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RESEARCH ARTICLE

The effect of *Rosa (L. Rosa canina)* on the incidence of urinary tract infection in the puerperium: A randomized placebo-controlled trial

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Urinary tract infection (UTI) is an infection that can occur in any area of the urinary tract which is characterized by a positive urine culture (U/C). The risk of UTI following cesarean section (CS) increases due to procedures such as catheterization. In vitro studies have demonstrated the effect of *Rosa canina* fruit in preventing *Escherichia coli* growth. This study was conducted to determine the effect of *R. canina* fruit in preventing the incidence of UTI in women following CS. This triple-blind randomized clinical trial was conducted in 2016 on 400 women following CS with negative U/C in Alzahra and Taleghani educational hospitals in the city of Tabriz-Iran. Participants were assigned into two groups of 200 women using block randomization. Each group received a twice daily dose of 500 mg capsules containing *R. canina* or placebo from the second day after CS for 20 days. Women were assessed by U/C on the 7th–10th and 20th days following CS. UTI was significantly lower in the intervention group compared with the control in the follow-ups conducted on the 7th–10th days (odds ratio = 0.22; confidence interval 95% [0.07, 0.67]; p = .006) and 20th day (odds ratio = 0.32; confidence interval 95% [0.14, 0.75]; p = .008). But the incidence of cystitis in the two groups was not statistically significant (p > .05). *R. canina* fruit capsules were able to reduce the incidence of UTI after CS. Thus, it is likely that administration of this medication can promote maternal health following CS.

KEYWORDS

cesarean section, post-partum period, *Rosa canina*, urinary tract infections

1 | INTRODUCTION

Urinary Tract Infection (UTI) has been defined as an inflammatory response of squamous urinary tract tissue to bacterial invasion and is divided into asymptomatic bacteriuria and symptomatic UTI (cystitis and pyelonephritis). Specific people are at greater risk for UTI (Gary Cunningham et al., 2014), which include pregnant women (Tadesse, Teshome, Merid, Kibret, & Shimelis, 2014), post-partum women (Hung et al., 2016), patients with spinal cord injuries or catheterization, older people, infants, patients with diabetes or sclerosis, patients with acquired immune deficiency or human immunodeficiency virus, and those with underlying urological disorders (Foxman, 2003).

UTI in post-partum period is rarely symptomatic, but lab tests might show the problems (Leth, Moller, Thomsen, Uldbjerg, & Norgaard, 2009). A study examined women for UTI at different intervals for 40 days post-partum reported the prevalence of UTI between 3% and 17% (Glazener et al., 1995). The source of post-partum UTI can be endogenous (due to maternal physiological changes in pregnancy) or exogenous (due to environmental contaminations, especially catheterization, to which mothers are exposed). Endogenous changes are the same in both types of delivery, but women that have undergone cesarean section (CS) are at greater risk for exogenous factor compared with those with natural childbirth because catheterization is performed continuously through cesarean delivery (Hung et al., 2016). According to the Ministry of Health's report, the prevalence of CS in

Iran is on average three times higher than the world standard (Azami-Aghdash, Ghojazadeh, Dehdilani, Mohammadi, & Asl Amin Abad, 2014). The conclusions of a review support the recommendation that prophylactic antibiotics should be routinely administered to all women undergoing CS to prevent infection (Mugford, Kingston, & Chalmers, 1989).

Many studies have proved herbal medicine economical and long-acting during post-partum. According to the World Health Organization, more than three quarters of the population of developing countries use herbal medicine in primary health care (Dante, Bellei, Neri, & Facchinetti, 2014; Luqman & Rizvi, 2014). One of the herbs used is the *Rosa canina* fruit. With the generic name of "*Dog rose*", *R. canina* is a small shrub belonging to the *Rosaceae* family (Ercisli, 2007). The fresh fruit of *R. canina* contains vitamin C, in the form of both ascorbic and hydro-ascorbic acids, and sources of polyphenols (Chrubasik C., Roufogalis, Muller-Lander, & Chrubasik S., 2008). The total phenolic content of *R. canina* has been found to be 96 mg GAE/g DW. This plant contains about 880 mg/100 mL of vitamin C (Ercisli, 2007) as well as various minerals such as calcium (18 mg/kg), magnesium (1909 mg/kg), iron (267 mg/kg), aluminum (157 mg/kg), manganese (244 mg/kg), zinc (22 mg/kg), and copper (5 mg/kg; Basgel & Erdemoglu, 2006). The antioxidant property of this herb, due to vitamin C (Czyzowska, Klewicka, Pogorzelski, & Nowak, 2015) and antibacterial activity of this herb, due to Flavonoid especially quercetin (Wu et al., 2013), can inhibit the growth of bacteria, particularly *Escherichia coli* (Kumarasamy, Cox, Jaspars, Nahar, & Sarker, 2002), which causes most of the UTIs (Gary Cunningham et al., 2014).

