The Association Between Dietary Intake and Reported History of *Candida* Vulvovaginitis

Barbara D. Reed, MD, MSPH, Martha L. Slattery, PhD, MPH, and Thomas K. French, M Stat
Ann Arbor, Michigan

The association between dietary intake and the history of Candida *vulvovaginitis was evaluated in 166 women who had a history of* Candida *vulvovaginitis in the past 5 years (cases) and in 207 women without such a history (total population), as well as in 74 women with five or more episodes in the past 5 years and 125 women with no history of* Candida *vulvovaginitis. Women were interviewed about their demographic data, past medical and sexual history, and their history of vaginal or pelvic infections. An extensive dietary history was taken to determine each woman's usual adult dietary intake. Results indicate associations between total caloric intake, carbohydrates, and fiber and a history of* Candida *vulvovaginitis. The results were not altered by controlling for age, body mass index, smoking, use of oral contraceptives, and sexual activity variables. These results suggest several dietary constituents may influence susceptibility to* Candida *vulvovaginitis infections. A follow-up prospective study, using culture confirmation of* Candida *infection, is needed.*

Candida vulvovaginitis is a common cause of morbidity among postpubertal women. Several factors have been hypothesized that may account for the increase in a women's risk for developing the disease, including using oral contraceptives, wearing tight clothing, having diabetes mellitus, having a depressed immunological competency, obtaining *Candida* from sexual contact, or reacquiring the infection from the gastrointestinal tract.[1] Unfortunately, these risk factors fail to explain the reason for infection in a large number of women.

Recently, dietary intake has been hypothesized as playing a role in the development of *Candida* infections[2]; however, the role of diet in the pathogenesis of *Candida albicans* infections is not clear. Although patients with diabetes mellitus have been known to have an increased incidence of *Candida* infections,[3] the role of sugar and other dietary constituents in most patients with *Candida* vulvovaginitis is unknown. It has been suggested that dietary intake of dairy products, artificial sweeteners, sucrose, and zinc may be associated with an increased risk of culture-confirmed vaginal *Candida* species.[2,4] The prevalence or persistence of *Candida* in the oral cavity has been associated with increased carbohydrate intake[5–9] and iron deficiency.[8,10,11] A study using an extensive dietary history to evaluate dietary nutrients associated with vaginal *Candida* infection, however, has not been done.

This study was performed to evaluate potential associations between self-reported *Candida* vulvovaginitis and various nutritional constituents of the adult diet as assessed by a comprehensive dietary interview. The hypotheses that the intake of calcium, carbohydrates, kilocalories, artificial sweeteners, nitrites, fiber, iron, and zinc are associated with *Candida* vulvovaginitis were tested. The role of nitrites in genital infection was evaluated because of their known association with cancer, including genitourinary cancer,[12] and hence the possibility that nitrites may affect cellular or immunological resistance that could be expressed as a change in infection rates.

METHODS

Women, 20 to 49 years of age, living in four urban Utah counties (commonly known as the Wasatch front) were

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From the Department of Family and Preventive Medicine, University of Utah School of Medicine, Salt Lake City. Requests for reprints should be directed to Dr Barbara D. Reed, Department of Family Practice, University of Michigan, 1018 Fuller St, Ann Arbor, MI 48109.

interviewed. These women served as the controls for a population-based, case-control study on the role of dietary intake as it relates to cervical cancer.[13] A random-digit dialing telephone sampling technique was used to identify these women.[14] Although population-based, this control population was matched by 5-year age categories to the cervical cancer population.

