



Graduating into Lower Risk: Chlamydia and Trichomonas Prevalance among Community College Students and Graduates

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Abstract

Background: Community colleges enable youth from economically disadvantaged and minority populations to access college and may enable social mobility including improved health outcomes. However, educational health disparities studies rarely assess the health outcomes for community college graduates.

Methods: Chlamydia and trichomonas prevalence were assessed with nucleic acid based tests in a nationally representative sample of 6233 high school graduates (ages 18–25) from five educational levels: young adults without post-secondary credentials who were not enrolled in college, community college students, 4-year college students, associate’s degree, and bachelor’s degree. To reduce confounding between educational attainment and STI status, we used full matching to balance on 22 measures of demographics, socioeconomic status, educational factors, and sexual risk-taking. Estimates of associations between educational attainment and STI status were obtained from multivariate regression in the full (n=6233) and matched (n=1655) samples.

Results:Four-year college students (adjusted incidence rate ratio (IRR) = 0.41, 95% CI [0.27, 0.61], p

Conclusions: Community college students come from populations with greater health risks than 4-year college students, but community college graduation may reduce the likelihood of chlamydia infection. STI interventions can meet the needs of young adults who access college through community college by partnering with community college health clinics to encourage continued STI prevention, testing, and treatment after the intervention ends. Public health studies that use inclusive educational attainment measures that incorporate sub-baccalaureate credentials will better capture health disparities.

Keywords

young adults; health disparities; propensity score; chlamydia; trichomonas; educational status.

Cover Page Footnote

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ABSTRACT

Background: Community colleges enable youth from economically disadvantaged and minority populations to access college and may enable social mobility including improved health outcomes. However, educational health disparities studies rarely assess the health outcomes for community college graduates.

Methods: Chlamydia and trichomonas prevalence were assessed with nucleic acid based tests in a nationally representative sample of 6233 high school graduates (ages 18–25) from five educational levels: young adults without post-secondary credentials who were not enrolled in college, community college students, 4-year college students, associate's degree, and bachelor's degree. To reduce confounding between educational attainment and STI status, we used full matching to balance on 22 measures of demographics, socioeconomic status, educational factors, and sexual risk-taking. Estimates of associations between educational attainment and STI status were obtained from multivariate regression in the full (n=6233) and matched (n=1655) samples.

Results: Four-year college students (adjusted incidence rate ratio (IRR) = 0.41, 95% CI [0.27, 0.61], $p < 0.001$), associate's degree holders (IRR = 0.38 [0.15, 0.98], $p = 0.05$), and bachelor's degree holders (IRR = 0.45 [0.23, 0.90], $p = 0.02$) were less than half as likely to test positive for chlamydia than non-college-enrolled high school graduates in multivariate regression. After full matching, associate's degree holders were also less likely to test positive for chlamydia (IRR 0.46 [0.23, 0.85], $p = 0.03$) than community college students. Four-year college students (IRR = 0.52 [0.24, 1.12], $p = 0.10$) and associate's degree holders (IRR = 0.34 [0.12, 0.97], $p = 0.04$) were half as likely to test positive for trichomonas than nonstudents/non-graduates in multivariate regression but did not differ after full matching.

Conclusions: Community college students come from populations with greater health risks than 4-year college students, but community college graduation may reduce the likelihood of chlamydia infection. STI interventions can meet the needs of young adults who access college through community college by partnering with community college health clinics to encourage continued STI prevention, testing, and treatment after the intervention ends. Public health

studies that use inclusive educational attainment measures that incorporate sub-baccalaureate credentials will better capture health disparities.

Keywords: young adults; health disparities; propensity score; chlamydia; trichomonas; educational status.

INTRODUCTION

The United States has well-documented and substantial health disparities, but disparities may be reduced by social mobility. People with upward social mobility have reduced health risks than people who stay at the socioeconomic level of their upbringing (Johnson-Lawrence, Kaplan, & Galea, 2013). Disadvantaged youth have opportunities for social mobility through community college (Settersten & Ray, 2010). Community colleges are affordable and have reduced traditional barriers to admission to disadvantaged youth who would be unlikely to attend 4-year college (Rosenbaum & Rosenbaum, 2013). Community college has become a substantial part of the post-secondary educational system in the United States: 43.5% of recent high school completers in 2012 attended community college (National Center for Educational Statistics, 2013, Table 302.10).

As a result of community college's lower entry barriers, community college students are similar to other high school graduates, with just slightly higher socioeconomic status, grades, and test scores than high school graduates who do not matriculate in post-secondary education (Rosenbaum, 2012). By contrast, 4-year college students have higher grades and test scores, socioeconomic status, better health, and fewer health risk behaviors than 2-year college students before college matriculation (Rosenbaum, 2012). Despite not differing from non-enrolled high school graduates, community college graduates with certificates or associate's degrees have higher incomes, better job quality, and lower rates of smoking, which may suggest that community college graduation causes improved outcomes (Rosenbaum, 2012; Rosenbaum & Rosenbaum, 2013).