Given the prevalence of UTI in women who have undergone CS, and that no studies were found on the effect of different forms of *R. canina* fruit on the incidence and recurrence of post-partum UTI, the present study was conducted to determine the effect of *R. canina* fruit capsules on the incidence of post-partum UTI.

2 | METHODS

2.1 | Study design and participants

The present triple-blind randomized controlled clinical trial (the participants, assessor, and data analyser were unaware of the type of intervention given to every participant) recruited 400 women who underwent CS from August 2016 to March 2017 in Alzahra and Taleghani hospitals in the city of Tabriz-Iran. Primary outcome examined in this study was the incidence of UTI (the presence of any type of UTI including asymptomatic bacteriuria, cystitis, and pyelonephritis) during the 20-day follow-up and secondary outcomes were the incidence of asymptomatic bacteriuria, cystitis, and pyelonephritis, separately during the 20-day follow-up. For this purpose, women are examined at two stages (7–10 days and 20 days after surgery). Asymptomatic bacteriuria was diagnosed by conducting urine culture in two follow-up time points. Cystitis and pyelonephritis were diagnosed through the development of symptoms during the study and positive urine culture after presentation of symptoms during the study.

The study inclusion criteria were CS in the last 48 hr, post-operative administration of maximum three doses of antibiotics, follow-up contact number, and non-participation in similar studies. Exclusion criteria were symptoms of UTI, requiring administration of antibiotics after discharge, the use of immunosuppressive or respiratory system medications, and no catheterization during CS.

Considering the results from Glazener et al. (1995) study, P_1 = 17%, P_2 = %8.5, α = 0.05, and power = 80%, the sample size was estimated 190 women and was raised to 200 to cover 5% sample loss for each group.

2.2 | Sampling

Sampling began in Alzahra and Taleghani hospitals in the city of Tabriz-Iran after obtaining permission from the ethics committee of Research and Technology Deputy of Tabriz University of Medical Sciences (ethics code: IR.TBZMED.REC.1395.231) and registering the present study in Iranian Registry of Clinical Trials site (code: IRCT2016040910324N30). The women who underwent CS were assessed in terms of inclusion and exclusion criteria in the post-operative ward. The study objectives and method and voluntary participation and the right to withdraw at any stage were explained to eligible women, and informed written consents were obtained from them after explaining stages of the study. After initial selection of participants, urine culture was performed for all participants. Participants were asked to discard the first part of their urine, pour the midstream urine in the cup, and discard the final part. Then, all urine samples were examined by a laboratory technician in each centre. Participants with negative culture were included, and their socio-demographic characteristics questionnaire were completed in an interview by the researcher.

2.3 | Randomization

Participants were assigned into intervention (*R. canina*) and control (placebo) groups by blocked randomization with a block sizes of 4 and 6 and allocation ratio of 1:1. Allocations of placebo and *R. canina* capsules were concealed by placing them in opaque sealed sequentially numbered envelopes. Blocking and preparation of envelopes were carried out by a person not involved in sampling or data analysis.

2.4 | Intervention

In the present study, the 500 mg *R. canina* and placebo (contain starch) capsules that were identical in appearance (odor, color, and shape) were prepared by a pharmacist colleague. *R. canina* fruit with the generic name of *L. Rosa canina* was procured from herbalist market in Tabriz-Iran and milled into a powder. We used starch powder for placebo capsules. Microbial control tests were performed. Microbes were eradicated by placing *R canina* fruit powder in an oven at 50°C and starch powder in an oven at 80°C. Total aerobic microbial count was conducted on both herbal and starch samples, which showed a microbial count of less than 1,000 CFU/g (colony-forming units per gram). None of the samples tested contained *E. coli* or Salmonella. According to United States Pharmacopeia guidelines, *R. canina* fruit powder and starch showed acceptable levels of microbial control. Using total phenol test (flavonoid analysis), capsules were standardized in terms of their active ingredient, which were phenolic compounds

in this sample. The 500 mg capsules were filled either with rose fruit powder or starch.