Study participants were interviewed in their homes by trained female interviewers. The subjects were questioned about the demographic variables of age, marital status, religious preference, church attendance practices, education and income; and smoking history, contraceptive history, medical history including history of venereal infections, and sexual history (obtained by a self-administered questionnaire). Most of the 1- to 2-hour interview was devoted to obtaining information about the participants' usual adult diet. A list of 183 foods used to elicit detailed information on the frequency each food was eaten, its method of preparation, and the typical amount consumed. Open-ended questions were used to allow respondents to include foods eaten at least once a month that were not listed in the 183-item food questionnaire. Dietary visual aids, including hand cards, were used to assist in ascertaining accurate frequencies of food intake and method of preparation, and NASCO food models were used to help respondents estimate typical serving sizes. The food intake reported was converted into nutrient measurements using the Utah State University Nutrient Data Base (based on the United States Department of Agriculture's Handbook 8), literature reviews, and analyses of food consumed in Utah.

Women were asked whether they ever had *Candida* infections or other types of vaginal, cervical, or pelvic infections. To increase the likelihood that the diagnosis was accurate and remembered correctly, only those patients with a history of *Candida* vulvovaginitis in the 5 years preceding the interview were classified as cases. Those without a history of *Candida* vulvovaginitis and those with a history more remote than 5 years were classified as controls. A second, more rigid definition of cases and controls was also used to assess further the association between dietary intake and *Candida* vulvovaginitis, classifying as cases only those patients with five or more episodes of *Candida* vulvovaginitis in the past five years, and classifying as controls only those with no past history of this infection. This group was labeled subgroup A.

In the analyses, the dietary constituents were categorized into quartiles of consumption based on the frequency distribution in the control population. Associations between the case or control status and each dietary variable were determined by odds ratios and 95% confidence intervals. In calculating the odds ratios, the lowest quartile of ingestion was classified as the referent group, and each of the other three quartiles was compared with that group. To assess potential confounding and effect modification, those dietary variables found to have a statistically significant association with *Candida* vulvovaginitis were stratified by the other potential risk factors (age, adult weight, use of oral contraceptives longer than 6 months, age at first intercourse, number of lifetime sexual partners, smoking status, and the body mass index of weight/height^2). Multiple logistic regression models were used to estimate the effects of nutrient intake while simultaneously controlling for the other confounding variables.

RESULTS

In this study, 373 women younger than 50 years of age were included. Of these, 166 (44.5%) reported a history of *Candida* vulvovaginitis in the previous 5 years and were classified as cases; the remaining 207 women were classified as controls (55.5%). Subgroup A comprised 74 women who reported more than five infections during the past 5 years and 125 controls who reported never having this infection. Because 95% of Utah's population is white, only white patients were studied (including seven cases and nine controls, who were Hispanic). Table 1 displays the population characteristics. Women aged 40 years or more were less likely than the younger women to have a history of *Candida* infection in the past 5 years. Patients with a history of using oral contraceptives for 6 or more months, those who were smokers, and those with a lower ratio of weight to height squared were also more likely to have a history of a *Candida* infection within the past 5 years. Also, those who were 17 years or younger when they first had intercourse were more likely to have had *Candida* vulvovaginitis than those who had been older. There were no case-control differences in marital status, parity, religion, or levels of income and education. Past histories of other genitourinary infections (herpes, *Chlamydia,* gonorrhea, *Trichomonas,* nonspecific vaginosis, or urinary tract infections) were not associated with a history of *Candida* vulvovaginitis. Results were similar using patients in subgroup A with two exceptions: the association with the younger age group was not statistically significant, and there was a positive association between having had more than one lifetime sexual partner and a history of five or more episodes of *Candida* vulvovaginitis in the past 5 years.

