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Efficacy of live lactobacillus preparations in treating cervical inflammation and clearing viral infections in patients with HPV infection complicated by bacterial vaginosis

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Abstract

This study aimed to evaluate the efficacy and safety of Dingjunsheng, a live Lactobacillus preparation, as adjuvant therapy in patients with human papillomavirus (HPV) infection complicated by bacterial vaginosis (BV). A retrospective analysis was conducted on 152 eligible patients, randomly divided into two groups: the observation group (n=87) receiving standard BV antibacterial therapy plus Dingjunsheng, and the control group (n=65) who received standard BV antibacterial therapy alone. The patients were followed up for six months. Primary outcomes included HPV clearance rate and cervical cytological inflammation improvement, while secondary outcomes involved BV recurrence rate and adverse reaction incidence. The results showed that the observation group had a significantly higher HPV clearance rate (73.6% vs 53.9%) and inflammation improvement rate (90.8% vs 76.9%), as well as a lower BV recurrence rate (3.1% vs 13.9%) compared to the control group. Dingjunsheng was identified as an independent protective factor for HPV clearance (OR=2.5, 95%CI:1.3–5.1). The incidence of adverse reactions was similar between both groups. We conclude that Dingjunsheng adjuvant therapy demonstrated effectiveness in improving HPV clearance, alleviating inflammation, and reducing BV recurrence, with good safety, making it a valuable treatment strategy for these patients. *(Afr J Reprod Health 2026; 30 [13]:112-122).*

Keywords : Bacterial Vaginosis; Live Lactobacillus Preparations; Human Papillomavirus; Vaginal Microecology; Adjuvant Therapy

Résumé

Cette étude visait à évaluer l'efficacité et l'innocuité du Dingjunsheng, une préparation de Lactobacillus vivant, en tant que traitement adjuvant chez les patientes présentant une infection à papillomavirus humain (VPH) compliquée de vaginose bactérienne (VB). Une analyse rétrospective a été menée auprès de 152 patientes éligibles, réparties aléatoirement en deux groupes : un groupe d'observation (n = 87) recevant un traitement antibactérien standard de la VB associé au Dingjunsheng, et un groupe témoin (n = 65) recevant uniquement un traitement antibactérien standard de la VB. Les patientes ont été suivies pendant six mois. Les critères d'évaluation principaux étaient le taux d'élimination du VPH et l'amélioration de l'inflammation cytologique cervicale, tandis que les critères d'évaluation secondaires incluaient le taux de récidive de la VB et l'incidence des effets indésirables. Les résultats ont montré que le groupe d'observation présentait un taux d'élimination du VPH significativement plus élevé (73,6 % vs 53,9 %) et un taux d'amélioration de l'inflammation significativement plus élevé (90,8 % vs 76,9 %), ainsi qu'un taux de récidive de la VB plus faible (3,1 % vs 13,9 %) comparativement au groupe témoin. Le dingjunsheng a été identifié comme un facteur protecteur indépendant pour l'élimination du VPH (OR = 2,5, IC à 95 % : 1,3–5,1). L'incidence des effets indésirables était similaire dans les deux groupes. Nous concluons que le traitement adjuvant par dingjunsheng s'est avéré efficace pour améliorer l'élimination du VPH, atténuer l'inflammation et réduire les récidives de vaginose bactérienne, avec un bon profil de sécurité, ce qui en fait une stratégie thérapeutique précieuse pour ces patientes. *(Afr J Reprod Health 2026; 30 [13]: 112-122).*

Keywords: Vaginose bactérienne ; Préparations de lactobacilles vivants ; Papillomavirus humain ; Microécologie vaginale ; Traitement adjuvant

Introduction

Persistent infection with human papillomavirus (HPV) is the primary causative factor in the development of cervical intraepithelial neoplasia and ultimately cervical cancer.[1,2] Although most HPV infections are transient and can be spontaneously cleared by the body's immune

system, the persistence of some infections, especially high-risk HPV types, constitutes a clear precancerous risk.[3,4] It is noteworthy that the microenvironment of the female lower genital tract, particularly the homeostasis of the vaginal microbiota, plays a crucial role in the outcome of HPV infection.[5] Among them, Bacterial Vaginosis (BV) is a common microecological disorder characterized by a reduction in Lactobacillus that produces hydrogen peroxide in the vagina, along with excessive proliferation of anaerobic bacteria and Gardnerella and other microorganisms.[6] BV has been confirmed by multiple studies to be closely related to an increased risk of HPV infection and the progression of cervical lesions.[7,8] The mechanism may involve BV-induced disruption of local immune barriers, increased release of inflammatory mediators, and alterations in the cervical epithelial cell microenvironment, thereby creating favourable conditions for HPV invasion, replication, and immune evasion.[9,10]

