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Can Female Adolescents Tell Whether They Will Test Positive for Chlamydia Infection?

Wändi Bruine de Bruin, PhD, Julie S. Downs, PhD, Pamela Murray, MD, MHP, Baruch Fischhoff, PhD

**Objectives.** Having better predictors of chlamydia infection may improve health care providers’ decisions about when to provide testing for Chlamydia trachomatis (Ct). Adolescents’ probability judgments of significant life events in the next year and by age 20 y have shown promising validity, being significantly correlated with subsequent self-reports of having experienced these events. Here, the authors examine whether female adolescents’ probability judgments of having chlamydia were correlated with the objective outcome of a Ct polymerase chain reaction assay. **Methods.** Three hundred sexually active female adolescents were recruited from urban health care clinics in Pittsburgh. They assessed “the percent chance that you have chlamydia right now,” then answered questions about their demographic background and sexual history. Subsequently, the authors tested for Ct infection using a self-administered introital swab. **Results.** Adolescents’ probability judgments of having chlamydia “right now” were correlated with whether they tested positive for Ct infection, even after controlling for demographic variables and sexual history. This result held when probability judgments were dichotomized in terms of whether adolescents had assigned a zero or nonzero probability. Adolescents’ mean probability judgment was less than their infection rate, indicating that, on average, they underestimated their actual risk. **Conclusions.** Adolescents can tell whether they are at increased risk for chlamydia but may need better information about its absolute magnitude. Eliciting adolescents’ probability judgments of having chlamydia can add value to clinical decision making. **Key words:** risk communication; risk perception; cognitive psychology; survey methods; pediatrics; preventive medicine, screening; women’s health. (Med Decis Making 2010;30:189–193)

Effective diagnosis is essential to managing the risks of sexually transmitted infections (STIs). Guidelines recommend annual screening for Chlamydia trachomatis (Ct) of sexually active women younger than 25 y because of their increased risk of infection. However, only 22% of sexually active adolescents receive STI-related services during routine physical examinations, with clinicians being more likely to test older adolescents and African Americans. Demographic variables including age and race may have limited validity for predicting current STIs. Self-reports of previous infection are the best, but still a relatively weak, predictor of current STIs, perhaps because they are often unreliable. Having additional predictors of STI might prompt clinicians to test their higher risk patients for STIs, increasing the likelihood of effective diagnosis and treatment.

Here, we report on a new possible indicator of chlamydia risk: adolescents’ judgments of the probability that they are currently infected with chlamydia. Our validity criterion is the outcome of a clinical Ct polymerase chain reaction (PCR) assay, controlling for standard predictors including demographic variables, self-reported sexual behavior, and prior Ct infection. We focus on chlamydia because it is the most common bacterial STI, thereby providing the greatest statistical
power for the validation test, and because it has serious sequelae such as pelvic inflammatory disease, ectopic pregnancy, and infertility.\textsuperscript{1,8}

As potential predictors, probability judgments have the benefit of being easily elicited, avoiding the need for detailed self-reports about sensitive matters. These simple questions allow individuals to pool what they know about their sexual history, such as their own and their partner’s fidelity, without revealing anything that they would rather not share—or that a clinician might not ask. Previous studies have found that adolescents’ expectations for significant life events, expressed on a scale ranging from 0% to 100%, have promising concurrent validity and predictive validity.\textsuperscript{9,10} For example, female adolescents’ judged probabilities of getting pregnant in the next year are correlated with their concurrent self-reports of risk factors such as sexual activity\textsuperscript{9} and their subsequent reports, a year later, of having gotten pregnant.\textsuperscript{10} Here, we use a biological marker to validate adolescents’ probability judgments rather than self-reports. We asked whether adolescents’ probability judgments of having a chlamydia infection were correlated with whether or not they actually had a Ct infection, as revealed by a Ct PCR assay.