The risk estimates of *Candida* vulvovaginitis associated with the daily dietary intake of carbohydrate-related constituents for the total population and for subgroup A are given in Table 2. The history of *Candida* vulvovaginitis in the past 5 years was associated with high intakes of kilocalories (odds ratio [OR] = 2.44, 95% confidence interval [CI] = 1.36 to 4.37) and neutral detergent fiber (OR = 2.30, 95% CI = 1.27 to 4.14). Although a slight

TABLE 1. CHARACTERISTICS OF THE STUDY PARTICIPANTS, UTAH 1984–1987

	Total Population			Subgroup A*		
	Case n = 166	Control n = 207		Case n = 74	Control n = 125	
Characteristics	No. (%)	No. (%)	OR (95% CI)†	No.(%)	No. (%)	OR (95% CI)†
Age (years)						
≤40	150 (90)	163 (79)	1.00 (referent)	65 (88)	106 (86)	1.00 (referent)
≥40	16 (10)	44 (21)	0.40 (0.22–0.72)	9 (12)	19 (14)	0.77 (0.33–1.81)
Current marital status						
Not married	32 (19)	35 (17)	1.00 (referent)	17 (23)	21 (17)	1.00 (referent)
Married	134 (81)	172 (83)	0.85 (0.50–1.45)	57 (77)	104 (83)	0.68 (0.33–1.39)
Pregnancy history						
Ever	146 (88)	179 (86)	1.00 (referent)	66 (89)	102 (82)	1.00 (referent)
Never	20 (12)	28 (14)	0.88 (0.47–1.62)	8 (11)	23 (18)	0.54 (0.23–1.26)
Income‡						
≥$20,000	127 (77)	154 (75)	1.00 (referent)	54 (73)	89 (72)	1.00 (referent)
<$20,000	38 (23)	52 (25)	0.89 (0.55–1.43)	20 (27)	35 (28)	0.94 (0.49–1.80)
Education (years)						
>12	128 (75)	162 (78)	1.00 (referent)	52 (70)	97 (78)	1.00 (referent)
1–12	41 (25)	45 (22)	1.18 (0.73–1.92)	22 (30)	28 (22)	1.47 (0.76–2.81)
Religion						
LDS§	103 (62)	139 (67)	1.00 (referent)	45 (61)	85 (68)	1.00 (referent)
Non-LDS	63 (38)	68 (33)	1.25 (0.52–1.23)	29 (39)	40 (32)	1.37 (0.75–2.50)
Smoked in the past 5 years						
No	129 (78)	178 (86)	1.00 (referent)	49 (66)	106 (85)	1.00 (referent)
Yes	37 (22)	29 (14)	1.76 (1.03–3.00)	25 (34)	19 (15)	2.85 (1.45–5.58)
Adult weight (lb)‡						
≤145	134 (81)	166 (80)	1.00 (referent)	59 (81)	98 (78)	1.00 (referent)
>145	31 (19)	41 (20)	0.94 (0.56–1.59)	14 (19)	27 (22)	0.86 (0.42–1.78)
Body mass index¶						
>21.6	64 (39)	107 (52)	1.00 (referent)	27 (37)	64 (51)	1.00 (referent)
≤21.6	101 (61)	100 (48)	1.69 (1.12–2.56)	46 (63)	61 (49)	1.79 (0.99–3.22)
Oral contraceptive use						
No (≤6 mo)	56 (34)	91 (44)	1.00 (referent)	20 (27)	68 (54)	1.00 (referent)
Yes (>6 mo)	110 (66)	116 (56)	1.54 (1.01–2.35)	54 (73)	57 (46)	3.22 (1.75–5.94)
Age at first intercourse (years)‡						
>17	98 (61)	144 (74)	1.00 (referent)	43 (60)	90 (73)	1.00 (referent)
≤17	62 (39)	50 (26)	1.82 (1.16–2.86)	29 (40)	34 (27)	1.79 (0.97–3.30)
Number of lifetime sexual partners‡						
≤1	72 (45)	101 (53)	1.00 (referent)	30 (41)	77 (63)	1.00 (referent)
>1	89 (55)	91 (47)	1.37 (0.90–2.09)	43 (59)	46 (37)	2.40 (1.33–4.32)

** Subgroup A includes cases defined as women with a history of 5 or more episodes of* Candida *vulvovaginitis in the past 5 years. Control subjects are defined as women with no history of* Candida *vulvovaginitis in their lifetimes*