Cervical cytology screening serves not only as a vital tool for detecting cervical abnormalities, but the description of inflammatory severity within its reports also indirectly reflects the local inflammatory state of the cervix.[11] In the complex microenvironment where HPV and BV coexist, the local inflammatory response in the cervix is often more pronounced. Therefore, exploring comprehensive intervention strategies that can simultaneously improve the vaginal microbiota, alleviate local cervical inflammation, and promote HPV clearance holds significant clinical importance. In recent years, the therapeutic concept based on microbiota modulation has garnered increasing attention.[12]

Probiotic therapy, exemplified by live Lactobacillus preparations, aims to restore the vaginal acidic environment and enhance local mucosal immunity by exogenously supplementing beneficial bacterial flora to competitively inhibit pathogenic colonization.[13] Theoretically, this microecological regulatory effect may not only effectively treat BV but also influence the outcome of HPV infection by improving the overall vaginal environment.[12] However, there remains a lack of high-quality evidence from real-world clinical practice regarding the application of live Lactobacillus preparations in the specific population of HPV infection complicated by bacterial vaginosis.

Based on this, the present study aims to evaluate, through a retrospective cohort analysis, the actual clinical efficacy of live Lactobacillus preparations (Dingjunsheng) as an adjunctive therapy in patients co-infected with HPV and diagnosed with BV. This assessment focuses on changes in the degree of inflammation indicated by cervical cytology and subsequent HPV clearance rates. Through systematic analysis of recent clinical data from our institution, we seek to provide an optimised, evidence-based approach to microbiome modulation therapy for the clinical management of this combined condition.

Methods

Patient population

This retrospective analysis study consecutively enrolled female patients attending Hepingli hospital between June 2023 and April 2025 who met diagnostic criteria for both high-risk HPV infection and bacterial vaginosis. Researchers conducted an initial screening of cases through hospital electronic medical record systems and laboratory information systems, using diagnostic codes and keywords. Ultimately, 152 patients meeting all criteria were confirmed and included in the study.

Inclusion and exclusion criteria

Inclusion criteria: (1) Age ≥18; (2) HPV typing test confirmed the presence of at least one type of HPV infection; (3) Patients diagnosed with BV by Nugent score (≥7 points) during the same period [14]; (4) Received standard initial antibacterial treatment for BV (oral metronidazole or clindamycin, course of treatment in accordance with guidelines) [15]; (5) Patients with complete clinical data.

Exclusion criteria: (1) Combined with other lower genital tract-specific infections (such as trichomoniasis, gonococcal infection, chlamydial infection, etc.); (2)Combined cervical intraepithelial neoplasia, cervical carcinoma, or other malignant tumours of the reproductive system; (3) Immunodeficiency or long-term use of immunosuppressive agents; (4) Pregnant and breastfeeding female patients.

Grouping criteria

According to the different treatment schemes documented in the electronic medical records, the

enrolled patients were retrospectively divided into the observation group and the control group; no randomization was performed. Group assignment was determined by the actual clinical decision recorded at the time of initial BV treatment. Patients in the control group received only standard initial antibacterial treatment for BV (oral metronidazole or clindamycin, in accordance with guideline recommendations). Patients in the observation group received Dingjunsheng (live Lactobacillus preparation) as adjuvant therapy on the basis of the same standard antibacterial treatment for BV. Dingjunsheng (vaginal capsule, Inner Mongolia Shuangqi Pharmaceutical Co., Ltd., China, National Medical Products Administration approval No. S20030005) contains 0.25 g/capsule of live Lactobacillus spp. with $\geq 2.5\times10^5$ CFU per capsule. The strain is cultured in de Man-Rogosa-Sharpe medium, harvested by centrifugation, freeze-dried with skim-milk and trehalose protectants, and filled into gelatin capsules under aseptic conditions; the finished product is stored at 2–8 °C.

Patients in the observation group inserted one capsule deep into the vagina every night for 10 consecutive nights after completing the standard antibacterial course, following the manufacturer's instructions.

