**The Sexually Transmitted Disease Knowledge Questionnaire**
**(STD-KQ; Jaworski & Carey, 2007)**

**Instructions:** For each statement below, please circle true (T), false (F), or I don't know (DK). If you don't know, please do not guess; instead, please circle DK.

| | | True | False | Don't Know |
|---|---|---|---|---|
| 1. | Genital Herpes is caused by the same virus as HIV. | T | F | DK |
| 2. | Frequent urinary infections can cause Chlamydia. | T | F | DK |
| 3. | There is a cure for Gonorrhea. | T | F | DK |
| 4. | It is easier to get HIV if a person has another Sexually Transmitted Disease. | T | F | DK |
| 5. | Human Papillomavirus (HPV) is caused by the same virus that causes HIV. | T | F | DK |
| 6. | Having anal sex increases a person's risk of getting Hepatitis B. | T | F | DK |
| 7. | Soon after infection with HIV a person develops open sores on his or her genitals (penis or vagina). | T | F | DK |
| 8. | There is a cure for Chlamydia. | T | F | DK |
| 9. | A woman who has Genital Herpes can pass the infection to her baby during childbirth. | T | F | DK |
| 10. | A woman can look at her body and tell if she has Gonorrhea. | T | F | DK |
| 11. | The same virus causes all of the Sexually Transmitted Diseases. | T | F | DK |
| 12. | Human Papillomavirus (HPV) can cause Genital Warts. | T | F | DK |
| 13. | Using a natural skin (lambskin) condom can protect a person from getting HIV. | T | F | DK |
| 14. | Human Papillomavirus (HPV) can lead to cancer in women. | T | F | DK |
| 15. | A man must have vaginal sex to get Genital Warts. | T | F | DK |
| 16. | Sexually Transmitted Diseases can lead to health problems that are usually more serious for men than women. | T | F | DK |
| 17. | A woman can tell that she has Chlamydia if she has a bad smelling odor from her vagina. | T | F | DK |
| 18. | If a person tests positive for HIV the test can tell how sick the person will become. | T | F | DK |
| 19. | There is a vaccine available to prevent a person from getting Gonorrhea. | T | F | DK |
| 20. | A woman can tell by the way her body feels if she has a Sexually Transmitted Disease. | T | F | DK |
| 21. | A person who has Genital Herpes must have open sores to give the infection to his or her sexual partner. | T | F | DK |
| 22. | There is a vaccine that prevents a person from getting Chlamydia. | T | F | DK |
| 23. | A man can tell by the way his body feels if he has Hepatitis B. | T | F | DK |
| 24. | If a person had Gonorrhea in the past he or she is immune (protected) from getting it again. | T | F | DK |
| 25. | Human Papillomavirus (HPV) can cause HIV. | T | F | DK |
| 26. | A man can protect himself from getting Genital Warts by washing his genitals after sex. | T | F | DK |
| 27. | There is a vaccine that can protect a person from getting Hepatitis B. | T | F | DK |

**Scoring for the STD Knowledge Questionnaire:**

Score 1 for each correct response.

False is the correct response for these items:
1, 2, 5, 7, 10, 11, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26.

True is the correct response for the remaining items:
3, 4, 6, 8, 9, 12, 14, 27.

Total scores range from 0—27.

**If you use this scale, please cite:**

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ORIGINAL PAPER

# Development and Psychometric Evaluation of a Self-administered Questionnaire to Measure Knowledge of Sexually Transmitted Diseases

**Beth C. Jaworski · Michael P. Carey**

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**Abstract** This research developed and evaluated a brief but comprehensive measure of knowledge about sexually transmitted diseases (STDs) for use in research and applied settings. Questionnaire construction involved a review of empirical precedents as well as qualitative work with STD experts ($n$ = 6) and the target population ($n$ = 40). Eighty-five items were piloted ($n$ = 50) and tested ($n$ = 391) with college students. Item- and test-level analyses identified items that were eliminated to shorten the questionnaire. Factor analyses revealed a two-factor model of STD knowledge, including a Cause/Cure factor and a General Knowledge factor. Six supplemental items were added to the final questionnaire for their public health value and resulted in the 27-item STD-Knowledge Questionnaire (STD-KQ). The STD-KQ demonstrated internal consistency ($\alpha$ = .86) and test–retest reliability ($r$ = .88) over a brief period. Evidence for the validity of the STD-KQ was obtained through a comparison with a validated HIV knowledge questionnaire (Carey & Schroder, 2002); treatment outcome sensitivity was obtained in response to an educational program. Use of the STD-KQ will enable researchers and health educators to identify knowledge deficits, measure knowledge for theory testing, evaluate risk reduction programs, and assess treatment response in research and applied settings.

