Epidemiology of Urinary Tract Infection: II. Diet, Clothing, and Urination Habits

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Abstract: Although several health habits and behaviors are commonly cited in medical and nursing textbooks as potential causes of urinary tract infection (UTI) in women, few have been studied in a systematic fashion. In a case-control study, we evaluated the associations between UTI and the most commonly mentioned risk factors: urination habits, diet, clothing, and soaps. Because sexual intercourse and diaphragm use increase the risk of UTI, we assessed the effect of health habits and behaviors controlling for these two risk factors. Women with initial UTI were compared with controls with no UTI history; women with a second UTI were compared to those with initial UTI. For the 25 initial cases, 19 secondary cases, and 181 controls enrolled in the study from a university health service, we found using tampons and drinking soft drinks to be moderately associated (RR ≥ 1.4) with both initial and recurrent UTI. Although several other individual habits had only small associations with UTI, several of these behaviors together might substantially increase risk of initial or recurring UTI. (*Am J Public Health* 1985; 75:1314–1317.)

Introduction

Every year 2.7 per cent of all women in the United States seek physician treatment for a urinary tract infection (UTI).[1] A review of medical and nursing textbooks revealed urination habits, clothing, diet, menstrual protection, birth control method, and sexual intercourse as possible causes of UTI.[2–8] With the exception of sexual intercourse and diaphragm use,[9,10] however, these risk factors appear to be only speculative, since no actual investigations are cited as references. After an extensive search, we found no studies in the literature other than those mentioned addressing these possible associations. In this paper we report the results of a case-control study evaluating the effect on UTI of urination habits, diet, clothing, menstrual protection, and soaps, controlling for sexual intercourse and diaphragm use.[9,10]

Methods

Cases and controls were identified at the University of California at Los Angeles (UCLA) Student Health Service (SHS), a large ambulatory facility serving the health care needs of all students. All women students who used the SHS between October 1982 and June 1983 and consented to participate in the study were considered possible study participants. To be eligible for the study, cases and controls could not be pregnant, have diabetes, vaginitis, or candidiasis, or have been hospitalized or catheterized during the four weeks before enrollment.

All subjects completed a self-administered questionnaire before their diagnosis was known. Since UTI presumably has a short induction period in regard to the factors under study, the study questionnaire concentrated on exposures occurring during the preceding four weeks. The questionnaire addressed diet, urination habits, clothing worn, sexual habits, and birth control method.

A midstream urine specimen of each potential case was cultured according to the method described in Bailey and Scott.[11] A UTI case was defined as a woman who had at least 50,000 colonies of a single bacteria per milliliter urine, and who reported the presence of one or more of the following symptoms suggesting UTI, regardless of duration or severity: painful urination; frequent urination; urination at night; urgent need to urinate; or blood in the urine. If the woman did not report any previous urinary tract infections, she was considered a primary case; if she reported one prior UTI was was considered a secondary case; cases with more than one prior UTI were excluded.

A control for the primary case group was defined as a woman visiting the SHS without urinary symptoms or a history of UTI. Self-report of prior infection on the study questionnaire was considered sufficient evidence to exclude a potential control from the study, since the current visit could not affect the woman's UTI history. The controls for the secondary cases were the primary cases. Thus, we sampled the source populations for the primary and secondary cases to obtain their respective control groups.

Analytic Methods

A measure of association—the odds ratio— was calculated to estimate the relative risk for the various potential risk factors and UTI. Primary cases were compared with the controls; secondary cases were compared with primary cases. Because we believe that sexual intercourse and diaphragm use are strong risk factors for UTI, the data were stratified into three groups: 1) no sexual intercourse; 2) sexual intercourse but no diaphragm use; and 3) sexual intercourse and diaphragm use. We calculated the Mantel-Haenszel summary risk ratio (RR) over the strata, and exact 95 per cent confidence intervals around the summary RR.[12,13]

Results

A total of 44 cases and 181 controls were enrolled in the study. Nineteen of the 44 cases had had one prior urinary tract infection. Participants were not substantially different from other UCLA women students with respect to year in school, age, and college major. Study participants ranged in age from 16 to 39, with a mean of 21.5 years; the majority were single (94 per cent). There were no important differences with respect to demographic variables between primary and secondary cases and controls.[9]

We present the number of primary and secondary cases and controls exposed to each factor and the crude associations in the Appendix (Table A1). In general, the unadjusted associations are similar in direction and magnitude to the associations adjusted for sexual intercourse and diaphragm use.