† OR, odds ratios; CI, confidence interval

‡ Missing values were as follows: income for 1 case and 1 control; adult weight for 1 case; age at first intercourse for 6 cases and 13 controls; and number of lifetime sexual partners for 5 cases and 15 controls

§ LDS, members of the Church of Jesus Christ of Latter-day Saints

¶ Body mass index = weight/height squared

increased risk for *Candida* vulvovaginitis was observed for carbohydrate intake (OR = 1.65), this association was not statistically significant at the .05 level; however, a chi-square test of trend analysis[15] of all four quartiles indicates an association is present ($P<.05$). Crude fiber intake was not associated statistically with *Candida* vulvovaginitis, but an OR of 1.70 was noted and a trend of increasing *Candida* vulvovaginitis was observed with increasing levels of crude fiber intake. Saccharin ingestion was not related to the history of this infection. When the more restrictive definitions were used (subgroup A), crude odds ratios comparing quartiles of nutrient intake to the referent (low-intake) group in cases and controls were similar to those found with the original definitions with the exceptions that the associations between kilocalories and neutral detergent fiber with *Candida* vulvovaginitis increased (OR = 3.10, 95% CI = 1.31 to 7.30 for kilocalories; OR = 3.16, 95% CI = 1.36 to 7.32 for neutral detergent fiber).

TABLE 2. ASSOCIATION BETWEEN CASE-CONTROL STATUS AND CARBOHYDRATE-RELATED DIETARY CONSTITUENTS

	Total Population			Subgroup A*		
	Case n=166	Control n=207		Case n=74	Control n=125	
	No. (%)	No. (%)	OR (95% CI) †	No. (%)	No. (%)	OR (95% CI) †
Kilocalories (kcal/d)						
≤1716	27 (16)	52 (25)	1.00 (referent) ‡	10 (14)	32 (26)	1.00 (referent) ‡
1717–2294	41 (25)	52 (25)	1.52 (0.82–2.81)	19 (26)	35 (28)	1.74 (0.71–4.23)
2295–2734	31 (19)	50 (24)	1.31 (0.70–2.47)	15 (20)	27 (22)	1.78 (0.70–4.53)
>2734	67 (40)	53 (26)	2.44 (1.36–4.37)	30 (41)	31 (25)	3.10 (1.31–7.30)
Carbohydrates (g/d)						
≤223.1	35 (21)	52 (25)	1.00 (referent) ‡	14 (20)	30 (24)	1.00 (referent) ‡
223.2–287.8	26 (16)	52 (25)	0.73 (0.39–1.37)	10 (14)	39 (31)	0.55 (0.22–1.39)
287.9–372.0	46 (28)	52 (25)	1.29 (0.72–2.31)	22 (30)	25 (20)	1.89 (0.81–4.40)
>372.0	59 (36)	52 (25)	1.65 (0.94–2.91)	28 (38)	31 (25)	1.94 (0.86–4.34)
Crude fiber (g/d)						
≤3.592	33 (20)	51 (25)	1.00 (referent) ‡	14 (20)	31 (25)	1.00 (referent) ‡
3.593–5.237	36 (22)	54 (25)	1.03 (0.56–1.89)	16 (22)	36 (29)	0.98 (0.42–2.31)
5.238–7.010	41 (25)	51 (25)	1.24 (0.68–2.26)	17 (19)	31 (25)	1.21 (0.52–2.86)
>7.010	56 (34)	51 (25)	1.70 (0.95–3.02)	27 (37)	27 (22)	2.21 (0.98–5.02)
Neutral detergent fiber (g/d)						
≤8.357	27 (16)	52 (25)	1.00 (referent) ‡	11 (15)	36 (29)	1.00 (referent) ‡
8.358–11.048	28 (17)	52 (25)	1.04 (0.54–1.99)	14 (20)	29 (23)	1.58 (0.63–3.94)
11.049–16.367	49 (30)	51 (25)	1.85 (1.01–3.39)	21 (28)	31 (25)	2.22 (0.94–5.24)
>16.367	62 (37)	52 (25)	2.30 (1.27–4.14)	28 (38)	29 (23)	3.16 (1.36–7.32)
Saccharin (mg/d)						
None	117 (71)	135 (65)	1.00 (referent)	51 (69)	83 (66)	1.00 (referent) ‡
≤97.59	29 (18)	35 (17)	0.96 (0.55–1.65)	14 (20)	18 (14)	1.27 (0.59–2.74)