B. C. Jaworski · M. P. Carey (✉)
Center for Health and Behavior, Syracuse University, 430 Huntington Hall, Syracuse, NY 13244-2340, USA
e-mail: mpcarey@syr.edu

B. C. Jaworski
California State University San Bernardino, San Bernardino, CA, USA

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## Introduction

The United States has the highest rate of sexually transmitted diseases (STDs) compared to other industrialized countries (Institute of Medicine, 1997). Among American college students, the decreasing age of sexual debut (Sawyer & Smith, 1996), the rise in number of sexual partners and non-monogamous relationships (Jaworski & Carey, 2001), and the low and inconsistent use of condoms (Bryan, Aiken, & West, 1996) contribute to the STD epidemic. As part of the Healthy People 2010 Initiative, the U.S. government has targeted the reduction of STDs (U.S. Department of Health and Human Services, 2000). In its focus on college students, the Initiative seeks to increase college students' knowledge of STDs.

Although knowledge about HIV appears to have increased over the years, knowledge about the larger category of STDs remains low (Jaworski & Carey, 2001; Yacobi, Tennant, Ferrante, Pal, & Roetzheim, 1999). Sexual health education efforts, media campaigns, and research have focused on HIV. Relative lack of exposure to information about other STDs, and to new and changing information about new and existing STDs contribute to the paucity of college students' knowledge. Although other STDs are similar to HIV with respect to transmission and prevention, there are important differences that warrant more comprehensive education and assessment.

Measuring STD knowledge is important because such knowledge is often identified as a determinant of risk behavior in extant theories (e.g., Theory of Reasoned Action [TRA]: Fishbein & Ajzen, 1975; Health Belief Model [HBM]: Becker, 1974; Information-Motivation-Behavior Skills [IMB] model: Fisher & Fisher, 1992). In most theories, knowledge is not a distinct construct, but is incorporated into perceived vulnerability (susceptibility). Individuals acquire STD-related information and evaluate it in terms of its personal relevance to risk reduction.

In the IMB model, though, knowledge (termed ''Information'') is distinct. Knowledge subsumes a broader range of factors that include (a) information about transmission as well as other basic STD knowledge (i.e., etiology, natural history, treatment, consequences, prevention), (b) misinformation or myths about sexual health, and (c) cognitive processing that biases knowledge and sexual decision-making. Whereas the first two components of the knowledge construct encompass objective STD facts, the third component reflects the distortion of STD facts through the use of various biases and heuristics (e.g., availability heuristic, unrealistic optimism, base rate fallacy) that occurs within a context (e.g., type of partner, timing in a relationship). According to the IMB model, knowledge can operate independently to influence behavior, but often joins with motivation to influence behavior through behavioral skills.

Whether defined narrowly, as in the majority of the theories and models, or broadly, as in the IMB, no specific level of STD knowledge has been identified to promote protective behavior and reduce risk behavior. Implicit though, is that individuals must possess fundamental STD knowledge that enables them to estimate their STD risk accurately, understand the modes of transmission, be informed about prevention strategies, identify signs of STDs, appreciate the consequences of infection, and understand STD testing and treatment recommendations.

Researchers and health educators have developed STD knowledge questionnaires to identify knowledge deficits, guide risk reduction programs, and assess treatment response. Many of these questionnaires have focused on a single STD (primarily HIV). Among the more than 25 currently identified diseases that are sexually transmitted (Centers for Disease Control and Prevention [CDC], 2000), six STDs (i.e., chlamydia, genital herpes, gonorrhea, hepatitis B, HIV, Human Papilloma Virus [HPV]) were included in the present investigation because they have high prevalence rates among college-aged individuals and can cause significant morbidity (CDC, 2003; Miller et al., 2004).

None of the existing STD knowledge questionnaires designed for, or used with, college students is current, encompasses all of the major STDs, and demonstrates adequate psychometric properties and treatment outcome sensitivity. There is a great need for a comprehensive STD knowledge questionnaire that can illuminate individuals' confusion among the STDs and minimize respondent burden compared to use of separate questionnaires for each STD.