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TABLE 1—Associations of Selected Foods Consumed During the Past Four Weeks with UTI, Controlling for Sexual Intercourse and Diaphragm Use

Food Consumed	Primary Cases of UTI[a] RR (95% CI)[c]	Secondary Cases of UTI[b] RR (95% CI)[c]
Cranberry juice	1.64 (0.43,5.64)	3.74 (0.85,17.39)
Vitamin C	1.36 (0.45,4.33)	1.51 (0.35,7.76)
Soda pop	1.61 (0.52,5.05)	2.37 (0.55,10.48)
Vegetarian diet	0.59 (0.06,2.96)	3.08 (0.35,36.52)
Orange juice	1.15 (0.20,12.07)	0.27 (0.02,2.00)
Citrus juice (not orange)	1.19 (0.37,4.32)	1.30 (0.25,7.47)
Garlic	0.38 (0.07,2.83)	0.0 (0.00,2.26)
Ginger	0.72 (0.16,3.29)	1.62 (0.33,8.13)
Chile peppers	0.71 (0.19,3.10)	1.98 (0.29,24.15)
Beer, wine, liquor	0.58 (0.12,3.93)	0.35 (0.04,2.50)
Tea	3.51 (0.61,33.20)	0.31 (0.03,2.22)
Cola soft drinks	2.65 (0.62,15.85)	0.33 (0.04,1.84)
Coffee	1.55 (0.47,6.17)	0.45 (0.09,2.17)
Milk	1.55 (0.35,9.69)	0.65 (0.08,4.91)

[a]compared with 181 controls without UTI history.
[b]compared with the primary cases.
[c]exact 95% confidence interval for the odds ratio.

Diet and UTI

When comparing the sexual intercourse- and diaphragm-adjusted associations between primary UTI and selected foods eaten during the past four weeks, we see in Table 1 a strong positive association with the consumption of tea, and cola soft drinks, a slight to moderate association with the consumption of cranberry juice, vitamin C, soda pop, orange and citrus juices, coffee, and milk, and a negative association with a vegetarian diet, garlic, ginger, chile peppers and alcoholic beverages. Among secondary cases, consuming cranberry juice, soda pop and a vegetarian diet showed a strong positive association, consuming vitamin C, citrus juice, ginger, and chile peppers a moderate association, and consuming orange juice, beer, wine, or liquor, tea, cola soft drinks, coffee, and milk a negative association.

Menstrual Protection, Soaps, Spermacides, and UTI

We observed a moderately positive association between primary UTI and using tampons, sanitary napkins (deodorant and non-deodorant) and deodorant soap, and a slight association with using bubble bath and spermicide foam (Table 2). Tampon use was also moderately associated with secondary UTI. Using douches and spermicide foam, however, were strongly associated with secondary UTI, especially douches ($RR = 8.0$; $1.18 \leq RR \leq \infty$).

TABLE 2—Associations of Menstrual Protection, Soaps, and Spermicides Used During the Past Four Weeks with UTI, Controlling for Sexual Intercourse and Diaphragm Use

Items	Primary Cases of UTI[a] RR (95% CI)[c]	Secondary Cases of UTI[b] RR (95% CI)[c]
Tampons	1.78 (0.33,17.73)	1.55 (0.08,96.49)
Deodorant tampons	0.00 (0.00,1.32)	— (—,—)[d]
Sanitary napkins	1.33 (0.46,3.86)	0.31 (0.06,1.40)
Deodorant napkins	2.51 (0.34,15.59)	0.36 (0.01,5.23)
Deodorant soap	2.16 (0.77,6.71)	0.97 (0.24,3.99)
Bubble bath	1.18 (0.18,5.52)	0.42 (0.01,5.67)
Douches[e]	0.0 (0.00,20.76)	∞ (1.18,∞)
Foam[e]	1.17 (0.02,16.97)	3.00 (0.13,174.00)

[a]compared to 181 controls without UTI history.
[b]compared to the primary cases.
[c]exact 95% confidence interval for the odds ratio.
[d]insufficient data.
[e]sexually active women only.

TABLE 3—Associations of Clothing Items Worn during the Past Four Weeks with UTI, Controlling for Sexual Intercourse and Diaphragm Use

Items	Primary Cases of UTI[a] RR (95% CI)[c]	Secondary Cases of UTI[b] RR (95% CI)[c]
All cotton panties	0.36 (0.10,1.33)	∞ (2.13,∞)
All synthetic panties	0.55 (0.11,2.22)	1.75 (0.29,10.60)
Pantyhose	1.07 (0.29,4.12)	0.63 (0.13,3.19)
Jeans	0.25 (0.04,1.96)	0.00 (0.00,2.46)
Pants, slacks	0.00 (0.00,9.79)	— (—,—)[d]

[a]compared to 181 controls without UTI history.
[b]compared to primary cases.
[c]exact 95% confidence interval for the odds ratio.
[d]insufficient data.