The 500 mg capsules were taken orally twice daily, half an hour after meals (breakfast and dinner) with a glass of water. Taking these medications began 48 hr after CS and continued until the end of study (20 days after CS). Participants were followed up through telephone contacts to ensure taking medication. Instead of a 40-day, a 20-day post-partum intervention was conducted in order to reduce withdrawals, increase compliance, and increase complete medication use.

2.5 | Flavonoid analysis

The chemical characterization is essential to validate the pharmaceutical use of raw materials. Ultraviolet spectroscopy, as an important technique to determine flavonoids, could be the appropriate way of the assessment of the flavonoids of *R. canina*. For the first step, 300 g of the dried and ground fruits of the *R. canina* was macerated by methanol. The methanol extract as well as quercetin was subjected to total flavonoids test. The amount of total flavonoids in the extract was measured spectrophotometrically as previously reported. Briefly, 25 mg of each extract was mixed with 100 mL of 80% methanol, 133 mg of 10% aluminum chloride ($AlCl_3.6H_2O$), 400 mg of sodium acetate ($NaC_2H_3O_2.3H_2O$), and 400 µl of distilled water. After incubation for 40 min, absorbance was measured at 415 nm using a spectrophotometer. To calculate the concentration of flavonoids, we prepared a calibration cure using quercetin as standard. The flavonoid concentration is expressed as quercetin equivalents in 0.02 mg per 500 mg of extract. All assays were carried out in triplicate.

2.6 | Determination of ascorbic acid

The amount of ascorbic acid of the *R. canina* was determined according to the methods of Association of Official Analytical Chemist (AOAC, 1984). Briefly, aliquots of 0.1 g of lyophilized powder of fruit samples were dissolved in 1 mL of deionized water. This solution (0.1 mL) was mixed with 2.8 mL of deionized water, 2 mL of 2% sodium carbonate (Na2CO3), and 0.1 mL of 50% Folin–Ciocalteau reagent. After incubation at room temperature for 30 min, the absorbance of the reaction mixture was measured at 750 nm against a deionized water blank on a spectrophotometer (Thermo, Model Nicolet 100 UV–Vis). Gallic acid was chosen as a standard. On the basis of this test, the amount of vitamin C in the plant was 0.005 g/kg of this plant.

2.7 | Follow-up and data collection

Urine samples were taken from participants for laboratory tests on two occasions of 7–10 days and 20 days (end of the study) after CS. On these occasions, participants completed a checklist for side effect, satisfaction with the intervention, and presence or absence of urinary symptoms. Researcher's phone number was made available to participants, and they were advised to contact the researcher if they noticed symptoms of cystitis and pyelonephritis, including dysuria, urinary urgency, urine discoloration, hematuria, backache, fever and chills, and general malaise, and to attend relevant health centres urgently for examinations and urine test. Those with asymptomatic UTI diagnosed in tests were visited by a colleague gynecologist and received antibiotics; however, they continued taking capsules until the end of the study. All tests were also performed for these women, and none of them were excluded from the study. Details of antibiotic used and duration of therapy were recorded on the relevant checklist. Side effects of intervention were recorded in the checklist. The satisfaction rate of received intervention was assessed by a question with three response options including completely satisfied, relatively satisfied, completely dissatisfied. To ensure medication consumption, medication checklists were marked daily by the participants after consumption of capsules. The validity of socio-demographic characteristics questionnaire and checklists was confirmed by content and face validity. To assess the reliability of the tests, the first 10 samples were examined by two laboratory experts independently and inter-rater correlation were evaluated and confirmed.

2.8 | Statistical analysis

Data collected were analysed in SPSS version 19 using intent-to-treat analysis. The homogeneity of the study groups was examined with Pearson Chi-square, Chi-square for trend, Fisher's exact, and independent *t* tests. The two groups were compared in terms of total incidence of UTI, asymptomatic bacteriuria, cystitis, and pyelonephritis using Chi-square test. $P < .05$ was considered as a significant level.