Prior to the emergence of HIV, there were a few STD knowledge questionnaires that focused on the salient STDs of the time. As the deadly nature of HIV became apparent, research focused on HIV. Few broadly focused STD knowledge questionnaires were developed even though STD information expanded, new STDs were identified (e.g., HPV), and STD prevalence rates rose. Earlier STD knowledge questionnaires have become outdated.

Therefore, the goal of the current research was to develop and evaluate an up-to-date and comprehensive STD knowledge questionnaire. Thus, we reviewed the scientific literature, conducted focus groups with students, garnered information from STD experts' review and evaluation, completed item and factor analyses, assessed internal consistency reliability and test–retest reliability, and obtained evidence of the measure's validity, including treatment outcome sensitivity in a series of five studies, which are described in this paper.

## Study 1: Item Development

Study 1 was designed (a) to define the test objectives, and (b) to develop an initial item pool through a systematic review of the literature and formative research. The test objectives included the fundamental STD knowledge types (i.e., etiology, transmission/non-transmission, consequences of infection, testing and detection, risk reduction/prevention, treatment/cure) and were written as instructional objectives (Bloom, Hastings, & Madaus, 1971). Each objective had at least 2 items per specific STD, and two general items that pertain to all STDs. Items were written to correspond to one objective, resulting in at least 84 items.

In addition to the test objectives, the following guidelines were used to construct items. Non-essential, overly technical questions that have little relevance to risk reduction were avoided. All items were written as declarative statements. Items used good grammar and widely understood vocabulary, were relatively short in length, were written in the present tense, had one correct answer, and included more false items because

they discriminate better. Negatives (e.g., not, none), items that contain universals (e.g., always, never), complex or compound items and biased or ''offensive'' items were avoided. An alternative choice format (i.e., true/false) with a ''don't know'' option was used. More items that pertained to women were developed, because women have greater and more varied health consequences from STDs.

The literature review included both review of existing STD knowledge questionnaires and current STD information. Published questionnaires served as an important resource for item development. Information gathered from these questionnaires was checked to ensure that the information was up-to-date and accurate. State-of-the-science information was obtained from the CDC, Division of STD Prevention, an authoritative text on STDs (Institute of Medicine, 1997), and a leading text (Kalichman, 2003).

Focus groups helped to ensure the relevance of the questionnaire. Participants worked together to delineate the types of STD knowledge relevant to risk reduction, develop item content, and nominate content. Content from the focus groups was used to develop additional items that were combined with the other items to make up the initial item pool. By defining the test objectives, conducting a thorough research review, and gathering information from focus groups, the foundation for the construct validity of the questionnaire was laid.

### Method

The participants were 18 male and 22 female students, who were recruited from a public university in southern California. The investigator described the study at a class meeting, encouraging participation from students who were comfortable discussing STDs (Greenbaum, 2000). Interested students provided written informed consent and met in same-sex groups of 6–8 students. Focus groups lasted two hours and followed established procedures (Morgan, 1998). Thus, the moderator encouraged participants to work collaboratively while she facilitated the activities of the focus groups, avoided answering participants' questions, asked participants to focus on generating ideas only, and recorded participants' responses in their argot.

### Results

All groups generated numerous ideas for item content. Content that matched the test objectives was included in the item pool. The nominations by STD were as follows: chlamydia (4), genital herpes (22), gonorrhea (13), hepatitis B (16), HIV (26), HPV (27). Three additional types of information (i.e., information about risk groups, types of relationships [e.g., monogamous, casual relationships] and importance of knowing a partner's sexual history) were also nominated but were excluded because they may inadvertently communicate that: (a) only members of specific groups are at risk; (b) certain types of relationships confer risk or protection; and (c) knowledge of a partner's sexual history is sufficient to judge sexual risk.