Disadvantaged youth who access college through community college have higher risks of sexually transmitted infections (STI) than 4-year college students (Centers for Disease Control and Prevention, 2007, 2008). Numerous studies have measured STI and HIV risks of students attending 4-year colleges (Buhi, et al., 2014; James, Simpson, & Chamberlain, 2008; LeBlanc, Sutton, Thomas, & Duffus, 2014) and graduates of 4-year colleges (Annang, Walsemann, Maitra, & Kerr, 2010), but few studies have investigated STI risk among community college students or compared STI rates at community colleges with rates at 4-year colleges or among graduates of community colleges. Several studies have evaluated STIs among community college students attending a small number of colleges in California (Rich, Holmes, & Hodges, 1996; Shapiro, Radecki, Charchian, & Josephson, 1999; Sipkin, Gillam, & Grady, 2003; Trieu, Bratton, & Marshak, 2011). One of few studies to conduct STI tests combined the estimates for community and 4-year college students (Sipkin, Gillam, & Grady, 2003). The annual study of STI diagnosis at college health centers under-represents community colleges, and doesn't present data separately (Smith & Roberts, 2009). The STI screening program of the National Job Training Program (Centers for Disease Control and Prevention, 2009) serves a more educationally disadvantaged population than community colleges (Fernandes-Alcantara, 2015). The STI literature lacks comparisons of STI rates between students at 2-year and 4-year colleges, particularly from nationally representative samples.

We expect that STI rates will be higher at 2-year colleges than 4-year colleges, based on past research of health risks among the populations. Compared with 4-year college students, community college students have greater rates of smoking (Berg, et al., 2011; Lenk, et al., 2012), poorer diets (Nelson, Larson, Barr-Anderson, Neumark-Sztainer, & Story, 2009), and rates of binge drinking that are as high or higher (Coll, 1999; McAloon, 1994; Sheffield, Darkes, DelBoca, & Goldman, 2005; Wall, Bailey-Shea, & McIntosh, 2012), adjusting for socioeconomic factors. We expect that people with associate's degrees will have lower STI rates than community college students after adjusting for age, based on the results of a nationally representative study that matched on baseline health and socioeconomic status (Rosenbaum, 2012).

This research examines disparities in STI prevalence by educational level among a nationally representative sample of high school graduates ages 18–25. First, we compared STI prevalence among young adults not enrolled in college in 2001, students at 2-year and 4-year colleges, and graduates of 2-year and 4-year colleges, and evaluated whether these differences remain after stratifying by age. Second, we estimated the adjusted relative risk of STIs for each educational group, relative to young adults not enrolled in college in 2001. Third, we examined whether students at community colleges have higher STI prevalence than graduates of community colleges matched by age, race, socioeconomic status, high school grades, and sexual risk-taking.

METHODS

Sample

We used the National Longitudinal Study of Adolescent and Adult Health (Add Health) data, a nationally representative sample of students enrolled in grades 7–12 in 1995 (Udry, 2003).¹ Respondents and parents were interviewed in their homes in 1995 (baseline) and 1996, and respondents were followed in 2001 and 2008. Sensitive questions were asked by audio computer-assisted self-interview. This study used the 1995 parent and adolescent interviews and 2001 adolescent interview and urine tests.

The study population comprised respondents who participated in the wave 3 survey; had graduated high school; were unmarried; had available survey sampling weights and a primary sampling unit (PSU) identifier; had available educational attainment; and had participated in the STI test (n=6233). Figure 1 shows the construction of the sample with numbers excluded due to successive application of the exclusion criteria.

The PSU corresponds to the participant's high school or middle school; the PSU is used in estimating standard deviations in survey sample data to yield accurate estimates that adjust for clustering by high school homogeneity. Survey sampling weights relate to the probability of being selected for the Add Health sample and permit us to estimate the STI prevalence among all young adults in the US who were enrolled in high school in 1994 and subsequently reported graduating.

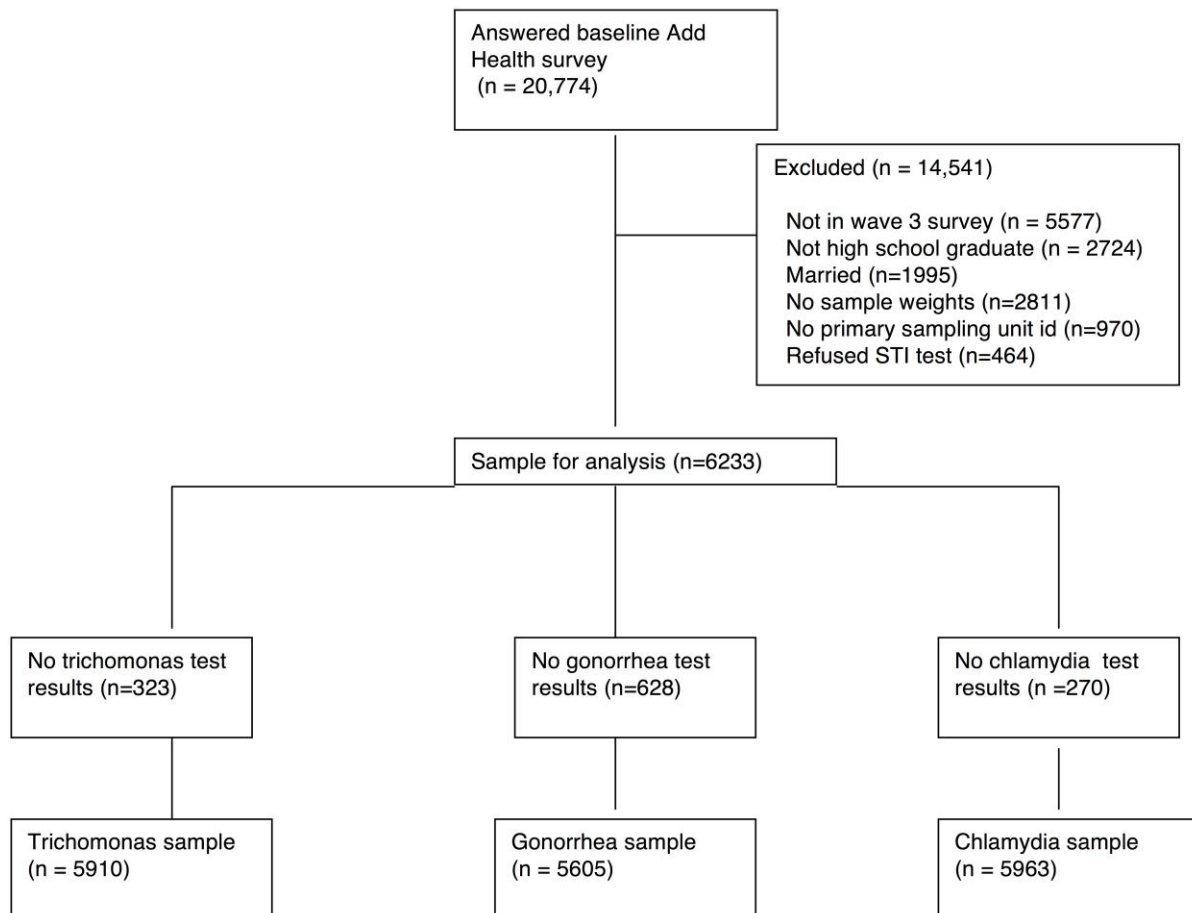
¹ This research uses data from Add Health, a program project directed by Kathleen Mullan Harris and designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill, and funded by grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 23 other federal agencies and foundations. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Information on how to obtain the Add Health data files is available on the Add Health website (<http://www.cpc.unc.edu/addhealth>). No direct support was received from grant P01-HD31921 for this analysis.