\textbf{METHODS}

\textbf{Participants}

We present secondary analyses of baseline data from a longitudinal study evaluating an interactive DVD intervention about sexual decisions.\textsuperscript{11} Three hundred sexually active female adolescents aged 14 to 18 y were recruited from urban health care clinics in Pittsburgh. The Institutional Review Board at each participating institution approved this study. Consent was obtained from participants and from parents or guardians for those younger than 18 y.

\textbf{Procedure}

Participants were asked to estimate “the percent chance that you have chlamydia right now” by placing a mark on a 101-point scale ranging from 0% (no chance) to 100% (certainty). We avoided asking participants to fill in a blank because it increases the use of “50-50,” which may reflect uncertainty about what number to give instead of a numeric probability.\textsuperscript{12} Participants reported their age and race; whether they had, ever and in the past 3 mo, been told by a physician or nurse that they had chlamydia; their age at first intercourse; the number of times they had had sex in the past 30 d; the number of people with whom they had had sex in the past 3 mo (truncated at “6 or more people”); and how often they had used a condom in the past 3 mo (on a 6-point scale anchored at never and every time with every partner). Finally, participants self-administered an introital swab, which was tested with the Roche Ct PCR assay, which has good sensitivity (81%) and specificity (100%), performing as well as or better than other commonly used techniques.\textsuperscript{\textdegree} Those who tested positive received treatment and help with partner notification.

\textbf{Analyses}

Nine participants who tested positive and reported having been diagnosed with chlamydia in the past 3 mo were excluded because their probability judgments might reflect knowledge about an unresolved infection rather than expectation of a new one. Reported number of sexual encounters and lifetime number of sexual partners had skewed distributions both were log-transformed.

First, we assessed group-level accuracy of probability judgments about currently having chlamydia by comparing the mean of all participants’ judgments to the rate of positive Ct PCR results. Second, we compared the probability judgments of participants with positive and negative Ct PCR results. Third, we examined the association between probability judgments and Ct PCR results. We computed nonparametric Goodman-Kruskal correlations ($\gamma$)\textsuperscript{13} because the probability judgments were not normally distributed (Figure 1) and because our data included many ties. We also conducted a hierarchical logistic regression using Ct PCR results as the dependent variable, entering age, race, sexual behaviors, and previous chlamydia infection in step 1, then entering probability judgments of testing positive for chlamydia in step 2. Because the log-transformed probability judgments remained somewhat skewed, we repeated this analysis using a dichotomization of the probability judgments as zero and nonzero. We computed the variance inflation factor (VIF) and tolerance statistics to examine multicollinearity between independent variables.

\textbf{RESULTS}

Figure 1 shows female adolescents’ expectations of currently having chlamydia, with 69.5% judging their probability at a 0% chance and most others
The first column of Table 1 shows descriptive statistics for the whole sample. The mean probability judgment for current chlamydia infection was 5.9% (s = 14.9), with a median of 0%. Overall, 13.4% of these female adolescents actually had chlamydia at the time, as indicated by positive Ct PCR results. Thus, on aggregate, our participants appear to underestimate their risk.

The next 2 columns of Table 1 show descriptive statistics for those with negative and positive Ct PCR results, respectively. The 4th column shows the results of statistical tests, indicating that those with a positive Ct PCR result gave significantly higher probabilities of having chlamydia and were more likely to give a nonzero probability. They were also less likely to be white and more likely to report having had chlamydia in the past.

Probability judgments and Ct PCR results were positively correlated (γ = 0.38, P < 0.001). Table 2 shows logistic regressions examining that relationship while controlling for additional variables. Adolescents’ probability judgments for having chlamydia, entered in step 2 of model 1, were significantly correlated with positive outcomes of the Ct PCR assay, beyond the sexual behavior and demographic variables entered in step 1. Model 2 shows that the same is true for the dichotomized probability judgments of having chlamydia, such that giving any judgment of probability greater than zero was correlated with a positive Ct

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### Table 1  Descriptive Statistics for Overall Sample and by Outcome of the Ct PCR Assay