Participants were generally informed about most aspects of HIV/AIDS, although some were confused about the difference between HIV and AIDS, whereas they were generally uninformed about hepatitis B and HPV. Many were unaware of the relationship between HPV and genital warts. Regarding the other STDs, confusion and misinformation were widespread across the fundamental knowledge types. Although they were knowledgeable about the main STD transmission modes, they were unsure about which STDs could be transmitted via skin-to-skin contact and a few held erroneous beliefs about casual transmission of STDs. Many participants thought that an outbreak was necessary for transmission of genital herpes. Aside from vaginal and penile sores/warts, participants were uninformed about other symptoms of STDs. They did not know which STDs could be cured and which could only be managed. They were unsure about the time period to develop symptoms and were almost universally unaware that some STD infections show no symptoms. Finally, they lacked information about condoms, other than latex. Informed by the test objectives, the focus group data and research review produced 93 items for the Sexually Transmitted Disease-Knowledge Questionnaire (STD-KQ).

## Study 2: Expert Review and Known Groups Evidence

In Study 2, STD experts reviewed the STD-KQ. They answered the items, which served to evaluate the accuracy of items, and revealed item construction problems. These data also provided known groups evidence for the validity of the STD-KQ. Through an item-objective matching task, threats to the construct validity of the questionnaire were investigated, which included: (a) if no items are matched to a particular objective; (b) if items match more than one objective; and (c) if some items do not match any of the objectives (Haynes, Richard, & Kubany, 1995). The experts

also provided feedback about item content and construction as well as suggestions for additional items or item content.

### Method

The participants were three nurse practitioners and three medical doctors who provide direct services to college students in the diagnosis and treatment of STDs. The lead investigator contacted the STD experts, and asked them to complete the 93-item STD-KQ and respond to a series of structured questions regarding how well each item matched the test objectives.

### Results

A total score on the STD-KQ was created by summing the correct responses. Out of 93 items, the experts scored 77, 83, 84, 86, 88 and 89 (i.e., 83–96% correct). Incorrect responses were scrutinized to: (a) detect scoring errors; (b) identify item construction problems that may have led to the error(s); and (c) evaluate if the item was too difficult, even for the experts. Scoring errors and item construction problems were corrected; items that were too difficult were modified or deleted. Eight items were deleted from the STD-KQ, including 6 items that were too technical, and 2 items that were not clearly true or false. The STD experts' comments and suggestions about item content and construction led to additional changes. Twelve other items were reworded to improve the precision of the items. Finally, the content of 2 items was changed to increase the variability of the questionnaire's content.

Rovinelli and Hambleton's index of item-objective congruence was calculated to evaluate the agreement of the experts on each item (cf. Waltz, Strickland, & Lenz, 2004). The index represents experts' agreement on each item and can be used with more than two experts. Experts rated each item as a definite measure of the test objective (+1), definitely not a measure of the test objective (–1), or undecided (0). The mean ratings for each item were evaluated against a designated cutoff score (i.e., 0.67). Index scores for all of the STD-KQ items were 100%, with all of the STD experts in perfect agreement on the match between items and objectives. The data also verified that all objectives had at least 2 items and that each item met at least one objective. All items matched a single objective except for items that were scored as matching the risk reduction objective. These items were also scored as matching the transmission objective. After the experts' review, the STD-KQ was reduced to 85 items.

## Study 3: Pilot testing and psychometric evaluation

Study 3 tested the STD-KQ in a brief pilot, and then in a larger psychometric evaluation. The pilot provided data about the variation and difficulty of items and helped to identify problematic items to guide revisions (Crocker & Algina, 1986). The larger psychometric evaluation included item analyses, internal consistency analyses, and factor analyses. Item analyses provided information about item difficulty and discrimination. Internal consistency analyses provided information about the homogeneity and quality of items. Exploratory factor analysis (EFA) was performed on the revised questionnaire. Principal factor analysis (PFA) was selected as the factor analytic model to identify the nature and number of latent variables that explain the relationships among the items. Confirmatory factor analysis (CFA) tested the hypothesized model from the EFA.

### Method

#### *Participants*

Pilot participants were 50 students (82% female) who ranged in age from 18 to 49 years (M = 27), and 52% self-identified as Hispanic. Participants also self-identified as African-American (12%), White (30%), Asian/Pacific Islander (2%), American Indian or Alaska Native (2%), Mixed/Multiracial (16%), or Other (38%). All described themselves as exclusively or predominately heterosexual with 18% reporting no sexual partners in the last 6 months, 70% reporting one partner, and 12% reported two or more partners.

Participants for the large-scale test were 391 undergraduate students (84% female) who ranged in age from 18 to 74 years (M = 27). Forty-two percent self-identified as Hispanic. Participants also self-identified as African-American (10%), White (36%), Asian/Pacific Islander (8%), Mixed/Multiracial (14%), or Other (33%). Ninety-six percent described themselves as heterosexual, 3% as homosexual, and 1% as equally heterosexual and homosexual.