High school equivalence credentials (GEDs) were not counted as high school diplomas because of observed differences in their employment and health outcomes in other studies (Barbea, Kreiger, & Soobader, 2004).

Pre-college variables were measured in the baseline in-home interview in 1995, when the sample was ages 12–18. Educational attainment, college enrollment, and STI status were measured in 2001, when the sample was ages 18–25.

Over 99% of the sample in 2001 was ages 18–25, the target age for chlamydia prevention. The sample had a mean age of 21.5 (sd 1.6), and was 46% male, 64% White, 23% Black, 13% Latino, and 8% Asian; 70% were born in the US, and 76% had parents born in the US; 92% spoke English as their primary home language.

Figure 1
Construction of sample for analysis



Measures

Outcomes: STI status. The primary outcomes were testing positive for chlamydia, gonorrhea, and trichomonas in 2001. Respondents who gave a urine sample for STI testing received an extra \$10 incentive; 91.5% of unmarried high school graduates gave a sample. Some STI tests did not return results: 270 chlamydia tests, 323 trichomonas tests, and 628 gonorrhea tests of the 6233 urine samples analyzed in our sample (Figure 1). These results were coded as missing and not analyzed.

Chlamydia and gonorrhea screening used the FDA-approved Ligase Chain Reaction amplification technology in the Abbot LCx Probe System, and respondents could call a toll-free number to get their results.

Trichomonas was detected with a lab-developed (non-FDA) PCR-ELISA test for *Trichomonas vaginalis* DNA developed by Marcia Hobbs at University of North Carolina. This test has a sensitivity of 91% in woman and 89% in men, and an adjusted specificity of 93% in women and 95% in men (Add Health Biomarker Team, n.d.). The test was not FDA-approved, so the results were not available to participants.

Educational enrollment/attainment. Respondents' educational attainment was measured as the highest degree that a respondent listed in response to the question "What degrees or diplomas have you received? Indicate all that apply." in 2001. College enrollment was measured as responses to two questions, whether the respondent is currently attending regular school, and report of whether it is a high school, two-year college, four-year college, or graduate school. Educational attainment and school enrollment were self-reported according to the respondent's own definitions.

Control variables. The analysis used 4 categories of control variables, all measured at baseline unless noted.

The 9 demographic measures included gender, race/ethnicity (black, Latino, Asian), age in 2001, respondent and parent nativity (born in the US versus not), whether English was the primary language spoken at home, and whether the respondent grew up with biological father at home. We matched on age in comparing students and graduates because chlamydia is more common among younger people. Age was divided into 4 categories for stratified analysis: 18-19, 20-21, 22-23, and 24-26 years old.

Socioeconomic status was measured in the parent interview in 1995: parent's educational attainment (less than high school, high school diploma, bachelor's degree or above), household income (log scale), and whether the household has enough money to pay bills.

The 5 educational factors predict the likelihood of college graduation, and might otherwise confound the association between college graduation and STIs: intention to attend college (Likert scale), Peabody Vocabulary Test percentile, high school grade average (mean of all available grades in English, math, science, and history on a 4.0 scale), an indicator for grade not reported for all 4 courses, and binary indicator of having problems completing homework at least once per week.

The 5 sexual risk measures were self-reported history of STIs, perceived likelihood of STI, past pregnancy, past sexual activity, and contraceptive use at first sex, all measured at baseline before college enrollment. Controlling for pre-college variables avoids introducing bias into the association between college enrollment/graduation and STI diagnosis; sexual risk variables measured concurrently with college enrollment/graduation could be intermediate between educational attainment and STIs.

Analysis

Data analysis used survey-weighted data to make prevalence estimates nationally representative (Chantala & Tabor, 2010). We performed data analysis using StataSE, version 11.2 (StataCorp, College Station, Texas) and created figures and conducted matched sampling using the R statistical package, version 3.4.0 (R Foundation for Statistical Computing).

Associations between STI prevalence and educational level. We plotted STI prevalence by educational level, and stratified by gender and by age. We assessed statistical significance of these associations with univariate survey-weighted logistic regression predicting each STI from educational level as an ordinal factor. Due to privacy concerns, cells with fewer than 5 cases are displayed as 0 prevalence.