** Subgroup A includes cases defined as women with a history of 5 or more episodes of* Candida *vulvovaginitis in the past 5 years. Controls are defined as women with no history of* Candida *vulvovaginitis in their lifetimes*
† OR, odds ratios; CI, confidence interval
‡ Significant linear trend, P<.05

Table 3 indicates the associations between the other dietary constituents studied and the history of *Candida* vulvovaginitis, again using the two classification categories. Although not statistically significant, increased risk estimates were noted for the intake of nitrite, calcium, iron, or zinc and the history of *Candida* vulvovaginitis. Trends toward an association with increasing intake of these nutrients and more infections were also noted (ORs comparing the highest with the lowest quartiles = 1.58, 1.68, 1.60, and 1.61, respectively). When the restrictive definitions were used, the association between zinc intake and iron intake with a history of *Candida* vulvovaginitis increased (OR = 2.06, 95% CI = 0.95 to 4.47 for zinc; OR = 2.10, 95% CI = 0.90 to 4.97 for iron).

Because fiber in the diet may be associated with decreased absorption of iron and zinc, the potential associations between iron and zinc with the history of *Candida* vulvovaginitis were stratified by fiber intake (crude and neutral detergent); no association was found.

Multiple logistic regression was performed to evaluate the association of kilocalories and neutral detergent fiber with a history of *Candida* vulvovaginitis in the past 5 years, controlling for potential confounders (including carbohydrates, age, body mass index, smoking status, use of oral contraceptives for more than 6 months, age at first intercourse, and number of lifetime sex partners). The adjusted risk estimates using age and body mass index alone, as well as using the above potential confounders, were similar to the crude odds ratios and confidence intervals; therefore, these estimates are not listed.

Furthermore, correlation coefficients were determined between the dietary constituents of interest: kilocalories, carbohydrates, crude and neutral detergent fiber, saccharin, nitrite, calcium iron, and zinc. The only correlation of ≥0.70 was that between kilocalories and carbohydrates (0.94). The association between each of the other nutrients and a history of *Candida* vulvovaginitis was evaluated by logistic regression while controlling for kilocalories to assess potential confounding. Statistically significant associations were still present between *Candida* vulvovaginitis and increasing levels of intake of neutral detergent fiber and crude fiber in the total population and in subgroup A. The