TABLE 4—Tightness of Jeans among Cases and Controls

Tightness of Jeans	Controls (n = 181) No.	(%)[a]	Primary UTI (n = 25) No.	(%)[a]	RR	Secondary UTI (n = 19) No.	(%)[a]	RR
Tight/very tight	26	(15)	7	(29)	6.7	4	(21)	1.8
Not too tight	103	(58)	14	(58)	3.4	12	(63)	2.6
Sometimes tight	25	(14)	2	(8)	2.0	3	(16)	4.2
Loose/very loose	25	(14)	1	(4)	1.0[b]	0[c]	(—)	1.0[b]

[a]percent of total non-missing responses.
[b]comparison group.
[c]Since at least one cell in the table has an observed zero, the correction given in Schlesselman, p. 175, is used: 1/2 is added to each cell in calculating the OR.

Items of Clothing and UTI

With the exception of pantyhose which had a slightly positive association, the adjusted associations between primary UTI and wearing any of the items of clothing measured were all negative (Table 3). Wearing pantyhose also had a negative association with secondary UTI. In contrast, wearing cotton panties showed a strong positive association and wearing synthetic panties a mild positive association with secondary UTI. As shown in Table 4, wearing tight jeans as compared to loose or very loose jeans was strongly associated with primary UTI ($RR = 6.7$; test-based[12] 95% CI = 0.98, 45.75), and moderately associated with secondary UTI ($RR = 1.8$; test based 95% CI = 0.38, 8.55). Unfortunately, our numbers were insufficient to control for the potential confounding effects of sexual intercourse frequency and diaphragm use.

Urination Habits and UTI

The adjusted associations for urinating more or less than five or six times a day, and hesitating to excuse oneself to urinate show these factors to have a mild negative association with primary UTI, but a moderate to strong association with secondary UTI (Table 5). For urination habits around the time of sexual intercourse, we limited the analysis to sexually active women. As shown in Table 5, sometimes, frequently, or always urinating before sexual intercourse was moderately associated with both primary and secondary UTI when controlled for frequency of sexual intercourse and diaphragm use; whereas sometimes, frequently, or always urinating

TABLE 5—Associations of Urination Habits with UTI, Controlling for Sexual Intercourse and Diaphragm Use

Habits	All Women	
	Primary Cases of UTI[a] RR (95% CI)[c]	Secondary Cases of UTI[b] RR (95% CI)[c]
All Women		
Urinate more or less than 5–6 times/day	0.86 (0.30,2.55)	2.15 (0.50,10.05)
Wait more than 1 hour to urinate	0.0 (0.00,1.28)	0.00 (0.00,3.07)
Hesitate to excuse oneself to urinate	0.19 (0.05,0.59)	1.3 (0.31,5.39)
Sexually Active Women		
Urinate <30 minutes before intercourse	1.50 (0.38,7.89)	1.07 (0.15,8.78)
Urinate <15 minutes after intercourse	0.40 (0.09,2.17)	0.92 (0.18,4.88)

[a]compared to 181 controls without UTI history.
[b]compared to primary cases.
[c]exact 95% confidence interval for the odds ratio.

after sexual intercourse had a negative association with both primary and secondary UTI.

Discussion

The effects of several health habits and behaviors on UTI were estimated in this case-control study. Using tampons and drinking soft drinks had adjusted RRs greater than 1.4 among both initial and recurrent cases. These associations are consistent with those from some case-studies reported in the literature.[14,15] Inserting or removing tampons might spread bacteria from the vagina to the urethral opening. In addition, the inserted tampon might press against the urethra, inhibiting complete emptying of the bladder. Soft drinks increase urine pH, which might facilitate bacterial growth.

Douching, taking vitamin C, and drinking cranberry juice were also associated with UTI, especially secondary UTI. These factors, however, are more likely to be effects of UTI rather than causes. Cranberry juice and vitamin C are well-known folk remedies for UTI. Douching is not only recommended to prevent UTI, but may be indicated because of the vaginitis which often follows antibiotic treatment. Thus, one would expect a stronger association with secondary rather than primary UTI.