Adjusted associations between STI prevalence and educational level. To estimate the adjusted measures of association, we used multivariate regressions to predict chlamydia and trichomonas test results from educational attainment, controlling for demographics, baseline SES, and baseline sexual risk. The regressions used a Poisson working model with robust standard errors to yield consistent and unbiased estimators that are also easily interpretable (Cummings, 2009; Lumley, Kronmal, & Ma, 2006; McNutt, Wu, Xue, & Hafner, 2003; Zou, 2004).

Full matching to compare community college students and associate's degree holders. To test whether associate's degree holders had lower STI prevalence than similar current community college students, the study identified a matched comparison group of community college students using full matching using the R MatchIt library (Ho, Imai, King, & Stuart, 2008). Full matching preserves sample size, so it is useful for smaller samples (Stuart & Green, 2008): in this case, there were 490 associate's degree holders and 1165 community college students (n=1655).

The factors used for full matching were potential confounders of the relationship between STIs and graduation: age, African-American race, parent education (less than high school, high school diploma, college degree), high school grade average, high school grade average not reported, baseline marijuana use, and gap of more than a year before college matriculation measured in 2001. After matching, we tested balance on 22 factors, including whether respondents were monogamous and always used condoms in 2001. We matched on age because age predicts STI status for both men and women (Joesoef & Mosure, 2006). Matching on age ensures that if graduates have lower STI rates than students, lower rates of STIs are not attributable to students' younger age. Matching results in balance on a larger number of variables than used for matching.

The differences between associate's degree holders and community college students were measured as standardized differences: the differences in means divided by the pooled standard deviation, a measure of effect size that can be interpreted on the same scale as Cohen's effect size (Austin, 2009; Ho et al., 2008). Standardized differences are displayed in a Love plot (Love, 2002); standardized differences under 0.1 are considered insignificant (Austin, 2009).

Associations between STI prevalence and associate's degree within matched sample. We used multivariate regression within the matched sample of community college students and graduates to test the hypothesis that graduates of community college have lower STI prevalence than similar current community college students. The outcomes were chlamydia and trichomonas test results, and the primary predictor was having graduated from community college with an associate's degree versus being a community college student. Matching minimizes confounding, but the matched sample had few cases: 73 chlamydia and 35 trichomonas. Regressions within the

matched sample adjusted for a minimal set of covariates: gender, Black race, age, and grade average.

RESULTS

In this sample, 3.44% tested positive for chlamydia, 1.73% for trichomonas and 0.3% for gonorrhea. The prevalence of chlamydia, gonorrhea, and trichomonas by educational level are in Figure 2. Due to low gonorrhea prevalence --- with only 0-5 cases among college students and graduates --- further analyses focus on chlamydia and trichomonas.

Associations between STI prevalence and educational level

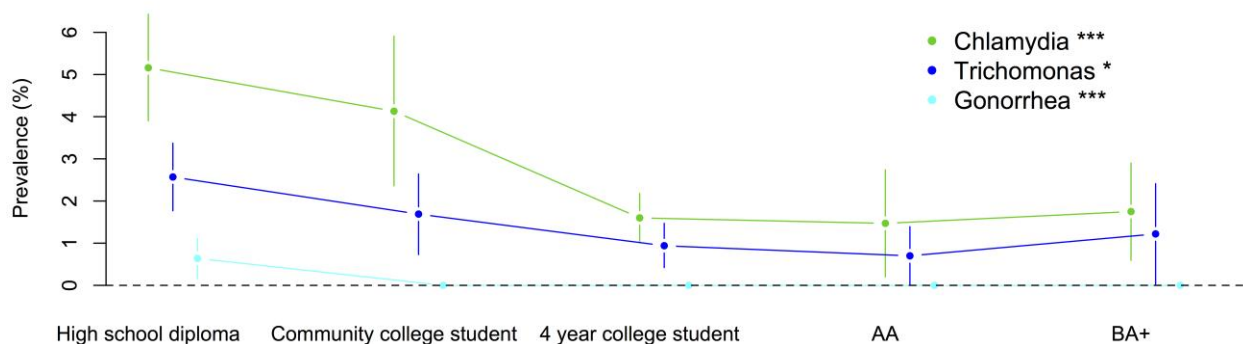
Chlamydia prevalence decreased with educational level for all participants ($F(4, 124)=11.2, p<0.001$); for women ($F(4, 122)=9.0, p<0.001$); and for men ($F(4, 124)=4.0, p=0.004$) (Figure 2.) Students at 4-year colleges (Odds ratio (OR) = 0.30, 95% CI [0.20, 0.44]), associate's degree holders (OR = 0.29 [0.11, 0.74]), and bachelor's degree holders (OR = 0.33 [0.17, 0.67]) had lower chlamydia prevalence than young adults whose highest degree was a high school diploma not enrolled in college and two-year college students (Figure 2.)

Trichomonas prevalence decreased with educational level for all participants ($F(4, 124)=3.1, p = 0.02$) and for women ($F(4, 122)=6.4, p<0.001$), but not for men ($F(4, 124)=1.0, p=0.4$) (Figure 2.) Associate's degree holders (OR=0.28, [0.10, 0.81]) and 4-year college students (OR=0.36, [0.18, 0.71]) had lower prevalence of trichomonas than young adults whose highest degree was a high school diploma not enrolled in college and 2-year college students (Figure 2).