Data collection

All data were independently extracted by two researchers, both trained to the same standard, from the hospital's electronic medical record system, laboratory information system, and nursing records. Cross-checking was performed to ensure accuracy. The collected data included two categories: baseline data and follow-up data. (1) Baseline data: General clinical data (age, body mass index [BMI]), BV-related data (BV duration, BV history [first episode/recurrence]), demographic and reproductive data (marital status [married/unmarried/divorced], reproductive history [yes/no], contraceptive method [condom/intrauterine device/other/none]), and laboratory examination data (HPV infection type [low-risk/high-risk], baseline cervical cytological inflammation grade [mild/moderate/severe]). (2) Follow-up data: All patients were followed up for 6 months after the end of treatment. The follow-up indicators included HPV typing re-examination results (clearance/persistence), cervical cytological inflammation grade re-evaluation results, vaginal discharge re-examination results (BV recurrence [yes/no]), and adverse reactions during treatment (type, number of cases, severity; graded according to CTCAE 5.0 standard [16]).

Observed indicators

Primary observed indicators: (1) HPV clearance rate at 6 months after treatment: Defined as the proportion of patients with negative HPV typing re-examination results at 6 months after treatment among the total number of patients in the group. Stratified analysis was conducted according to HPV infection type (low-risk/high-risk) and age group (≤39 years/>39 years). (2) Improvement rate of cervical cytological inflammation at 6 months after treatment: Modified definition—Defined as the proportion of patients with either reduced cervical cytological inflammation grade or alleviated clinical symptoms (e.g., decreased vaginal discharge, relieved pruritus) at 6 months after treatment compared with baseline among the total number of patients in the group. Notes: Cervical cytological inflammation grading criteria refer to the Bethesda System for Reporting Cervical Cytology [17]: Mild inflammation—A small number of inflammatory cells are present, accounting for <30% of the total cells; Moderate inflammation—Inflammatory cells account for 30%-50% of the total cells; Severe inflammation—Inflammatory cells account for >50% of the total cells, with obvious tissue hyperemia and edema.

Secondary observed indicators: (1) BV recurrence rate at 6 months after treatment: Defined as the proportion of patients with positive BV re-diagnosis (Nugent score ≥7 points) at 6 months after treatment among the total number of patients in the group. (2) Association between HPV clearance status and BV recurrence: The recurrence rate of BV was compared between patients with HPV clearance and those with persistent HPV infection in both groups. (3) Incidence of adverse reactions during treatment: Defined as the proportion of patients with adverse reactions during treatment.

Exploratory observation indicator: Influencing factors of HPV clearance at 6 months after treatment: To explore whether treatment method, age, HPV type, baseline inflammation grade, and BV history are independent influencing factors of HPV clearance.

Statistical analysis

Statistical analysis was conducted using SPSS 26.0 (IBM Corp., Armonk, NY, USA) software. Measurement data that conformed to normal distribution were expressed as Mean ± Standard Deviation (Mean ± SD), and the comparison between groups was performed using independent samples t-test. Count data were expressed as number (percentage) [n (%)], and the comparison between groups was performed using chi-square (χ^2) test. For data that did not meet the application conditions of chi-square test (expected frequency <5), Fisher's exact test was used. Multivariate Logistic regression analysis was used to explore the independent influencing factors of HPV clearance, with "HPV clearance at 6 months after treatment" as the dependent variable (clearance=1, persistence=0), "treatment method" as the main independent variable (observation group=1, control group=0), and age, HPV type, baseline inflammation grade, and BV history as confounding factors. A two-sided P value <0.05 was considered statistically significant.

Ethical approval

This study strictly adhered to all principles of the Declaration of Helsinki. The research protocol has been reviewed and approved by the Ethics Committee of Beijing Hepingli Hospital (Approval No.: BJSHPLYY-IRB-KYXM-2025-20), with the approval date being October 17, 2025.

Results

Comparison of baseline characteristics between the two groups

A total of 152 patients with HPV infection complicated with BV were enrolled in this study, including 87 cases in the observation group and 65 cases in the control group. The comparison of baseline data between the two groups showed no statistically significant differences in age, BMI, BV duration, marital status, reproductive history, contraceptive method, HPV infection type, baseline cervical cytological inflammation grade, and BV history (P > 0.05), indicating that the baseline data of the two groups were comparable. The detailed distribution of baseline characteristics is shown in Table 1.