3 | RESULTS

Of the 200 women in each group, 193 in the intervention group and 195 in the control group were analysed in the first follow-up (7th–10th days after operation) and 184 in the intervention group and 189 in the control group in the second (20th days after operation; Figure 1). Sixteen participants in the intervention group and 11 participants in the control group were excluded from the study due to lack of attendance for follow-up and reluctance to continue the study. All the participants who continued the study filled out medication use checklist and based on this checklist, all they consumed the medicine completely.

No significant difference was found between the two groups in terms of pregnancy, childbirth, and socio-demographic characteristics, except spouse's education ($p > .05$). More than 53% (175) of participants were experiencing their second pregnancies, and 53% (212) were experiencing their second childbirth. A total of 245 women had history of CS, of whom, more than 82% stated the CS was non-elective (due to indications). Of those with previous CS, more than 22% (90) had history of post-operative UTI. Of all participants, 98% were anesthetized with epidural anesthesia. The majority of women and their spouses had primary and secondary school education (approximately 40%); 96% were housewives, and 30% of their spouses were workers. Almost 59% of participants had relatively adequate incomes and owned their private houses. Mean (standard deviation) age and duration of the marriage of participating women were 30 years (5.8) and 9 years, respectively, with mean body mass index of 26.5 (4.6; Table 1).

Before the intervention, all participants had negative urine culture. On the 7–10 days after intervention, four women from the

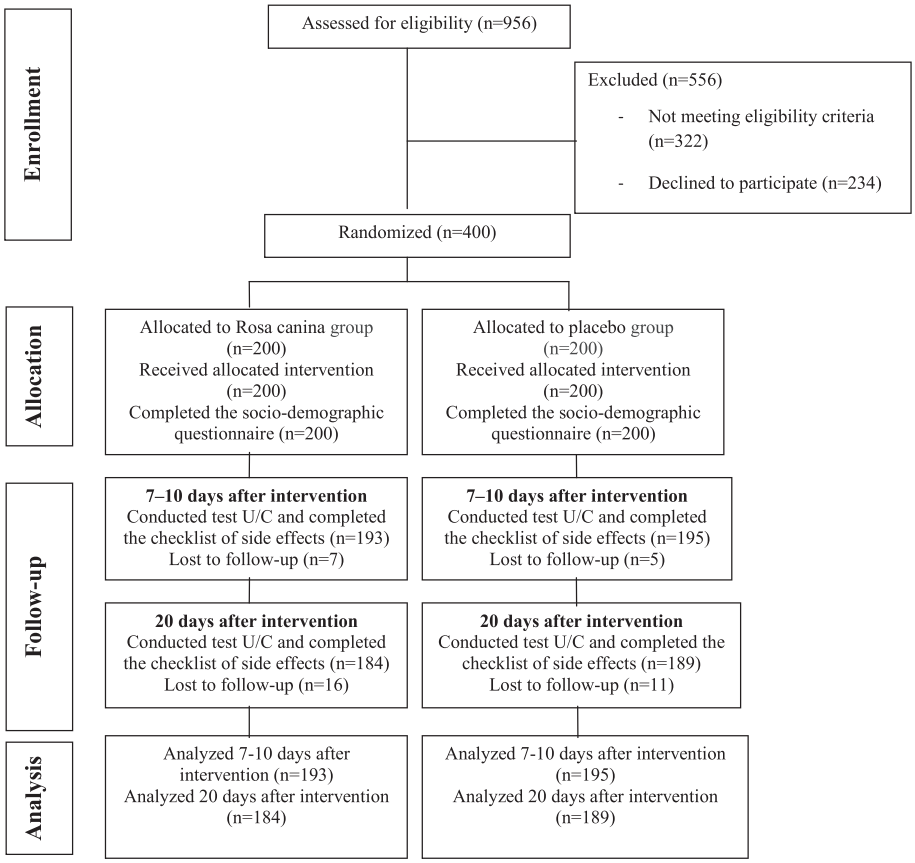

FIGURE 1 Study flowchart

intervention group and 13 from the placebo group (odds ratio [OR] = 3.37; confidence interval [CI] 95% [1.08, 10.54]; $p < .001$) and 20 days after 1 intervention, three women from the intervention group and 19 from the placebo group (OR = 6.74; CI 95% [1.96, 23.19]; $p < 0.001$) had positive asymptomatic urine cultures, which meant that they had asymptomatic UTI. Thus, the risk of asymptomatic UTI was significantly higher in the control group compared with the intervention group. Asymptomatic bacteriuria in present study was defined as presence of at least 10^5 CFU/mL in urine samples obtained from patients without any symptoms or signs attributable to urinary infection. Most women with asymptomatic bacteriuria had positive culture due to *E. coli*. In four of the women, positive culture was due to the presence of *Enterobacter cloacae*, and two women were positive culture due to the presence of *Enterobacter* aerogenes. Infected women were treated with Cephalexin 500 mg and Nitrofurantoin 100 mg for 7 days. From all participants afflicted with asymptomatic bacteriuria, none of which had cystitis until the end of the study because they were treated with antibiotics immediately after diagnosis.