TABLE 3. ASSOCIATION BETWEEN CASE-CONTROL STATUS AND CARBOHYDRATE-RELATED DIETARY CONSTITUENTS

	Total Population			Subgroup A*		
	Case n=166	Control n=207		Case n=74	Control n=125	
	No. (%)	No. (%)	OR (95% CI) †	No. (%)	No. (%)	OR (95% CI) †
Nitrite (mg/d)						
≤0.358	38 (23)	52 (25)	1.00 (referent)	17 (19)	31 (25)	1.06 (referent)
0.359–0.588	35 (21)	52 (25)	0.92 (0.51–1.67)	18 (24)	31 (25)	1.06 (0.47–2.41)
0.589–0.955	33 (20)	51 (25)	0.98 (0.49–1.62)	15 (20)	35 (28)	0.78 (0.34–1.80)
>0.955	60 (36)	52 (25)	1.58 (0.90–2.76)	24 (32)	28 (22)	1.56 (0.70–3.47)
Calcium (mg/d)						
≤720.1	34 (21)	52 (25)	1.00 (referent)	15 (20)	27 (22)	1.00 (referent)
720.2–1085.4	36 (22)	52 (25)	1.06 (0.58–1.94)	18 (24)	38 (30)	0.85 (0.37–1.97)
1085.5–1467.8	39 (24)	51 (25)	1.17 (0.64–2.12)	18 (24)	27 (22)	1.20 (0.51–2.84)
>1467.8	57 (34)	52 (25)	1.68 (0.95–2.97)	23 (31)	33 (26)	1.26 (0.55–2.84)
Iron (mg/d)						
<10.8	35 (21)	51 (25)	1.00 (referent) ‡	16 (22)	36 (29)	1.00 (referent) ‡
10.9–13.3	30 (18)	52 (25)	0.84 (0.45–1.56)	9 (12)	33 (26)	0.61 (0.22–1.73)
13.4–17.6	43 (26)	51 (25)	1.23 (0.68–2.21)	21 (28)	26 (21)	1.82 (0.74–4.51)
>17.6	58 (35)	53 (25)	1.60 (0.91–2.81)	28 (38)	30 (24)	2.10 (0.90–4.97)
Zinc (mg/d)						
≤9.9	37 (22)	52 (25)	1.00 (referent)	17 (23)	35 (28)	1.00 (referent)
10.0–12.2	30 (18)	52 (25)	0.81 (0.44–1.50)	16 (22)	30 (24)	1.10 (0.48–2.52)
12.3–15.5	42 (25)	52 (25)	1.14 (0.63–2.03)	13 (17)	32 (26)	0.84 (0.36–1.97)
>15.5	57 (35)	51 (25)	1.61 (0.90–2.88)	28 (38)	28 (22)	2.06 (0.95–4.47)

** Subgroup A includes cases defined as women with a history of 5 or more episodes of* Candida *vulvovaginitis in the past 5 years. Controls are defined as women with no history of* Candida *vulvovaginitis in their lifetimes*
† OR, odds ratios; CI, confidence interval
‡ Significant linear trend, P<.05

trends associating nitrite, calcium, and zinc intake with the case status were no longer observed using either case definition, although a linear trend of increasing risk of *Candida* infection with increasing iron intake was still demonstrated.

DISCUSSION

Little information is available in the literature regarding the association between dietary intake and *Candida* infections. Several studies have evaluated the association between oral *Candida* infections and carbohydrates,[5–7,9,16] iron deficiency,[10] and hypovitaminosis A, B1, and B2,[8] but controversy and conflicting results persist. Fewer studies have evaluated the role of diet in *Candida* vulvovaginitis infections. This study evaluated the potential associations between dietary constituents and *Candida* vulvovaginitis.

The results presented here suggest that an increased caloric intake highly correlated with carbohydrate intake is associated with the history of *Candida* vulvovaginitis. A study by Horowitz et al[2] evaluated the ingestion of sugar-containing foods, including dairy products, concentrated sweets, and alcohol, although they did not evaluate total caloric intake. A statistically significant association was found between these foods, urinary glucose excretion, and recurrent *Candida* vulvovaginitis. Changes in dietary intake resulted in an improvement in urinary glucose excretion and fewer complaints of vaginitis recurrences. These improvements may have also been secondary to total caloric intake alterations or changes in other factors. Further study is needed to assess the roles of total caloric intake and the specific source of the calories in the incidence of *Candida* vulvovaginitis.

Fiber is defined as the plant polysaccharide and lignin that is resistent to hydrolysis by the digestive enzymes of man.[17] In this study increased ingestion of neutral detergent fiber, which consists of the nonabsorbable fiber not including water-soluble polysaccharide, increased the risk of *Candida* vulvovaginitis. A trend was noted between crude fiber ingestion and this infection. Fiber in the intestines can result in a decreased rate of glucose absorption and a flatter glucose tolerance curve.[18] The mechanism by which fiber could influence *Candida* infection is not clear, but these results suggest this association is independent of total caloric intake.