HPV clearance rate at six months after treatment

The results of HPV typing re-examination at 6 months after treatment showed that the HPV clearance rate in the observation group was significantly higher than that in the control group, with a statistically significant difference (χ^2=6.37, P=0.012). Stratified analysis revealed that regardless of the type of HPV infection, the HPV clearance rate in the observation group was higher than that in the control group: in the high-risk HPV infection subgroup, the clearance rate was 70.4% (19/27) in the observation group versus 51.9% (14/27) in the control group, with no statistically significant difference (χ^2=1.95, P=0.163); in the low-risk HPV infection subgroup, the clearance rate was 75.0% (45/60) in the observation group versus 55.3% (21/38) in the control group, with a statistically significant difference (χ^2=4.12, P=0.042). The detailed HPV clearance effects are shown in Table 2.

Comparison of the degree of cervical cytological inflammation before and after treatment

Intra-group comparison showed that the degree of cervical cytological inflammation in both groups was significantly improved at 6 months after treatment compared with that before treatment (observation group: P<0.001; control group: P=0.004). Inter-group comparison indicated that the improvement rate of cervical cytological inflammation in the observation group was 90.8% (79/87) at 6 months after treatment, which was significantly higher than 76.9% (50/65) in the control group (χ^2=5.58, P=0.018). After treatment, the proportion of mild inflammation in the observation group was significantly higher than that in the control group, while the proportion of severe inflammation was significantly lower than that in the control group, with statistically significant differences (P=0.006). The distribution and improvement of cervical cytological inflammation before and after treatment in the two groups are shown in Table 3.

Table 1: Comparison of baseline characteristics between the two groups

Variables	Total (n = 152)	Control group (n = 65)	Observation Group (n = 87)	Statistic	*P*
Age (years), Mean ± SD	39.0 ± 6.4	39.3 ± 6.3	38.7 ± 6.5	t=0.50	0.618
BMI (kg/m²), Mean ± SD	22.6 ± 2.2	22.5 ± 2.4	22.7 ± 2.1	t=-0.66	0.511
BV Duration (days), Mean ± SD	7.6 ± 2.6	7.7 ± 2.5	7.6 ± 2.6	t=0.39	0.698
Marital Status, n(%)				χ^2=0.22	0.641
Married	131 (86.9)	57 (87.7)	74 (85.1)		
Unmarried/Divorced	21 (13.8)	8 (12.3)	13 (14.9)		
Reproductive history, n(%)				χ^2=0.11	0.739
No	40 (26.3)	18 (27.7)	22 (25.3)		
Yes	112 (73.7)	47 (72.3)	65 (74.7)		
Contraceptive Method, n(%)				χ^2=1.60	0.449
Condom	83 (54.6)	32 (49.2)	51 (58.6)		
Intrauterine Device	44 (29.0)	20 (30.8)	24 (27.6)		
Other/None	25 (16.5)	13 (20.0)	12 (13.8)		
HPV Type, n(%)				χ^2=1.79	0.181
Low-risk	98 (64.5)	38 (58.5)	60 (69.0)		
High-risk	54 (35.5)	27 (41.5)	27 (31.0)		
Baseline Inflammation Grade, n(%)				χ^2=0.30	0.862
Mild	41 (27.0)	19 (29.2)	22 (25.3)		
Moderate	72 (47.4)	30 (46.2)	42 (48.3)		
Severe	39 (25.7)	16 (24.6)	23 (26.4)		
BV History, n(%)				χ^2=0.85	0.356
First Episode	126 (82.9)	56 (86.2)	70 (80.5)		
Recurrence	26 (17.1)	9 (13.9)	17 (19.5)		

Table 2: HPV clearance rate in 6 months

HPV Type	Group	n	Number of Clearance Cases	Clearance Rate (%)	x^2 value	P value
Overall	Observation Group	87	64	73.6	6.37	0.012
	Control group	65	35	53.9		
High-risk	Observation Group	27	19	70.4	1.95	0.163
	Control group	27	14	51.9		
Low-risk	Observation Group	60	45	75.0	4.12	0.042
	Control group	38	21	55.3		

Table 3. Comparison of the degree of cervical cytological inflammation before and after treatment