Students responded to announcements and provided written informed consent. They attended small group sessions where the investigator described the study, explained the survey to familiarize participants with its format, and answered any questions. Next, the participants completed the 85-item STD-KQ as well as a brief questionnaire that asked about participants' sex, ethnicity, race, age, year in college, relationship status, and sexual history.

**Table 1** Item means and standard deviations of pilot and large-scale samples and item–total correlations of the large-scale sample

| Item No. | Item | Pilot ($n$ = 50) | | Large-scale test ($n$ = 391) | | |
|---|---|---|---|---|---|---|
| | | *M* | *SD* | *M* | *SD* | Item–total Correlation |
| 1. | The cause of Chlamydia is unknown. | .54 | .50 | .50 | .50 | .44 |
| 2. | A person can get Gonorrhea from sitting on a toilet seat that someone with Gonorrhea sat on. | .52 | .50 | .56 | .50 | .39 |
| 3. | Using a dental dam during oral sex can protect a person from getting a Sexually Transmitted Disease. | .28 | .45 | .26 | .44 | .32 |
| 4. | Genital Herpes is caused by the same virus as HIV. | .56 | .50 | .59 | .49 | .50 |
| 5. | HIV lowers the ability of a person's body to fight off diseases. | .96 | .20 | – | – | – |
| 6. | Frequent urinary infections can cause Chlamydia. | .38 | .49 | .40 | .49 | .55 |
| 7. | Genital Herpes sores on a man's penis come and go. | .80 | .40 | .76 | .43 | .44 |
| 8. | Hepatitis B is more difficult to get than other Sexually Transmitted Diseases. | .48 | .50 | .41 | .49 | .36 |
| 9. | There is a cure for Gonorrhea. | .42 | .50 | .40 | .49 | .39 |
| 10. | It can take several years after being infected with AIDS for a person to develop HIV. | .34 | .48 | .40 | .49 | .23 |
| 11. | The treatment of Chlamydia involves surgery. | .60 | .49 | .57 | .50 | .55 |
| 12. | Douching after sex reduces a woman's chances of getting HIV. | .76 | .43 | – | – | – |
| 13. | There are medications available to cure Hepatitis B. | .30 | .46 | .33 | .47 | .33 |
| 14. | It is easier to get HIV if a person has another Sexually Transmitted Disease. | .18 | .39 | .26 | .44 | .16 |
| 15. | Doctors remove Genital Herpes sores to treat the infection. | .48 | .50 | – | – | – |
| 16. | A person can tell if a man has Chlamydia by looking for sores on his penis. | .44 | .50 | .47 | .50 | .53 |
| 17. | Using a female condom during vaginal sex can help a woman avoid HIV infection. | .64 | .48 | .63 | .48 | .13 |
| 18. | A person can get Gonorrhea from anal sex. | .60 | .49 | .52 | .50 | .35 |
| 19. | A person should stop taking medications for a Sexually Transmitted Disease when the symptoms disappear. | .96 | .20 | – | – | – |
| 20. | Taking birth control pills can protect a woman from getting Human Papillomavirus (HPV). | .70 | .46 | .67 | .47 | .42 |
| 21. | Urinating (peeing) after sex can prevent a person from getting Hepatitis B. | .70 | .46 | .68 | .47 | .42 |
| 22. | Women are more likely to get HIV during vaginal sex than men. | .34 | .48 | .36 | .48 | .34 |
| 23. | A woman is unable to get pregnant while she has Gonorrhea. | .60 | .49 | .59 | .49 | .39 |
| 24. | The cause of Gonorrhea is known. | .36 | .48 | .29 | .45 | .35 |
| 25. | A person who has Genital Herpes is protected from getting other Sexually Transmitted Diseases. | .96 | .20 | – | – | – |
| 26. | A person who exercises regularly is less likely to get HIV. | .88 | .33 | .92 | .27 | .20 |
| 27. | Chlamydia can be transmitted to another person during oral sex. | .50 | .51 | .50 | .50 | .29 |
| 28. | Human Papillomavirus (HPV) is caused by the same virus that causes HIV. | .24 | .43 | .27 | .45 | .53 |
| 29. | People are regularly tested for Hepatitis B during their physicals. | .40 | .49 | .42 | .49 | .40 |
| 30. | A pap smear may tell if a woman has Human Papillomavirus (HPV). | .54 | .50 | .55 | .50 | .19 |
| 31. | Human Papillomavirus (HPV) can cause HIV. | .28 | .45 | .32 | .47 | .56 |
| 32. | Chlamydia can cause pain during urination (peeing). | .62 | .49 | .55 | .50 | .39 |
| 33. | Having anal sex increases a person's risk of getting Hepatitis B. | .22 | .42 | .22 | .41 | .27 |
| 34. | Some people are immune to (protected from getting) Sexually Transmitted Diseases. | .88 | .33 | .87 | .34 | .17 |
| 35. | Soon after infection with HIV a person develops open sores on his or her genitals (penis or vagina). | .66 | .48 | .60 | .49 | .51 |
| 36. | The cause of Genital Herpes is unknown. | .64 | .48 | .59 | .49 | .41 |
| 37. | There is a vaccine available to treat a person who has Hepatitis B. | .24 | .43 | – | – | – |
| 38. | There is a cure for Chlamydia. | .42 | .50 | .44 | .50 | .50 |
| 39. | Genital Herpes can lead to death in adults. | .36 | .48 | .41 | .49 | .37 |
| 40. | AIDS is the virus that causes HIV. | .68 | .47 | .66 | .47 | .32 |
| 41. | A woman who has Genital Herpes can pass the infection to her baby during childbirth. | .78 | .42 | .74 | .44 | .36 |