In terms of UTI on Day 20, 14 women from both groups had cystitis, with no significant statistical difference between the two groups ($p > .05$). Of these 14 women, six were treated with Cephalexin 500 mg, five with Nitrofurantoin 100 mg, and three with Gentamycin 80 mg. In the course of follow-up, none of the participants had pyelonephritis ($p > .05$).

Given the above, the total risk of UTI on the 7th–10th days (OR = 0.22; CI 95% [0.07, 0.67]; $p = .006$) and 20th days (OR = 0.32; CI 95% [0.14, 0.75]; $p = .008$) was significantly lower in the intervention group compared with the control group (Table 2).

Of all participants, eight women reported side effects: one had nausea and vomiting (slight); one had dizziness (slight); four had rashes (one medium and three slight), and two had a headache (slight). Of those that reported side effects, five were from the intervention group and three from the placebo group. From both intervention and control groups, 85% were completely satisfied with the use of medication; 13% were relatively satisfied, and only 2% were completely dissatisfied (Table 3).

4 | DISCUSSION

The present study is the first study in the world on the effect of *R. canina* fruit capsules on the incidence of UTI. The majority of studies conducted on the effects of this herb have been either in vitro or about other diseases. The present study results showed that *R. canina* fruit capsules significantly reduce post-partum UTI after CS, and this reduction is clearly seen in asymptomatic bacteriuria.

The positive effect of this herb on the incidence of UTI can be due to the presence of 880 mg/100 mL of vitamin C (Ercisli, 2007), or ascorbic acid, that can prevent UTI through its antioxidant properties. The antioxidant effect of this herb was proved in a study by Czyzowska et al. (2015) from the Netherlands.

In a study conducted by Ochoa-Brust et al. (2007) on 110 pregnant women, a 100 mg daily dose of ascorbic acid prevented UTI

TABLE 1 Socio-demographic and obstetrics characteristics of participants by study group

Variables	*Rosa canina* (*n* = 200) n (%)[f]	Control (*n* = 200) n (%)[f]	*p*	Variables	*R. Canina* (*n* = 200) n (%)[f]	Control (*n* = 200) n (%)[f]	*p*
Age (year) [a]	29.7 (5.7)	30.8 (5.8)	0.052[b]	Home			0.503[e]
Marriage age (year) [a]	21.5 (4.6)	22.0 (4.7)	0.278[b]	Personal	122 (61.0)	15 (57.5)	
BMI (kg/m2) [a]	26.6 (5.0)	26.4 (4.2)	0.629[b]	Tenant	52 (26.0)	48 (24.0)	
Education			0.363[c]	Her parents' house	1 (0.5)	1 (0.5)	
Primary school	10 (5.0)	14 (7.0)		Husband parents' house	25 (12.5)	36 (18.0)	
Secondary school	77 (38.5)	81 (40.5)		Gravida			0.786[c]
High school	36 (18.0)	31 (15.5)		First	48 (24.0)	42 (21.0)	
Diploma	53 (26.5)	56 (28.0)		Second	79 (39.5)	96 (48.0)	
University	24 (12.0)	18 (9.0)		Third	51 (25.5)	40 (20.0)	
Education spouse's			0.006[c]	The fourth and more	22 (11.0)	22 (11.0)	
Primary school	7 (3.5)	8 (4.0)		Parity			0.570[c]
Secondary school	74 (37.0)	103 (51.5)		First	58 (29.0)	54 (27.0)	
High school	32 (16.0)	24 (12.0)		Second	105 (52.5)	07 (53.5)	
Diploma	56 (28.0)	45 (22.5)		Third	28 (14.0)	27 (13.5)	
University	31 (22.5)	20 (10.0)		The fourth and more	9 (4.5)	12 (6.0)	
Occupation			0.201[d]	History of cesarean section			0.412[d]
Housekeeper	189 (94.5)	195 (97.5)		Yes	118 (59.0)	27 (63.5)	
Employed	11 (5.5)	5 (2.5)		No	82 (41.0)	73 (36.5)	
Occupation spouse's			0.223[e]	History of urinary infection after cesarean			0.550[d]
Unemployed	2 (1.0)	1 (0.5)		Yes	42 (21.0)	48 (24.0)	
Employee	33 (16.5)	18 (9.0)		No	158 (79.0)	52 (76.0)	
Worker	54 (27.0)	57 (28.5)		The current cesarean section			0.443[d]
Shopkeeper	43 (21.5)	45 (22.5)		Elective	39 (19.5)	32 (16.0)	
Other	68 (34.0)	79 (39.5)		Non-elective	161 (80.5)	68 (84.0)	
Income			0.111[c]	Several hours after of operation[a]	25.3 (13.3)	4.5 (11.7)	0.532[b]
Completely enough	22 (11.0)	12 (6.0)		Type of anesthesia			0.736[e]
Somewhat enough	117 (58.5)	118 (59.0)		Epidural	195 (97.5)	96 (98.0)	
Not enough	61 (30.5)	35 (70.0)		General	5 (2.5)	4 (2.0)	