In previous studies of *Candida* vulvovaginitis and oral candidiasis, a statistically significant association was observed between iron and zinc deficiencies and *Candida*.[4,8,10,11] In this study, a slight increased risk was observed with increased intake of iron, although no statistically significant association was found. The dietary intake and plasma levels of these minerals, however, may not correlate perfectly because of altered intestinal transit time or increased utilization or loss. Evaluation of both intake and plasma levels in future studies would help clarify their respective roles, if any, in the association with *Candida* vulvovaginitis.

This study used an extensive dietary questionnaire to assess the dietary intake of women. Although problems exist in assessing dietary intake, the dietary questionnaire used in this study was comprehensive and several dietary constituents were able to be analyzed. Additionally, women were asked to report their usual adult diet rather than their diet during any specific period. A major strength of this study is the detailed data on dietary intake available for analyses. Previous studies of associations between dietary constituents and *Candida* vulvovaginitis concentrated on specific foods and food groups, while this study evaluated the association between specific nutrients and this infection. While similar findings may result with these two methods of analysis, combinations of nutrients within specific foods could potentially result in associations not noted with individual nutrient analysis alone. Further evaluation comparing both foods and nutrients in the same population would help clarify this possibility.

A limitation of this study is that the dependent variable (the history of *Candida* vulvovaginitis) relied upon recall and timing of the diagnosis. Because diagnosis of *Candida* vulvovaginitis is not always clinically evident and, unless verified by culture, may be erroneous, these recollections may be inaccurate. For this reason, classification of the cases and the controls includes an error factor, the amplitude of which is not known. There is no reason, however, to suspect a difference in recall between patients in the case and control groups regarding the recent history of *Candida* vulvovaginitis. Furthermore, the stricter criteria for cases and controls should decrease the possibility of a patient being misclassified as a case by requiring five or more episodes of infection in the past 5 years. The analysis using these stricter criteria did substantiate the findings originally found for most of the nutrients, thereby supporting the conclusions. Future studies could minimize this potential source of error by requiring culture verification of *Candida* infections.

Other potential risk factors may be associated with the history of *Candida* vulvovaginitis, including the presence of diabetes mellitus, the use of antibiotics or oral contraceptives, gastrointestinal colonization, immunological deficiencies, or sexual transmission. This study did not address all of these factors. The estimated prevalence of diagnosed and undiagnosed diabetes mellitus in women aged 20 to 44 years in the United States is 2.2%, and for women 45 to 54 years is 8.6%.[19] Using those numbers and the ages of the participants, approximately 7 of the 373 women in this population-based study would be expected to have diabetes. Although the dietary intake of women may be different in those with diabetes from the intake in those without, the probability of this number of patients significantly altering the results is small. No information was available regarding the use of antibiotics prior to the onset of *Candida* vulvovaginitis in these women; however, this risk factor is not thought to be associated with dietary intake and therefore should also not confound the results. Future studies should include data on these variables to further define interactions between these potential risk factors.

In summary, in a population-based group of 373 women, aged 20 to 49 years, 44.5% had a history of *Candida* vulvovaginitis in the previous 5 years. These women were younger, were more likely to be smokers, had a lower ratio of weight to height squared, were more likely to have used oral contraceptives for a least 6 months, had a younger age of onset of sexual intercourse, and had more sexual partners than did those without a history of *Candida* vulvovaginitis as defined by one of the two case definitions used in this study. These factors, however, did not alter the observed relation of *Candida* vulvovaginitis to dietary intake. The history of *Candida* vulvovaginitis was associated with total calories, carbohydrates, and fiber ingestion. No statistically significant association was found between the history of *Candida* vulvovaginitis and nitrite, saccharin, iron, zinc, or calcium ingestion, although there was a trend associating nitrite, iron, zinc, and calcium ingestion with infection. Further studies of dietary associations with *Candida* vulvovaginitis need to be performed in which the diagnosis of *Candida* infection is verified by cultures.

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