**Table 1** continued

| Item No. | Item | Pilot ($n$ = 50) | | Large-scale test ($n$ = 391) | | |
|---|---|---|---|---|---|---|
| | | *M* | *SD* | *M* | *SD* | Item–total Correlation |
| 42. | A man is more likely to get HIV if he has an orgasm (cums). | .56 | .50 | .66 | .47 | .41 |
| 43. | Hepatitis B is caused by the same virus as HIV. | .36 | .48 | .41 | .49 | .47 |
| 44. | A woman can look at her body and tell if she has Gonorrhea. | .60 | .49 | .59 | .49 | .48 |
| 45. | Using a latex condom during oral sex can protect a person from getting Genital Herpes. | .60 | .49 | .59 | .49 | .22 |
| 46. | The early symptoms of HIV can be the same as the flu. | .88 | .33 | .74 | .44 | .16 |
| 47. | The same virus causes all of the Sexually Transmitted Diseases. | .72 | .45 | .76 | .42 | .42 |
| 48. | A woman who has HIV can be cured if treated soon after she gets it. | .88 | .33 | .81 | .39 | .41 |
| 49. | The Hepatitis B vaccine can cause a person to develop Hepatitis B. | .44 | .50 | .42 | .49 | .25 |
| 50. | A woman can tell by the way her body feels if she has a Sexually Transmitted Disease. | .74 | .44 | .64 | .48 | .41 |
| 51. | Human Papillomavirus (HPV) can cause Genital Warts. | .22 | .42 | .24 | .42 | .41 |
| 52. | Using a natural skin (lambskin) condom can protect a person from getting HIV. | .50 | .51 | .50 | .50 | .33 |
| 53. | There are medications available to cure Genital Herpes. | .62 | .49 | .60 | .49 | .47 |
| 54. | Human Papillomavirus (HPV) can lead to cancer in women. | .30 | .46 | .39 | .49 | .49 |
| 55. | There is a vaccine available that can reduce the health problems caused by AIDS. | .28 | .45 | .21 | .41 | .24 |
| 56. | A man must have vaginal sex to get Genital Warts. | .56 | .50 | .62 | .49 | .41 |
| 57. | Sexually Transmitted Diseases can lead to health problems that are usually more serious for men than women. | .52 | .50 | .51 | .50 | .39 |
| 58. | A woman who has HIV can give it to another woman through oral sex. | .50 | .51 | .52 | .50 | .32 |
| 59. | The cause of Genital Warts is unknown. | .54 | .50 | .50 | .50 | .48 |
| 60. | The symptoms of Sexually Transmitted Diseases can be the same as the symptoms of other diseases. | .78 | .42 | .66 | .47 | .25 |
| 61. | Some medications are available to treat HIV. | .78 | .42 | – | – | – |
| 62. | A woman can tell that she has Chlamydia if she has a bad smelling odor from her vagina. | .30 | .46 | .22 | .41 | .40 |
| 63. | A woman can give a man Human Papillomavirus (HPV) during anal sex. | .16 | .37 | .16 | .37 | .27 |
| 64. | If a person tests positive for HIV the test can tell how sick the person will become. | .84 | .37 | .75 | .43 | .38 |
| 65. | There is a vaccine available to prevent a person from getting Gonorrhea. | .56 | .50 | .49 | .50 | .57 |
| 66. | A man who has Gonorrhea may have a discharge (pus) from his penis. | .68 | .47 | .58 | .49 | .55 |
| 67. | A person who has Genital Herpes must have open sores to give the infection to his or her sexual partner. | .42 | .50 | .46 | .50 | .46 |
| 68. | Hepatitis B affects a person's liver. | .60 | .49 | .55 | .50 | .34 |
| 69. | Taking an HIV test one week after sex tells a person if he or she has HIV. | .80 | .40 | .73 | .45 | .43 |
| 70. | The birth control patch can protect a woman from getting a Sexually Transmitted Disease. | .94 | .24 | .97 | .17 | .21 |
| 71. | There are some over-the-counter medications (available without a prescription) to treat Sexually Transmitted Diseases. | .60 | .49 | – | – | – |
| 72. | A doctor can treat Genital Warts by removing them. | .28 | .45 | – | – | – |
| 73. | Chlamydia can lead to infertility in women. | .58 | .50 | .60 | .49 | .55 |
| 74. | Untreated Sexually Transmitted Diseases can develop into other Sexually Transmitted Diseases. | .26 | .44 | .26 | .44 | .42 |
| 75. | There is a vaccine that prevents a person from getting Chlamydia. | .56 | .50 | .47 | .50 | .60 |
| 76. | Using a latex condom during anal sex can prevent a woman from getting Gonorrhea from her sexual partner. | .62 | .49 | .53 | .50 | .39 |
| 77. | A man can tell by the way his body feels if he has Hepatitis B. | .64 | .48 | .49 | .50 | .48 |
| 78. | A pap smear can tell if a woman has Genital Herpes. | .24 | .43 | .18 | .38 | .27 |
| 79. | There is a vaccine that can protect a person from getting Hepatitis B. | .34 | .48 | .40 | .49 | .25 |
| 80. | Chlamydia causes obvious symptoms in most women. | .28 | .45 | .22 | .41 | .40 |
| 81. | Using a latex condom during anal sex can prevent a man from giving Chlamydia to his sexual partner. | .52 | .50 | .58 | .49 | .42 |