Clearly, the factors in this study do not comprise an exhaustive list of risk factors for UTI. These factors, however, are those most frequently suggested to women with UTI as habits they might change to decrease their risk of future infection. Primary cases had higher levels of exposure than secondary cases to drinking orange juice, beer, wine, or liquor, tea, cola soft drinks, coffee, and milk; using sanitary napkins, deodorant soap, bubble bath; wearing pantyhose; and urinating after sexual intercourse. In contrast, the secondary case group had greater levels of exposure than primary cases to drinking cranberry juice, vitamin C, soda pop and citrus juice; eating a vegetarian diet, garlic, ginger and chile peppers; using tampons, douches and spermicide foam; wearing cotton panties, synthetic panties and jeans; urinating more or less than five or six times a day, waiting to urinate, hesitating to excuse oneself to urinate, and urinating before sexual intercourse. Although the differences in exposure levels between the primary and secondary case groups were sometimes small, the different patterns of exposures may hold the key to why some women have repeated UTIs and others do not. Women who have a second UTI might be those who do *not* change their habits, or perhaps they change the wrong ones.

APPENDIX

TABLE A1—Crude Associations of Diet, Selected Foods, Menstrual Products, Soaps, Spermicides, Clothing, and Urination Habits with Primary and Secondary UTI

Total	Controls (n = 181) no. (%)[b]	Primary UTI (n = 25) no. (%)[b]	Primary UTI (n = 25) OR[c]	Secondary UTI (n = 19)[a] no. (%)[b]	Secondary UTI (n = 19)[a] OR[c]
Selected Foods					
Cranberry Juice	42 (23)	6 (26)	1.2	11 (61)	4.5*
Vitamin C	110 (61)	17 (68)	1.4	14 (74)	1.3
Soda Pop	52 (30)	10 (42)	1.7	11 (61)	2.2
Vegetarian Diet	28 (16)	2 (8)	0.5	4 (21)	2.9
Orange Juice	159 (88)	22 (92)	1.5	14 (74)	0.3
Citrus Juice	119 (66)	17 (74)	1.4	13 (76)	1.1
Garlic	153 (86)	20 (87)	1.1	17 (100)	6.0
Ginger	88 (55)	13 (59)	1.2	10 (67)	1.4
Chile Peppers	132 (78)	19 (79)	1.1	15 (88)	2.0
Beer, Wine or Liquor	142 (79)	21 (88)	1.9	14 (74)	0.4
Tea	138 (77)	22 (92)	3.3	14 (74)	0.3
Cola Soft Drinks	138 (77)	21 (88)	2.1	12 (67)	0.3
Coffee	126 (70)	20 (80)	1.8	12 (63)	0.4
Milk	150 (83)	21 (88)	1.4	15 (79)	0.5

(continued)

APPENDIX CONTINUED

TABLE A1—Crude Associations of Diet, Selected Foods, Menstrual Products, Soaps, Spermicides, Clothing, and Urination Habits with Primary and Secondary UTI

Total	Controls (n = 181) no. (%)[b]	Primary UTI (n = 25) no. (%)[b]	OR[c]	Secondary UTI (n = 19)[a] no. (%)[b]	OR[c]
Menstrual Products					
Tampons	145 (80)	22 (92)	2.7	18 (95)	1.6
Deodorant Tampons	20 (11)	0 (—)	0.2*	0 (—)	—
Sanitary Napkins	87 (48)	12 (50)	1.1	4 (21)	0.3*
Deodorant Sanitary Napkins	18 (10)	3 (13)	1.3	1 (5)	0.4
Soaps					
Deodorant Soap	61 (35)	13 (54)	2.2*	9 (50)	0.8
Bubble Bath	19 (11)	3 (14)	1.3	1 (6)	0.4
Spermicides					
Douches	4 (2)	0 (—)	0.8	4 (24)	15.7**
Spermicide Foam[d]	3 (4)	1 (6)	1.3	2 (15)	3.1
Clothing					
All Cotton Panties	130 (80)	14 (61)	0.4**	17 (100)	22.9***
All Synthetic Panties	40 (30)	4 (22)	0.7	6 (38)	2.1
Pantyhose	142 (78)	19 (79)	1.0	13 (68)	0.6
Jeans	159 (91)	21 (88)	0.7	19 (100)	6.3
Pants, Slacks	169 (94)	24 (100)	3.0	18 (100)	—
Urination Habits					
Urinate more or less than 5–6 times/day	115 (64)	14 (56)	0.7	14 (74)	2.2
Wait more than 1 hour to urinate	25 (14)	1 (4)	0.3	2 (12)	3.1
Hesitate to excuse to urinate	156 (87)	12 (50)	0.9***	11 (58)	1.4
Sexually Active Women Only					
Urinate <30 minutes before intercourse	67 (80)	15 (75)	0.8	12 (80)	1.3
Urinate <15 minutes after intercourse	77 (92)	14 (61)	0.1***	9 (56)	0.8

[a]compared to primary cases.
[b]percent of total non-missing responses.
[c]odds ratio.
[d]sexually active women only.
*p < .10 (chi square).
**p < .05 (chi square).
***p < .01 (chi square).

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