Gonorrhea prevalence decreased with educational level for all participants ($F(2, 126)=7.3, p=0.001$); for women ($F(1, 125)=8.9, p=0.003$); and for men ($F(2, 126)=2.6, p=0.08$) (Figure 2).

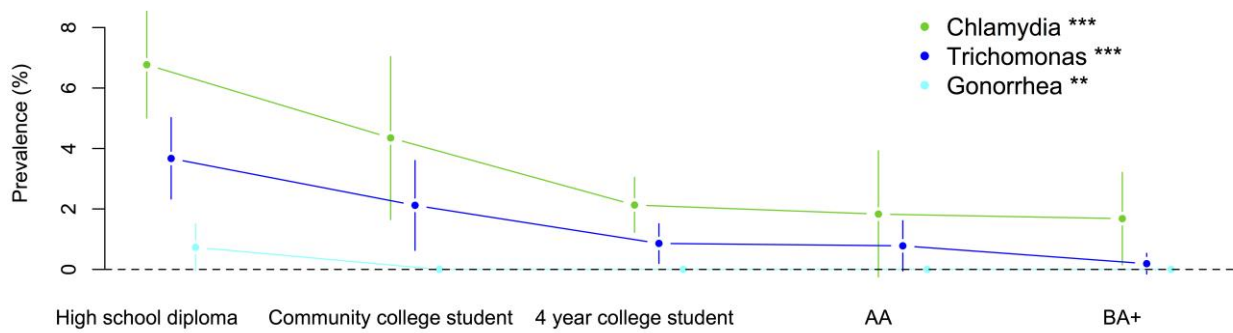
Figure 2. *Percentage of unmarried high school graduates with positive STI test by educational level in the survey-weighted data.*

All participants

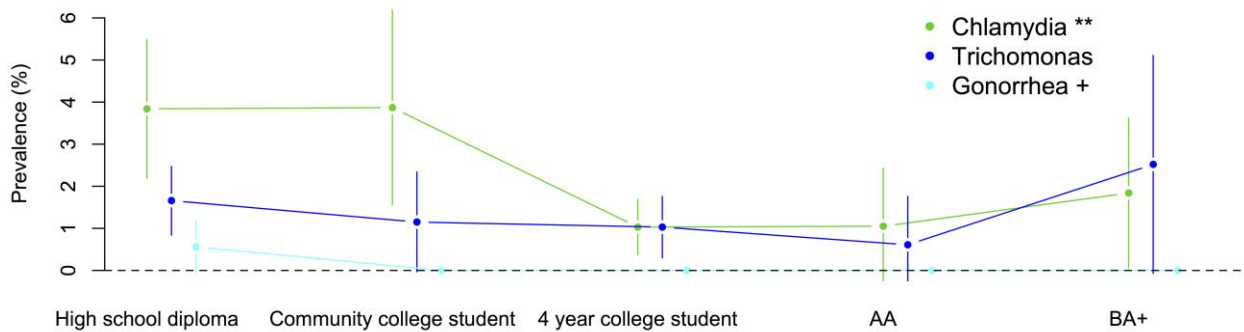


Female participants

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Male participants

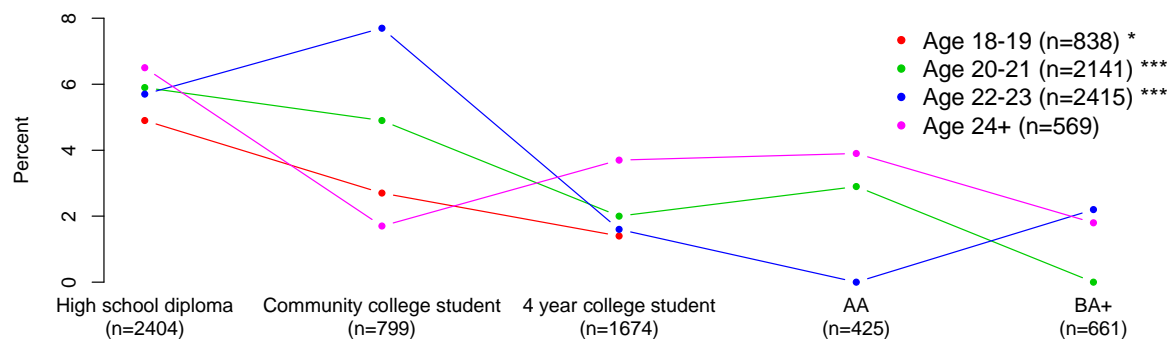


+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

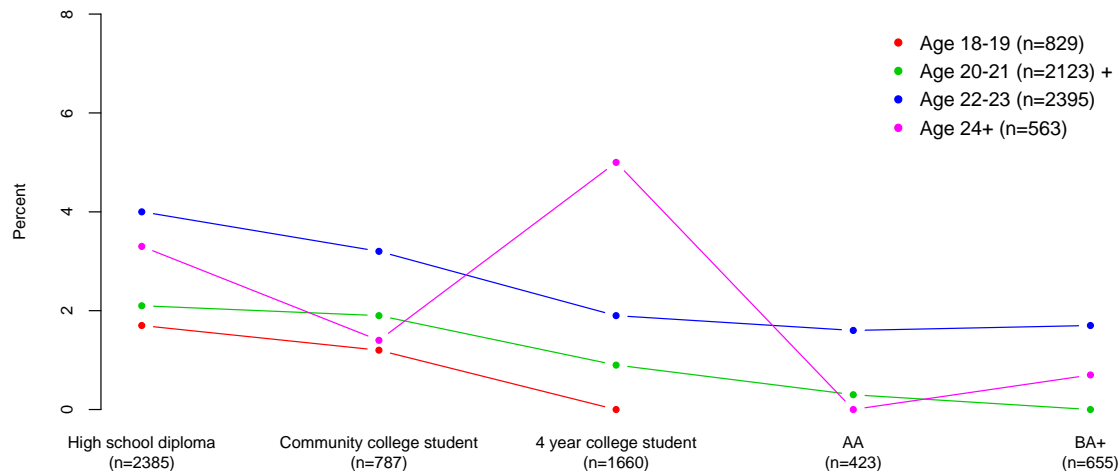
High school diploma = Highest degree is high school diploma; not enrolled in college.