Group	Time point	Mild	Moderate	Severe	Statistic	P value	Improvement Rate（%）
Observation Group	Before treatment	22 (25.3)	42 (48.3)	23 (26.4)	-	<0.001[a]	90.8 (79/87)
	Six months later	69 (79.3)	16 (18.4)	2 (2.3)			
Control group	Before treatment	19 (29.2)	30 (46.2)	16 (24.6)	10.90	0.004	76.9 (50/65)
	Six months later	37 (56.9)	21 (32.3)	7 (10.8)			
After treatment between groups		P=0.006[a]					x^2=5.58, P=0.018

[a]Fisher's precision probability test

Table 4: Recurrence of BV 6 months after treatment and the association with HPV clearance status

Group	HPV Status	n	Number of BV Recurrence Cases	Recurrence rate (%)	Statistic	P value
Observation Group	Cleared	64	2	3.1	-	0.013[a]
	Persistent	23	5	21.7		
Control group	Cleared	35	3	8.6	-	0.027[a]
	Persistent	30	10	33.3		
Between groups					4.65	0.031

[a]Fisher's precision probability test

Recurrence of BV 6 months after treatment and the association with HPV clearance status

The results of vaginal discharge re-examination at 6 months after treatment showed that the recurrence rate of BV in the observation group was 3.1% (2/64), which was significantly lower than 13.9% (9/65) in the control group, with a statistically significant difference (χ^2=4.65, P=0.031). Further analysis of the association between HPV clearance status and BV recurrence found that the recurrence rate of BV in patients with HPV clearance was significantly lower than that in patients with persistent HPV infection in both groups (observation group: 3.1% vs 21.7%, Fisher's exact test, P=0.013; control group: 8.6% vs 33.3%, Fisher's exact test, P=0.027). The detailed recurrence of BV is shown in Table 4.

HPV clearance effect in patients of different age groups

Patients were divided into two age subgroups: ≤39 years and >39 years. Inter-group comparison showed that within the same age subgroup, the HPV clearance rate in the observation group was higher than that in the control group. In the ≤39 years subgroup, the clearance rate was 83.0% (44/53) in the observation group versus 63.3% (19/30) in the control group, with a statistically significant difference (χ^2=4.06, P=0.044). In the >39 years subgroup, the clearance rate was 61.8% (21/34) in the observation group versus 42.9% (15/35) in the control group, with no statistically significant difference (χ^2=2.47, P=0.116). The overall comparison between the two groups showed that the HPV clearance rate in the observation group was significantly higher than that in the control group (χ^2=5.77, P=0.016). The HPV clearance effect in different age groups is shown in Table 5.

Comparison of adverse reactions during treatment

All patients in both groups completed the full course of standardized treatment, and there was no statistically significant difference in the incidence of adverse reactions between the two groups during treatment (χ^2=1.33, P=0.249). A total of 7 cases of adverse reactions occurred in the observation group, with an incidence rate of 8.1%, all of which were Grade 1 adverse reactions, including 3 cases of mild vaginal itching, 2 cases of vaginal burning sensation, and 2 cases of transient increased discharge. A total of 9 cases of adverse reactions occurred in the control group, with an incidence rate of 13.9%, including 4 cases of mild vaginal itching, 2 cases of vaginal burning sensation, and 3 cases of transient increased discharge. All adverse reactions did not require special treatment, were tolerable to patients, did not affect the treatment process, and relieved spontaneously after the end of treatment. The detailed occurrence of adverse reactions is shown in Table 6.

Exploratory analysis: multivariate logistic regression analysis of influencing factors of HPV clearance

Taking "HPV clearance at 6 months after treatment" as the dependent variable (clearance=1, persistence=0), "treatment method" as the main independent variable (observation group=1, control group=0), and age, HPV type, baseline inflammation grade, and BV history as confounding factors, a multivariate Logistic regression analysis was performed.

The results showed that after adjusting for the above confounding factors, Dingjunsheng treatment (observation group) was still an independent protective factor for promoting HPV clearance (OR=2.5, 95%CI: 1.3~5.1, P=0.010).

Table 5: HPV clearance effect in patients of different age groups

Age group	Group	n	Number of Clearance Cases	Clearance Rate（%）	Statistic	P value
≤39 years[a]	Observation Group	53	44	83.0	4.06	0.044
	Control group	30	19	63.3		
>39 years	Observation Group	34	21	61.8	2.47	0.116
	Control group	35	15	42.9		
Between groups					5.77	0.016

[a]The median age of all patients was taken as the cut-off value for grouping.

