

Acknowledgment

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ABSTRACT

Vulvovaginal candidiasis affects approximately 20% of women annually, but it is not well characterized epidemiologically. Of 1027 respondents to two mailed cross-sectional surveys at a large university, 37.5% reported a prior clinical diagnosis of vulvovaginal candidiasis. The frequency of first diagnosis increased rapidly after age 17, with an estimated 54.7% of women experiencing the condition by age 25. In a proportional hazards model of age at first diagnosis, vulvovaginal candidiasis was associated with initiation of sexual activity (rate ratio [RR] = 2.9; 95% confidence interval [CI] = 2.2, 3.8), oral contraceptive use (RR = 1.7; CI = 1.4, 2.2), and White (RR = 3.1; CI = 1.7, 5.7) and Black (RR = 5.9; CI = 3.0, 11.5) race vs Asian. (*Am J Public Health.* 1995;85:1146–1148)

The Epidemiology of Vulvovaginal Candidiasis among University Students

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Introduction

Vulvovaginal candidiasis is an inflammatory condition caused by yeast, predominantly *Candida albicans*. This condition results in severe genital itching, vaginal odor, and abnormal discharge. Self-reported history of vulvovaginal candidiasis ranges from 20% among students¹ to 45% of a general population sample² to 72% of family practice clinic users.³ Widely available vaginal antifungals cure the condition, but some 15% to 20% of women experience a second infection within 1 to 3 months.^{4,5} An estimated \$600 million per year is spent on the diagnosis and treatment of vulvovaginal candidiasis among women aged 15 to 45 years.⁶

Investigation of possible risk factors for vulvovaginal candidiasis should lead to an increased understanding of its pathogenesis, resulting in an improved ability to treat and prevent it. To date, oral contraceptives, sexual activity, antimicrobial use, and many other possible risk factors have been associated with vulvovaginal candidiasis in anecdotal reports and occasionally in clinic-based studies, but none of these associations has been conclusive.^{5,6}

To determine the age distribution of first onset in young women and to examine possible associations of this condition with sexual activity, contraceptive practices, and demographic characteristics, we conducted two mailed cross-sectional surveys of students at a large university. This is the first population-based study to address the age distribution of first onset and one of the few to

examine possible risk factors for vulvovaginal candidiasis.

Methods

Survey recipients were randomly selected from all female students registered at the University of Michigan in the fall terms of 1992 and 1993, stratified by year in school (four undergraduate years plus graduate students). Of those selected, 952 of 1000 in 1992 and 979 of 1050 in 1993 had correct local addresses, with 603 (63.3%) responding in 1992 and 458 (46.8%) in 1993. Graduate students were slightly more likely to respond than undergraduates. Of the 1061 respondents, 34 had data missing for multiple variables and were excluded, leaving a final sample size of 1027. All survey recipients received an explanatory letter, a return envelope, a small incentive, and an anonymous questionnaire asking about their history of clinically diagnosed vulvovaginal candidiasis, demographic characteristics, past sexual activities, and use of various contraceptives. The University of Michigan School of Public Health Human Subjects Review Committee approved both studies.

The Kaplan-Meier method,⁷ along with 95% Hall-Wellner confidence bands,⁸

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was used to estimate the cumulative probability of first clinical diagnosis of vulvovaginal candidiasis by age. Proportional hazards (Cox) models⁷ were used to explore associations between age at first onset and demographic characteristics, sexual activity, and use (ever/never) of contraceptive practices. Sexual activity was defined as genital touching by the respondent or a partner, receptive oral sex, or vaginal intercourse, and it was modeled as a time-dependent variable (age at initiation of sexual activity) in the proportional hazards model. Eleven women without a vulvovaginal candidiasis diagnosis whose age was missing were assigned the median age at survey completion. Forty-seven women with a vulvovaginal candidiasis diagnosis but no age at first diagnosis were assigned the median age at first diagnosis. These medians were calculated separately for each survey and year in school. Reanalysis deleting women with missing dates gave similar results. Separate analysis of the surveys identified no significant differences in the results, so the combined analysis is presented here. Analyses were completed with EGRET⁹ and SAS.¹⁰

Results

Women responding to the survey had a median age of 21.0 years (range = 17.0 to 52.2); 27.6% were graduate students, 85.3% were never married, and most (88.6%) had been sexually active. The racial composition of respondents (76.3% White, 10.1% Asian, 7.2% Black, and 6.3% other or missing) was similar to that of nonrespondents and the female student body (data not shown).^{11,12} With the exception of later age at first sexual activity among Asians, there were no statistically significant differences between the races in age at first sexual activity and in proportions ever participating in specific sexual activities (data not shown).

A clinical diagnosis of vulvovaginal candidiasis was reported by 37.5% of respondents. The proportion of women ever diagnosed increased rapidly after age 17, with an estimated 54.7% of women diagnosed by age 25 (Figure 1). In a proportional hazards model (Table 1), diagnosis of vulvovaginal candidiasis was associated with initiation of sexual activity; ever use of oral contraceptives; and White, Black, or other race (vs Asian). Past participation in both receptive oral sex and vaginal intercourse was more common in women with vulvovaginal