Community college student = enrolled in community college; 4 year college = enrolled in 4-year college; AA= held associate's degree; BA+ = held bachelor's degree or above.

Figure 3: Chlamydia and trichomonas by age and educational level, survey-weighted estimates
Chlamydia (n=5963)



Trichomonas (n=5910)



+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

High school diploma = Highest degree is high school diploma; not enrolled in college.

Community college student = enrolled in community college; 4 year college = enrolled in 4-year college; AA= held associate's degree; BA+ = held bachelor's degree or above.

Chlamydia prevalence is inversely proportional to age (Centers for Disease Control and Prevention, 2009). In this sample, college graduates were older on average than current students (22.4 years versus 20.5 years, $F(1, 126) = 492, p < 0.001$). To evaluate whether the observed association with educational level could be attributable to lower chlamydia prevalence for older respondents, we compared chlamydia prevalence by educational level after stratifying by age. Chlamydia prevalence decreased with educational level for each age group under 24: ages 18–19 ($F(2, 73) = 4.0, p = 0.02$); ages 20–21 ($F(3, 123) = 6.1, p < 0.001$); and ages 22–23 ($F(4, 90) = 6.9, p < 0.001$) (Figure 3). Trichomonas prevalence marginally decreased with educational level for ages 20–21 ($F(3, 123) = 2.3, p = 0.08$) (Figure 3).

Among people at the same educational level, chlamydia prevalence did not decrease with age, as expected. Trichomonas prevalence increased with age among young adults whose highest degree was a high school diploma who were not enrolled in college: each year increase of age predicted 20% greater odds of trichomonas infection (OR = 1.20, 95% CI [1.01, 1.42], $F(1, 127) = 4.6, p = 0.03$). Trichomonas prevalence increased with age among 4-year college students: each year increase of age predicted 55% greater odds of trichomonas infection (OR = 1.55 [1.13, 2.13], $F(1, 125) = 7.5, p = 0.007$).

Adjusted associations between STI prevalence and educational level

Chlamydia prevalence did not differ between community college students and non-students without post-secondary degrees after adjusting for demographics, baseline socioeconomic status (SES), and baseline sexual risk (IRR = 1.01, 95% CI = [0.64, 1.58], $p = 0.98$) (Figure 4). Four-year college students (IRR = 0.41 [0.27, 0.61], $p < 0.001$), associate's degree holders (IRR = 0.38 [0.15, 0.98], $p = 0.05$), and bachelor's degree holders (IRR = 0.45 [0.23, 0.90], $p = 0.02$) were less than half as likely to test positive for chlamydia than nonstudents/non-graduates (Figure 4).

Trichomonas prevalence did not differ between community college students and non-students without post-secondary degrees after adjusting for demographics, baseline socioeconomic status (SES), and baseline sexual risk (IRR = 0.92 [0.48, 1.77], $p=0.81$) (Figure 4). Four-year college students (IRR = 0.52 [0.24, 1.12], $p=0.10$) and associate's degree holders (IRR = 0.34 [0.12, 0.97], $p=0.04$) were half as likely to test positive for trichomonas than nonstudents/non-graduates (Figure 4). Bachelor's degree holders did not differ in trichomonas prevalence (IRR = 0.50 [0.16, 1.61], $p=0.24$).

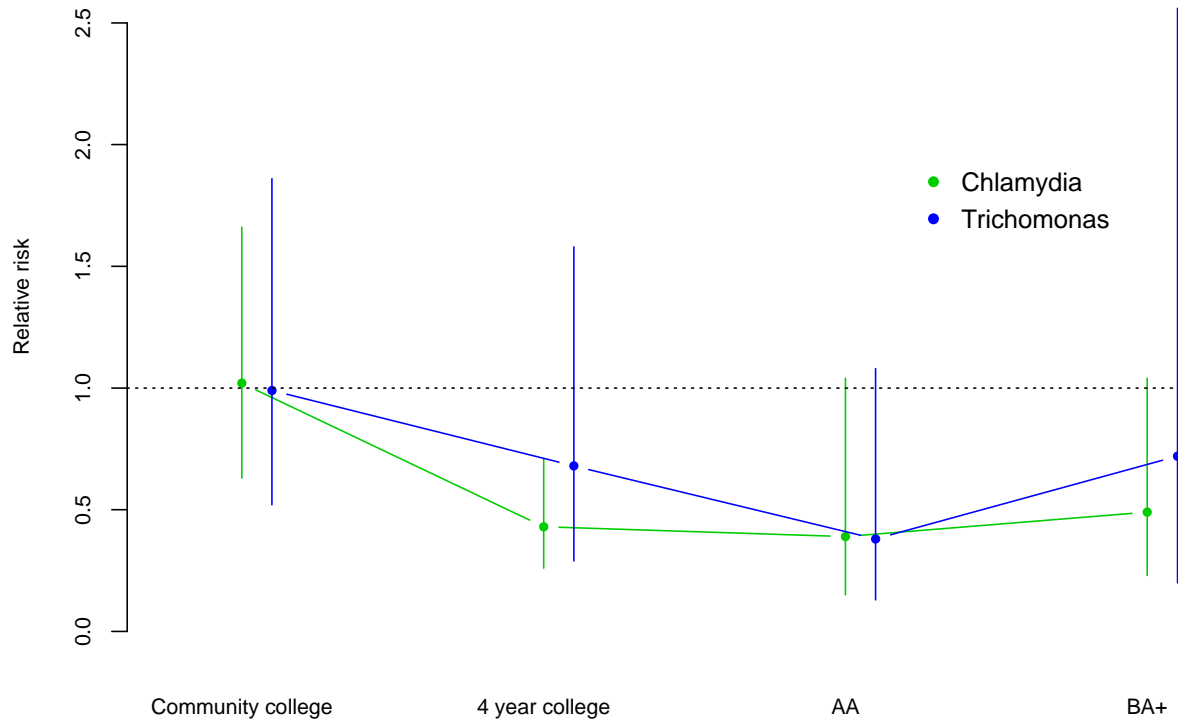
Full matching between community college students and associate's degree holders