**Table 1** continued

| Item No. | Item | Pilot ($n$ = 50) | | Large-scale test ($n$ = 391) | | |
|---|---|---|---|---|---|---|
| | | *M* | *SD* | *M* | *SD* | Item–total Correlation |
| 82. | If a person had Gonorrhea in the past he or she is immune (protected) from getting it again. | .74 | .44 | .70 | .46 | .45 |
| 83. | A man can protect himself from getting Genital Warts by washing his genitals after sex. | .72 | .45 | .69 | .46 | .48 |
| 84. | There are medications available to cure Human Papillomavirus (HPV). | .14 | .35 | .20 | .40 | .40 |
| 85. | There are medications that can reduce the health problems caused by Sexually Transmitted Diseases. | .76 | .43 | .77 | .42 | .27 |

*Note*. Items with dashes were removed after the pilot

## Results

### *Pilot Sample*

Item- and test-level analyses were performed on the 85-item STD-KQ to evaluate individual items and drop poorly functioning ones, and to evaluate the instrument as a whole. Participants' comments regarding the content and construction of items were investigated. Six items were confusing and interpreted differently by participants (items 12, 15, 37, 61, 71, 72). Few participants were familiar with the term 'douching.' Many participants questioned the meaning of the word 'treat' with some stating that they interpreted it as managing STD symptoms whereas other interpreted it as curing the STD. These items were deleted from the item pool. We deleted 3 additional items (items 5, 19, 25), which were too easy (i.e., answered correctly by ≥95%; see Table 1). Item means and standard deviations were examined for the surviving 76 items. Item means ranged from .14 to .94 with a mean of .55. Standard deviations ranged from .20 to .51. Scores on the 76-item STD-KQ ranged from 3 to 72. The shape of the response distribution was fairly normal ($M$ = 40.18; $SD$ = 14.55) with slight negative skew (–.11) and kurtosis (–2.29).