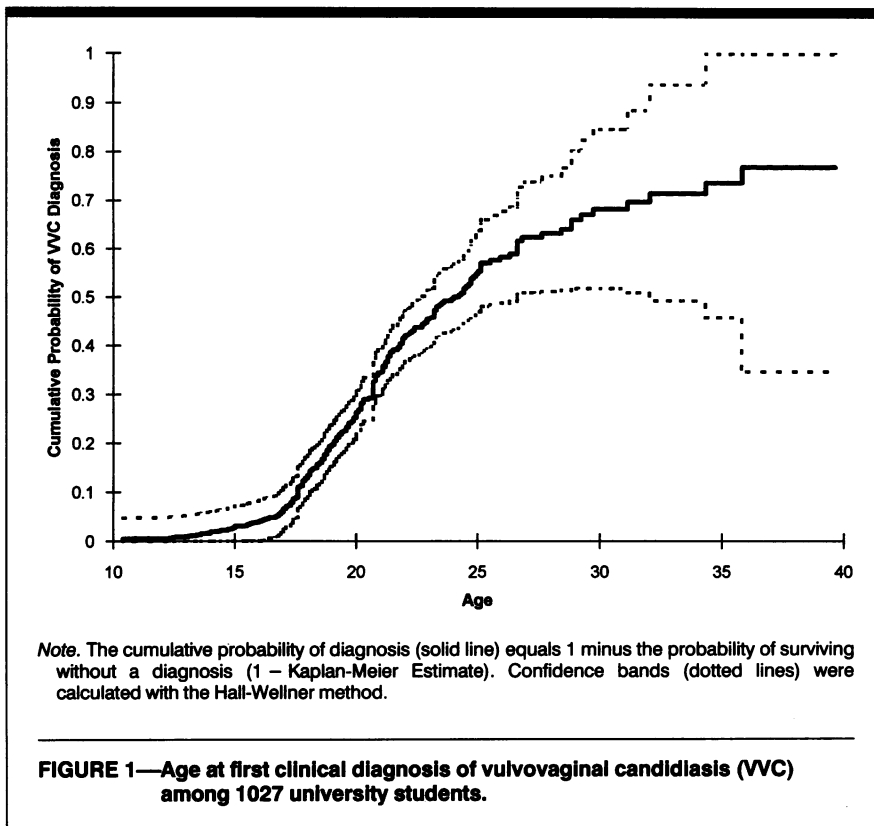


TABLE 1—The Association of Clinically Diagnosed Vulvovaginal Candidiasis (VVC) with Possible Risk Factors among 1027 University Students

	Students with VVC (n = 385), %	Students without VVC (n = 642), %	Hazard Rate Ratio ^a	Crude Odds Ratio	95% CI
Initiation of sexual activity ^b	97.7	83.2	2.9	...	2.2, 3.8
Ever used oral contraceptives	75.3	42.1	1.7	...	1.4, 2.2
Race					
Asian	2.9	14.5	1.0	...	Reference
Other/missing	5.5	6.9	2.8	...	1.4, 5.9
White	81.0	73.5	3.1	...	1.7, 5.7
Black	10.6	5.1	5.9	...	3.0, 11.5
Sexual activities ever done ^c					
Not active	2.4	17.0	...	1.0	Reference
Genital touching only	2.4	7.1	...	2.4	0.8, 7.1
Receptive oral sex only	3.7	7.2	...	3.7	1.4, 9.9
Vaginal intercourse only	3.1	4.7	...	4.8	1.7, 13.9
Both receptive oral sex and vaginal intercourse	88.5	64.1	...	9.9	4.8, 21.3

^aFrom a proportional hazards model including initiation of sexual activity, oral contraceptive use ever, and race.

^bModeled as a time-dependent variable, such that women are considered not active until the age at which they report their first sexual activity.

^cMutually exclusive categories, but receptive oral sex, vaginal intercourse, and both categories together may or may not include genital touching. Data unavailable for eight respondents (three with vulvovaginal candidiasis diagnosis and five without).

candidiasis, but we could not determine which specific sexual activities preceded the diagnosis. Use of contraceptives other than oral contraceptives was less frequent and not associated with vulvovaginal candidiasis (data not shown). Proportional hazards models run separately for each racial group provided similar hazard ratios for the initiation of sexual activity and oral contraceptive use (data not shown).

Discussion

Previous studies have also suggested that sexual activity^{1,2,13-18} and oral contraceptive use^{2,19-22} are associated with vulvovaginal candidiasis. The mechanism by which sexual activity may increase the risk for this condition is unknown, but possibilities include sexual transmission of yeast^{6,23} and trauma facilitating the invasion of vaginal mucosa by yeast.¹ Oral contraceptives may promote yeast adhesion and growth through increased nutrient availability or estrogen stimulation.^{6,24}

To our knowledge, race has never been associated with vulvovaginal candidiasis. Racial groups may differ in personal hygiene habits,²⁵ sexual activities, and contraceptive practices,^{26,27} all of which could contribute to differing incidences of the condition. To the extent that we could evaluate them, however, no important differences in sexual activity were found among the races. Finally, sexual activity, oral contraceptive use, and membership in certain racial groups may all result in increased pursuit of medical care for and/or diagnosis of vulvovaginal candidiasis.

Although this is one of the first population-based studies of vulvovaginal candidiasis, some limitations deserve mention. Women with a history of the condition may have been more likely to complete the survey, resulting in inflated estimates of its diagnosis. Reported diagnoses may be incorrect, either through respondent error or clinician misdiagnosis. Because our data were limited, we

were unable to evaluate adequately the role of specific sexual activities, contraceptive practices, antimicrobial use, and other potential risk factors for vulvovaginal candidiasis. Nevertheless, this is clearly a common condition, with further research required to define the role of sexual activity, contraceptive use, race, and other suspected risk factors in its pathology. □

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