To reduce confounding by pre-college factors, we used full matching between 2-year college students with associate's degree holders to yield balance on 22 potential confounders of the relationship between having an associate's degree and testing positive for an STI. Before matching, associate's degree holders were older; had higher baseline grade averages, test scores, and college expectancies; were more likely to have grown up living with their biological father; were more likely to have had sex at baseline; and were slightly less likely to be Black (Figure 5). After matching, the groups were similar on all factors (Figure 5).

Associations between STI prevalence and associate's degree within matched sample

After matching, associate's degree holders were half as likely to have chlamydia as similar community college students (IRR = 0.48, 95% CI [0.25, 0.93], $p=0.03$), but there was no difference in trichomonas (Table 1).

Figure 4: Adjusted relative risk of chlamydia and trichomonas for each educational group (community college student, 4 year college student, AA, and BA+) relative to young adults not enrolled in college in 2001 whose highest degree is a high school diploma.

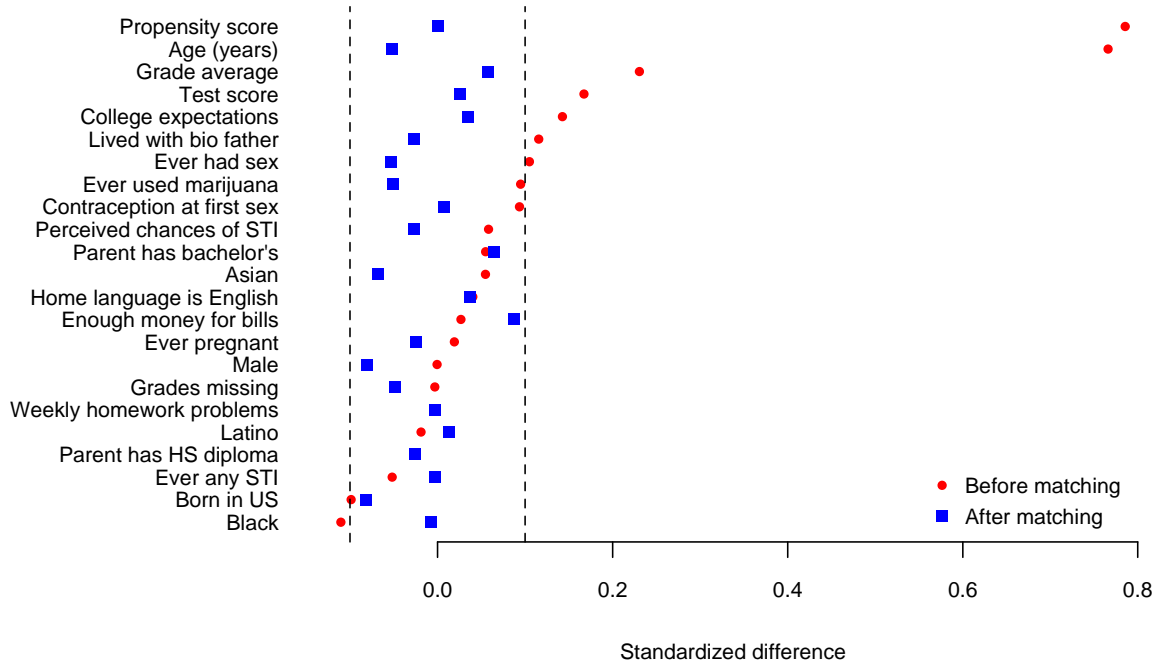


Estimates were obtained using survey-weighted multivariate regression with a Poisson working model, adjusting for demographics, SES, sexual risk, and educational factors. (n=5910 for analysis predicting trichomonas, n=5963 for analysis predicting chlamydia status)

High school diploma = Highest degree is high school diploma; not enrolled in college.

Community college student = enrolled in community college; 4 year college = enrolled in 4-year college; AA= held associate's degree; BA+ = held bachelor's degree or above.

Figure 5: Comparison of standardized differences of associate’s degree holders with community college students before and after full matching (n=1655 before and after matching).



Standardized differences may be interpreted using Cohen’s effect size guidelines: an absolute value below 0.1 is insignificant, 0.2-0.5 is small, 0.5-0.8 is medium. When the variables are greater for AA holders than community college students, the standardized differences are positive.

Table 1: Multivariate regression results with outcomes chlamydia and trichomonas within the matched sample of community college students and associate’s degree holders (n=1655).

