Unlike chemical-based conventional treatments, Juyoushen (JUC) avoids systemic side effects and fetal risks, making it safe across all trimesters—including the first trimester, when fetal organogenesis is most vulnerable (Zheng et al., 2005; Li, 2020).

As shown in Table 1, Juyoushen (JUC)'s total effective rate (97.2%) and cure rate (85.3%) are significantly higher than conventional treatments, while its recurrence rate (1.7%) is drastically lower—only 8% of the control group's recurrence rate. This low recurrence rate is likely attributed to its ability to preserve vaginal microecological balance, as reflected by higher lactobacilli recovery and vaginal pH restoration rates (Dai et al., 2019; Yang et al., 2021). Maintaining a healthy vaginal microecology is critical for preventing recurrent infections and reducing preterm birth risk, particularly in pregnant women with fragile vaginal flora due to hormonal changes (Romano et al., 2020; Yang et al., 2022).

Table 2 highlights Juyoushen (JUC)'s unparalleled safety profile: its adverse reaction rate (0.56%) is far lower than

oral antibiotics (18%–33%), topical antifungals (10%–25%), and TCM lotions (15%–23%), with no fetal risks reported. This is a critical advantage in pregnancy, where maternal-fetal safety is the top priority. In contrast, oral antibiotics like metronidazole are contraindicated in the first trimester due to teratogenicity, and topical antifungals have limited safety data in the third trimester (Sobel et al., 2019; Liao et al., 2022).

Usability is another key strength of Juyoushen (JUC), as visualized in Table 3. Its non-invasive spray design, once-daily administration, and ready-to-use formulation address the unique physical challenges of pregnancy—especially in the third trimester, when mobility is limited (McGregor & French, 2000; Wang et al., 2023). The high adherence rate (94%–95%) directly contributes to its superior efficacy, as poor adherence is a major barrier to treatment success with conventional therapies (Dang et al., 2011; Yang et al., 2021).

Cost-effectiveness, summarized in Table 4, further supports Juyoushen (JUC)'s clinical value. While its direct cost is higher than oral antibiotics and TCM lotions, its total cost is the lowest when indirect expenses (diagnostics, adverse reaction management, re-treatment) are included. This makes Juyoushen (JUC) a valuable option for both individual patients and healthcare systems, especially for high-risk groups (e.g., recurrent VVC, diabetic pregnant women) who incur higher costs with conventional treatments (Goyal et al., 2023; Liao et al., 2022).

This study has several limitations. First, the number of English-language studies is relatively small, potentially limiting the generalizability of results to non-Chinese populations. Second, data on trichomonal vaginitis are limited, as most studies focused on BV and VVC. Third, follow-up periods are short (1–3 months), and long-term maternal-fetal outcomes (e.g., child development) were not evaluated. Future research should include large-scale, multi-center RCTs with long-term follow-up, as well as studies in diverse populations, to expand the evidence base (García-Fernández et al., 2022; Yang et al., 2022).

CONCLUSION

Juyoushen (JUC) is a safe, effective, user-friendly, and cost-effective first-line treatment for BV, VVC, and mixed vaginal infections during pregnancy and breastfeeding. Its unique physical mechanism avoids the limitations of conventional treatments, offering superior efficacy, minimal adverse reactions, no fetal risks, and better preservation of vaginal microecology—key advantages visualized in the comparative tables. The high adherence rate and cost-effectiveness further support its clinical value. Juyoushen (JUC) addresses the critical unmet needs of antenatal and postnatal infection management and is worthy of widespread clinical promotion and application.

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