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall</th>
<th>Negative</th>
<th>Positive</th>
<th>Statistical Test a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage (count)</td>
<td>100.0 (291)</td>
<td>86.6 (252)</td>
<td>13.4 (39)</td>
<td>—</td>
</tr>
<tr>
<td>Mean (s) probability judgment of having chlamydia (%)</td>
<td>5.9 (14.9)</td>
<td>4.7 (12.4)</td>
<td>13.9 (24.3)</td>
<td>M-Wz = -2.79; P = 0.01</td>
</tr>
<tr>
<td>Dichotomized probability judgment of having chlamydia (% responses greater than 0%)</td>
<td>30.5</td>
<td>28.0</td>
<td>46.2</td>
<td>χ²(1) = 5.20; P = 0.02</td>
</tr>
<tr>
<td>Mean (s) number of sex partners in past 3 mo b</td>
<td>1.26 (0.81)</td>
<td>1.24 (0.83)</td>
<td>1.33 (0.66)</td>
<td>M-Wz = -1.49; P = 0.14</td>
</tr>
<tr>
<td>Mean (s) frequency of sexual encounters in past 30 d</td>
<td>5.0 (7.6)</td>
<td>5.0 (7.8)</td>
<td>5.1 (5.9)</td>
<td>M-Wz = -1.22; P = 0.22</td>
</tr>
<tr>
<td>Self-rated frequency of condom use c</td>
<td>4.3 (1.8)</td>
<td>4.3 (1.9)</td>
<td>4.4 (1.7)</td>
<td>M-Wz = -0.35; P = 0.73</td>
</tr>
<tr>
<td>Mean (s) age (y)</td>
<td>16.8 (1.2)</td>
<td>16.8 (1.2)</td>
<td>17.0 (1.2)</td>
<td>M-Wz = -0.69; P = 0.49</td>
</tr>
<tr>
<td>Race (% white)</td>
<td>15.2</td>
<td>17.5</td>
<td>0.0</td>
<td>χ²(1) = 8.06; P = 0.01</td>
</tr>
<tr>
<td>Ever had chlamydia (% self-reporting yes)</td>
<td>24.5</td>
<td>22.0</td>
<td>39.5</td>
<td>χ²(1) = 5.33; P = 0.02</td>
</tr>
</tbody>
</table>

Note: Ct = *Chlamydia trachomatis*; PCR = polymerase chain reaction.

a. Statistical tests were χ² tests for dichotomous dependent variables, and Mann-Whitney tests (z) for continuous variables. Conducting t tests instead of Mann-Whitney tests did not affect whether or not the presented results were significant (P < 0.05).

b. Number of sex partners was drawn from the category labels ranging from none to 6 or more people, with the latter recoded as 6.

c. Measured on a 6-point scale ranging from never to every time with every partner.
PCR result. We observed no multicollinearity among the variables in step 2 of either model (VIF ≤ 1.20; tolerance ≥ 0.83 for both models).

**DISCUSSION**

Female adolescents’ probability judgments for currently having chlamydia infection were significantly correlated with the results of a concurrent Ct PCR assay. This result held even after controlling for age, race, sexual behaviors, and previous chlamydia infection. Although valid in this relative sense, adolescents’ aggregate probability judgments underestimated their Ct infection rate. Because the risk of infection varies with behavior, it should not be inferred that all individuals underestimated their risk.

Previous research has found that adolescents make valid probability judgments for many significant life events, using self-reports as the criterion.\(^9\),\(^10\) We find that this pattern holds for adolescent females’ assessment of their risk of having chlamydia, using an objective criterion, a Ct PCR assay. Moreover, these probabilities seem to contain information beyond that found in sexual history and demographics. Even inquiring whether adolescents see any chance (>0%) can provide additional information.

By their mid-teens, most adolescents have the cognitive decision-making skills of adults,\(^14\) although they may be more strongly affected by emotions.\(^15\) However, we find that adolescents gave valid probability judgments about an important, potentially affect-laden event. Our sample is not representative, composed of sexually active urban females who had enrolled in a study evaluating interventions targeting sexual decisions. They might have been more willing than other adolescents to judge their probability of having chlamydia and to self-report their sexual history. However, there is no reason to believe that they had any special ability to judge probabilities.