Table 6: Comparison of adverse reactions during treatment

Adverse reactions	Observation Group（n=87	Control group （n=65）	Total (n=152)	Statistic	P value
Mild Vaginal Itching	3 (3.5)	4 (6.2)	7 (4.6)	-	0.462[a]
Vaginal Burning Sensation	2 (2.3)	2 (3.1)	4 (2.6)	-	1.000[a]
Transient Increased Discharge	2 (2.3)	3 (4.6)	5 (3.3)	-	0.652[a]
Total	7 (8.1)	9 (13.9)	16 (10.5)	1.33	0.249

[a]Fisher's precision probability test.

Table 7: Exploratory analysis: Multivariate Logistic regression analysis of influencing factors of HPV clearance

Variables	β	S.E	OR	95%CI	*P*
Group					
Control group			Reference	Reference	
Observation Group	0.9	0.4	2.5	1.3 ~ 5.1	0.010
Age	0.0	0.0	1.0	1.0 ~ 1.1	0.284
HPV Type					
Low-risk			Reference	Reference	
High-risk	-0.2	0.4	0.9	0.4 ~ 1.8	0.654
Baseline Inflammation Grade					
Mild			Reference	Reference	
Moderate	0.2	0.4	1.2	0.5 ~ 2.7	0.720
Severe	0.1	0.5	1.1	0.4 ~ 2.9	0.850
BV History					
First Episode			Reference	Reference	
Recurrence	-0.8	0.5	0.5	0.2 ~ 1.2	0.101

Age, HPV type, baseline inflammation grade, and BV history were not independent influencing factors of HPV clearance (all P>0.05). The results of Logistic regression analysis are shown in Table 7.

Discussion

This retrospective study explored the efficacy of Dingjunsheng (a live Lactobacillus preparation) as adjuvant therapy in patients with HPV infection complicated by BV, with a 6-month follow-up to evaluate key clinical outcomes. The core findings are summarized as follows: First, the HPV clearance rate in the observation group receiving Dingjunsheng adjuvant therapy was significantly higher than that in the control group treated with standard BV antibacterial therapy alone (73.6% vs 53.9%), especially in the low-risk HPV infection subgroup and the ≤39 years age subgroup. Second,

the improvement rate of cervical cytological inflammation in the observation group was superior to that in the control group (90.8% vs 76.9%), with a more favorable distribution of inflammation grades after treatment. Third, the recurrence rate of BV in the observation group was significantly lower (3.1% vs 13.9%), and subgroup analysis revealed that HPV clearance was closely associated with a reduced risk of BV recurrence in both groups. Finally, multivariate Logistic regression analysis confirmed that Dingjunsheng adjuvant therapy was an independent protective factor for HPV clearance, while no significant associations were found between age, HPV type, baseline inflammation grade, BV history and HPV clearance. Additionally, the incidence of adverse reactions was comparable between the two groups, indicating good safety of Dingjunsheng adjuvant therapy.

The superior efficacy of Dingjunsheng adjuvant therapy in promoting HPV clearance and reducing BV recurrence may be attributed to its role in regulating the vaginal microecosystem. The vaginal microenvironment is a complex ecosystem dominated by Lactobacillus, which maintains vaginal health by producing lactic acid to lower pH, inhibiting pathogenic bacteria proliferation, and enhancing local immune function.[18,19] BV is characterized by a decrease in Lactobacillus abundance and overgrowth of anaerobic bacteria, which disrupts the vaginal microecological balance [20]. This imbalance may further impair the vaginal mucosal barrier, facilitating HPV infection persistence and cervical inflammation progression [21]. Dingjunsheng, as a live Lactobacillus preparation, can supplement the vaginal Lactobacillus population, restore the acidic vaginal environment, and inhibit the growth of pathogenic bacteria associated with BV.[22] By re-establishing the vaginal microecological balance, Dingjunsheng may enhance the local immune response, thereby promoting HPV clearance and reducing BV recurrence. In previous studies, Zeng et al. conducted a study on 15 patients with vaginal candidiasis and found that using probiotic Lacidophilin Vaginal Capsules as an adjunctive drug could effectively alleviate the symptoms of vaginitis.[23] Zhang *et al*. also reported that BV patients who received vaginal probiotic capsules as adjunctive medication had a higher cure rate and a lower recurrence rate.[24] These studies are consistent with the results of this study and all demonstrate the clinical value of Dingjunsheng as an adjuvant drug in patients with BV. The significant efficacy in the low-risk HPV subgroup may be related to the relatively milder damage of low-risk HPV to the vaginal mucosal barrier, making it more responsive to microecological regulation.[25] Similarly, younger patients (≤39 years) may have a more robust immune function, which synergizes with the microecological regulatory effect of Dingjunsheng to achieve a higher HPV clearance rate.[26]