Note. BMI = body mass index.

[a]Mean (SD).

[b]independent samples t- test.

[c]Linear-by-Linear association.

[d]Fisher's Exact Test.

[e]Pearson Chi-Square.

[f]Number (Percent).

during pregnancy. The effects of nitrite and ascorbic acid on the development of *E. coli*, *Pseudomonas aeruginosa*, and *Staphylococcus saprophyticus* were assessed in a study conducted in Sweden, and concurrent use of nitrite and vitamin C was found to have a significant effect on inhibiting these UTI-causing bacteria (Carlsson, Wiklund, Engstrand, Weitzberg, & Lundberg, 2001).

Castello, Girona, Gomez, Mur, and Garcia (1996) investigated the prophylactic effect of ascorbic acid 2 g daily on the prevention of UTI in people with spinal injury and showed that ascorbic acid had no significant effect on the prevention of UTI in these patients, which disagrees with the present study. This may be due to the effect of nutrition and medication regimens used by this group of patients.

Flavonoids exhibit a broad range of biological activities including antibacterial activity. Among the flavonoids, quercetin has a great importance due to its strong antibacterial effect. In numerous studies, the presence of quercetin has been proven in *R. canina* using a high performance liquid chromatography-mass spectrometry method (Adamczak, Buchwald, Zielinski, & Mielcarek, 2012, Nowak & Gawlik-Dziki, 2007, Ozcan, Dilgin, & Yaman, 2012).

Several studies have been conducted in different regions of the world to investigate the effects of various flavonoids in experimental conditions on *E. coli* growth. In all of these studies, the inhibitory effect of flavonoids, especially quercetin, has been shown to prevent *E. coli* growth (Dadi, 2010; Woznicka et al., 2013; Wu et al., 2013).

TABLE 2 The incidence of urinary tract infections before and after the intervention for each study group

Variables	7–10 days after surgery		20 days after surgery		7–10 days after surgery	20 days after surgery
	Rosa Canina (*n* = 193) n (%)[d]	Control (*n* = 195) n (%)[d]	*R. Canina* (*n* = 184) n (%)[d]	Control (*n* = 189) n (%)[d]	*p*-value OR (95% CI)[a]	*p*-value OR (95% CI)[a]
Urinary tract infections					0.006[b] 0.22 [0.07, 0.67]	0.008[b] 0.32 [0.14, 0.75]
Afflicted	4 (2.1)	17 (8.7)	8 (4.3)	23 (12.2)		
Not afflicted	189 (97. 9)	178 (91.3)	176 (95.7)	166 (87.8)		
Asymptomatic bacteriuria					0.044[b] 3.37 [1.08, 10.54]	0.001[b] 6.74 [1.96, 23.19]
Afflicted	4 (2.1)	13 (6.7)	3 (1.6)	19 (10.1)		
Not afflicted	189 (97.9)	182 (93.3)	181 (98.4)	170 (89.9)		
Cystitis					0.061[b] 0.97 [0.95, 1.01]	0.332[c] 0.47 [0.11, 1.94]
Afflicted	0 (0.0)	5 (2.6)	6 (3.3)	3 (1.6)		
Not afflicted	193 (100.0)	190 (97.4)	178 (96.7)	186 (98.4)		
Pyelonephritis					-	-
Afflicted	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)		
Not afflicted	193 (100.0)	195 (100.0)	184 (100.0)	189 (100.0)		

[a]Odds Ratio (95% Confidence Interval).