Thus, adolescents’ probability judgments could improve clinicians’ decisions about whether to test for Ct and other STIs with which Ct may coexist.\(^16\),\(^17\) Guidelines recommend routine screening for chlamydia in sexually active women younger than 25 y,\(^2\),\(^3\) but probability judgments of having chlamydia may be more simple, nonintrusive, and reliable than self-reports of sexual activity.\(^6\) Moreover, using probability judgments in clinical decision making may benefit individuals who have not been screened as recommended and those who acquired a chlamydia infection between routine screening episodes. Thus, eliciting adolescents’ probability judgments of having chlamydia can add value to clinical decision making.

### Table 2  ORs, 95% CIs for ORs, and \(P\) Values for Hierarchical Logistic Regression Predicting Positive Outcomes of the Ct PCR Assay

<table>
<thead>
<tr>
<th>Predictor variable</th>
<th>Models 1–2, Step 1 (\text{OR}(95% \text{ CI}))</th>
<th>(P)</th>
<th>Model 1, Step 2 (\text{OR}(95% \text{ CI}))</th>
<th>(P)</th>
<th>Model 2, Step 2 (\text{OR}(95% \text{ CI}))</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability judgment of having chlamydia</td>
<td>— —</td>
<td>— —</td>
<td>1.03 (1.01, 1.05)</td>
<td>0.01</td>
<td>— —</td>
<td>— —</td>
</tr>
<tr>
<td>Dichotomized probability judgment of having chlamydia (reporting &gt; 0% chance)</td>
<td>— —</td>
<td>— —</td>
<td>— —</td>
<td>— —</td>
<td>2.33 (1.05, 5.18)</td>
<td>0.04</td>
</tr>
<tr>
<td>Log number of sex partners in past 3 mo</td>
<td>1.22 (0.31, 4.77)</td>
<td>0.78</td>
<td>0.93 (0.23, 3.75)</td>
<td>0.92</td>
<td>0.91 (0.23, 3.70)</td>
<td>0.90</td>
</tr>
<tr>
<td>Log number of sexual encounters in past 30 d</td>
<td>1.42 (0.90, 2.24)</td>
<td>0.13</td>
<td>1.57 (0.97, 2.52)</td>
<td>0.07</td>
<td>1.51 (0.94, 2.41)</td>
<td>0.09</td>
</tr>
<tr>
<td>Self-rated frequency of condom use</td>
<td>1.15 (0.91, 1.45)</td>
<td>0.24</td>
<td>1.16 (0.92, 1.47)</td>
<td>0.21</td>
<td>1.15 (0.91, 1.45)</td>
<td>0.25</td>
</tr>
<tr>
<td>Age</td>
<td>1.11 (0.81, 1.53)</td>
<td>0.52</td>
<td>1.15 (0.83, 1.61)</td>
<td>0.39</td>
<td>1.11 (0.80, 1.54)</td>
<td>0.53</td>
</tr>
<tr>
<td>Race (white)a</td>
<td>0.00 (0.00, 0.00)</td>
<td>1.00</td>
<td>0.00 (0.00, 0.00)</td>
<td>1.00</td>
<td>0.00 (0.00, 0.00)</td>
<td>1.00</td>
</tr>
<tr>
<td>Ever had chlamydia</td>
<td>2.18 (1.00, 4.78)</td>
<td>0.05</td>
<td>1.90 (0.85, 4.26)</td>
<td>0.12</td>
<td>1.83 (0.81, 4.10)</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Note: OR = odds ratio; CI = confidence interval; Ct = Chlamydia trachomatis; PCR = polymerase chain reaction.

Probability judgments were scaled from 0 to 100; dichotomized probability judgments were 0 and 1.
aNumbers for racial minority status reflect 0% of those testing positive being white, versus 17.5% of those testing negative.
REFERENCES