The close association between HPV clearance and reduced BV recurrence observed in this study further supports the mutual interaction between vaginal microecology, BV and HPV infection. Persistent HPV infection can disrupt the vaginal mucosal immune barrier, creating favorable conditions for the overgrowth of BV-related pathogenic bacteria, while BV-induced microecological imbalance can in turn inhibit HPV clearance.[27,28] This reciprocal relationship forms a vicious cycle that exacerbates both conditions. Dingjunsheng breaks this cycle by restoring the vaginal microecological balance, which not only promotes HPV clearance but also reduces the risk of BV recurrence.[29] In the study by Xu *et al.*[30], probiotic treatment significantly reduced the abundance and inflammatory level of vaginal HPV. Liu *et al.*[31] also reported that probiotic treatment could significantly increase the clearance rate of high-risk HPV and improve the state of vaginal inflammation. Moreover, the significant improvement in cervical cytological inflammation in the observation group highlights the role of microecological regulation in alleviating local inflammatory responses. Chronic cervical inflammation is a key driver of cervical lesion progression, and alleviating inflammation may reduce the risk of HPV-related cervical lesions, which is of great significance for the long-term management of HPV-infected patients.[32]

The findings of this study carry meaningful implications for the clinical management of women with concurrent HPV infection and BV. Firstly, they provide supportive real-world evidence for integrating vaginal microecological restoration as a complementary strategy alongside standard antibacterial therapy. Incorporating a live Lactobacillus preparation such as Dingjunsheng into treatment protocols could enhance HPV clearance rates and reduce BV recurrence, potentially lowering the long-term risk of cervical

neoplastic progression in this population. Secondly, our results suggest that even in resource-limited settings where HPV vaccination or advanced cervical screening may not be universally accessible, adjunctive probiotic therapy represents a relatively low-cost and safe intervention to improve gynecological health outcomes. From a policy perspective, these data advocate for greater consideration of microbiome health in national and international guidelines for managing lower reproductive tract infections and HPV-related care. Further cost-effectiveness analyses and implementation research would be valuable to guide broader adoption in routine practice.

Strengths and limitations

The strengths of this study include its focus on a clinically relevant comorbid condition (HPV+BV) and the evaluation of a practical, commercially available microecological modulator in a real-world setting. The use of standardized diagnostic criteria (Nugent score, Bethesda system) and a multivariate analysis adjusting for key confounders enhances the internal validity of our findings. However, several limitations should be acknowledged. First, this was a single-center retrospective study with a moderate sample size (n=152), which may limit the statistical power and generalizability of the results. Second, the follow-up duration was 6 months, and the long-term efficacy and potential impact on cervical lesion progression of Dingjunsheng adjuvant therapy remain to be confirmed. Third, due to the retrospective nature, some potential confounding factors (e.g., patients' detailed lifestyle habits, sexual behaviors, or partner HPV status) were not fully collected or adjusted for, which may have influenced the outcomes. Future research should involve large-sample, multi-center prospective randomized controlled trials to validate these findings. Additionally, extended follow-up is needed to assess the sustained benefits, and in-depth mechanistic studies are warranted to elucidate the precise pathways through which Dingjunsheng regulates the vaginal microecosystem and promotes HPV clearance.

Conclusion

In conclusion, adjuvant therapy with Dingjunsheng significantly improves HPV clearance rate, enhances cervical cytological inflammation improvement, and reduces BV recurrence rate in patients with HPV infection complicated by BV, with good safety. Multivariate analysis confirms Dingjunsheng as an independent protective factor for HPV clearance. This study provides reliable clinical evidence for applying vaginal microecological regulation strategies in managing such patients, supporting Dingjunsheng as a promising adjuvant therapeutic option.

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Conflict of interests

The authors declare no competing interests.

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Authors' contributions

Yan Cui designed and performed the research and wrote the paper;Xiaoping Cheng designed the research and supervised the report; Yan Cui ,Xiaoping Cheng designed the research and contributed to the analysis; Xiaoping Cheng provided clinical advice and supervised the report.

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