Variable	Chlamydia			Trichomonas		
	IRR	95% CI	P	IRR	95% CI	P
Associate’s degree (vs. community college student)	0.49	[0.25, 0.96]	0.03	0.64	[0.27, 1.53]	0.3
Male	0.91	[0.49, 1.71]	0.8	0.28	[0.08, 0.91]	0.03
African-American (vs. not)	7.61	[4.07, 14.2]	<0.001	2.88	[1.21, 6.88]	0.02
Age (years)	0.85	[0.69, 1.05]	0.14	1.11	[0.91, 1.35]	0.3
Grade average (4.0 scale)	0.71	[0.44, 1.13]	0.14	1.11	[0.57, 2.17]	0.8

IRR = incidence rate ratio, which can be interpreted as a relative risk.

Estimates were obtained using multivariate regression with a Poisson working model. All covariates were measured at baseline.

DISCUSSION

Associate’s degrees may reduce chlamydia infection among unmarried high school graduates. Unmarried associate’s degree holders had less than half the prevalence of chlamydia as similar unmarried community college students, after matching on 22 demographic, sexual risk, socioeconomic status, and educational factors. By contrast, community college students did not have lower prevalence of chlamydia and trichomonas than non-students without post-secondary degrees.

This result concurs with past research that sub-bachelor’s credentials predict better health than just a high school diploma (Rosenbaum, 2012; Zajacova & Johnson-Lawrence, 2016). Young adults with community college credentials had lower rates of smoking than those whose highest degree was a high school diploma, despite similar baseline health and socioeconomic factors, based on analysis of Add Health (5). Similarly, U.S. adults with academic associate’s degrees have lower levels of metabolic syndrome risk, cardiovascular risk, and total biologic risk than adults who have completed some college without a degree, whose risk levels are similar to high school graduates (Zajacova & Johnson-Lawrence, 2016).

Community college degrees appear to provide health gains that parallel the gains in earnings and job quality from community college degrees. Young adults without work experience have earnings gains from community college degrees but not isolated college credits (Belfield & Bailey, 2011; Grubb, 2002). Community college degrees may yield earnings gains because employers perceive that graduates have mastered a cohesive program of study as preparation for a specific career; by contrast, isolated college classes do not provide training for any specific job (Grubb, 2002). Adults with community college credentials also have better job quality than those who have completed only some college, with greater job satisfaction, autonomy, and perception of following a career ladder (Rosenbaum & Rosenbaum, 2013).

As a result of these economic and non-economic gains from community college degrees, unmarried young adults may gain access to lower risk sexual networks, develop more stable non-marital romantic partnerships, or be empowered to make better decisions about partners or condom use. Lower STI prevalence is not attributable to associate's degree holders having had pre-college safer sex habits than community college students; associate's degree holders were compared only with community college students with similar levels of baseline sexual risk. The lower STI prevalence among associate's degree holders is also not attributable to pre-college socioeconomic status or academic conscientiousness as measured by grades, test scores, or college expectations.

Chlamydia prevalence in community college populations does not decrease with age as in the general population. Students at higher risk of chlamydia may be more likely to delay matriculation or take longer to graduate. Chlamydia prevention interventions in community college populations should target all ages at risk for chlamydia (18-25). We found only one past STI screening intervention among community college students in the past research literature (Sipkin, Gillam, & Grady, 2003).

Chlamydia prevalence among four-year college students also did not decrease with age. Older 4-year college students' backgrounds are more similar to 2-year college students than their younger 4-year college student counterparts. Older 4-year college students in this sample delayed matriculation, had educational setbacks, and were more likely to be Asian-American, Latino, to have grown up without a resident father, or have parents born outside the US.

Implications for policy and practice

Health disparities may be described more accurately by inclusive educational attainment measures that incorporate sub-baccalaureate credentials, such as associate's degrees and community college certificates, and that discriminate between GED and high school diplomas (Barbeau, Kreiger, & Soobader, 2006). Classifying participants who earned sub-baccalaureate credentials in the same category as "some college" devalues their educational accomplishments and neglects the gains in earnings, job conditions, and health outcomes among those with sub-baccalaureate credentials (Belfield & Bailey, 2011; Grubb, 2002; Rosenbaum & Rosenbaum, 2013; Zajakova & Johnson-Lawrence, 2016). This study finds lower prevalence of chlamydia between associate's degree holders and individuals with "some college," even after matching that balanced on 22 pre-college factors.

Despite the greater risk of STIs at community colleges, STI prevention interventions in college settings disproportionately occur at 4-year colleges. Researchers should consider performing public health interventions at community colleges, especially in partnership with community college health clinics to encourage clinics to offer STI prevention, testing, and treatment after research ends.

Strengths and limitations

This study identified disparities in STI rates by educational level in a nationally representative sample of young people. This study is the only sample to our knowledge that accurately measures both educational factors and uses STI biomarkers rather than self-report.

This sample comprises community college students who were enrolled in 2001. STI prevalence among community college students may have changed since then. The Add Health data are the only available data about STI prevalence in a nationally representative sample of community college students. More recent data from community college students in nationally representative samples, such as the Beginning Postsecondary Students (BPS) data, are not allowed to assess risk behaviors or test for STIs. Community college degrees may have become more important after the 2008 recession, when even recent 4-year college graduates without work experience do not attain good jobs (Abel, Deitz, & Su, 2014). Contemporary community college graduates may have improved health than those in this study.

CONCLUSION

Many community college students come from populations that are relatively disadvantaged compared with 4-year college students, but community college graduation may improve social mobility and reduce health disparities. Public health studies that sample community college students and graduates and use inclusive educational measures that incorporate community college credentials will better capture health disparities in the contemporary educational landscape in which disadvantaged populations access college through community colleges.

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