[b]Fisher's Exact Test.

[c]Pearson Chi-Square.

[d]Number (Percent).

TABLE 3 Adverse events and the satisfaction of participants for each study group

Variables	Intervention group		Control group	
	7–10 days after surgery (*n* = 193) n (%)	20 days after surgery (*n* = 184) n (%)	7–10 days after surgery (*n* = 195) n (%)	20 days after surgery (*n* = 189) n (%)
Nausea and vomiting				
Yes	1 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)
No	192 (99.5)	184 (100.0)	195 (100.0)	189 (100.0)
Vertigo				
Yes	0 (0.0)	1 (0.5)	0 (0.0)	0 (0.0)
No	193 (100.0)	183 (99.5)	195 (100.0)	189 (100.0)
Skin rash				
Yes	1 (0.5)	0 (0.0)	1 (0.5)	2 (1.1)
No	192 (99.5)	184 (100.0)	194 (99.5)	187 (98.9)
Headache				
Yes	1 (0.5)	1 (0.5)	0 (0.0)	0 (0.0)
No	192 (99.5)	183 (99.5)	195 (100.0)	189 (100.0)
Satisfaction of the drug				
Completely satisfied	165 (85.5)	165 (89.7)	171 (87.7)	169 (89.4)
Relatively satisfied	27 (14.0)	18 (9.8)	24 (12.3)	19 (10.1)
Dissatisfied	1 (0.5)	1 (0.5)	0 (0.0)	1 (0.5)

A study conducted by Kumarasamy et al. (2002) on the antibacterial effects of herbs with the aim to reduce antibiotic consumption and prevent antibiotic resistance reported the antibacterial property of *R. canina* fruit, especially its positive effect in eradicating *E. coli*. All the above studies confirm the present study results.

A review of 30 studies to investigate the effect of restricting unindicated catheterization to obviate UTI concluded that most studies showed a 53% reduction in the incidence of UTI as a result of eliminating unindicated catheterization (Meddings et al., 2013). In the present study, because of CS, all participating women were catheterized, and given the catheterization-induced risk of UTI and the need for this intervention in CS, this environmental risk factor can be eliminated by reducing the frequency of CS. The number of CS in Iran is three times the global standard (Azami-Aghdash et al., 2014), while CS has slightly reduced or remained constant in America and Western countries since 1998 (Hung et al., 2016).

The effect of this herb in powder or extract form has been clinically studied only on osteoarthritis (Rein, Kharazmi, & Winther, 2004;

Rossnagel, Roll, & Willich, 2007; Warholm, Skaar, Hedman, Molmen, & Eik, 2003) and reducing symptoms of irritable bowel syndrome (Nobaek, Johansson, Molin, Ahrne, & Jeppsson, 2000). According to a review study conducted by Chrubasik et al. (2008) investigating the effects of *R. canina* fruit, there were only six trials, which related to the above diseases, and reported the positive effect of this herb on reducing symptoms of these diseases. In a database search, no clinical trial was found on the effect of this herb on other diseases.

According to the present study results, given the positive effect of *R. canina* fruit in preventing postcesarean UTI, it seems that this herb can be used in postcesarean post-partum as an inexpensive and cost-effective substance for promoting maternal health.

The strong points of the present study included total blinding (lack of bias in participating, measurement, and analysis of results), objectivity of results (through tests and completing questionnaires), large sample size, good compliance to the treatments, and high level of satisfaction in 85% of participants.

The study limitations included sample loss that was minimized by further follow-ups. Another weakness in the present study was 20-day post-partum follow-up instead of full post-partum follow-up. It is recommended that future studies investigate the effect of this herb in full post-partum and more frequent follow-ups.

5 | CONCLUSION

In the present study, UTI was significantly lower in the intervention group compared with the control group. Thus, *R. canina* fruit capsules were able to reduce the incidence of UTI after CS. It is likely that administration of this medication can promote maternal health following CS.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

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