### *Large-scale Test*

Item-level analyses again were performed on the revised 76-item STD-KQ with the addition of item discrimination analyses. Item means ranged from .16 to .97 with a mean of .51 (see Table 1). Standard deviations ranged from .17 to .50. Item discrimination analyses revealed that 10 items had low ($<.25$) point-biserial correlations (i.e., uncorrected item–total correlations), but were retained because they may be part of a smaller, secondary factor (Floyd & Widaman, 1995). Two easy items (items 26, 70) were deleted and a third item (item 3) was deleted because participants found it confusing (i.e., few were familiar with a "dental dam"). Test-level analyses on the revised 73-item STD-KQ indicated that scores ranged from 5 to 67. The shape of the response distribution was fairly normal ($M$ = 36.95; $SD$ = 13.39) with slight negative skew (–.03) and kurtosis (–.56). Internal consistency as measured by Cronbach's $\alpha$ was .92.

*Exploratory Factor Analyses* PFA were conducted on the surviving 73 items. Because standard PFA utilizes Pearson correlations based on continuous data, this approach would underestimate the correlations and artificially reduce relationships (e.g., percentage of explained variance) using the present dichotomous and non-normal data (Satorra & Bentler, 1994). Therefore, the current analyses used a matrix of tetrachoric correlations, suited for dichotomous data (Brown & Bendetti, 1977).

Principal axis factoring (PAF) of the tetrachoric correlation matrix resulted in a non-positive definite matrix that could not be factor analyzed. Non-positive definite matrices may be semidefinite (i.e., the matrix has one or more zero eigenvalues and other, positive eigenvalues) or indefinite (i.e., the matrix has one or more negative eigenvalues), and occur more frequently in tetrachoric and non-Pearsonian correlation matrices (Worthke, 1993).

Possible causes of the non-positive matrix were investigated. Neither univariate nor multivariate outliers were detected. Singularity (i.e., a variable that is a linear combination of two or more items) was ruled out because no variables were linear combinations of other variables. Thus, it was suspected that multicollinearity (i.e., variables that are very highly [generally $r > .90$] correlated) was the source of the problem because a number of items were similarly worded. No bivariate

or multivariate correlations were so highly correlated as to indicate multicollinearity clearly, but not all multivariate correlations are directly observable and tetrachoric correlations are suspected to have a lower threshold for multicollinearity (Worthke, 1993).

A series of PAF analyses were conducted using Pearson correlations to reduce the overall item pool for the purpose of eliminating any multicollinear items. The unrotated factor matrix was factorable (Kaiser–Meyer–Olkin Measure of Sampling Adequacy = .86) and produced 23 factors that met the Kaiser–Guttman criterion, with one large factor (11.96) and the remaining factors having eigenvalues ≤2.6, which accounted for 61% of the variance (see Table 2). The scree plot (not shown) revealed a pronounced slope change at factor 2 and more subtle changes at factors 3 and 9. Thus, a series of rotated (direct oblimin) PAF analyses were conducted with 2–9 factors. Direct oblimin rotation was chosen because the factors were correlated and to facilitate later analyses (i.e., CFA). Initial communalities were squared multiple correlations for each item, which were iterated until convergence was achieved. The pattern matrices were examined for the number and magnitude of the factor loadings, the direction of the loadings (i.e., positive or negative) and the presence of crossloadings. The factor correlation matrices were also examined to verify the presence of correlated factors, which calls for oblique rotation.

The 2-factor solution was interpretable with 26 items loading ≥.40 on the designated factors (see Table 3). Approximately 18% of the variance was explained by the two factors and all the loadings were positive with four crossloadings on the first factor (items 4, 6, 47, 48) and one crossloading on the second (item 66). The first factor was labeled a General Knowledge factor that included items concerning symptoms, consequences, transmission, prevention, detection and testing and three cause (item 4, 6 and 47) and one cure item (item 48). The second factor was labeled a Cause/Cure factor that encompassed cause and cure items and a single consequences item (item 66). The solution reduced the item pool and eliminated a number of items that were closely worded. Communalities were calculated, which indicate the amount of variance in each variable accounted for by the factor solution (see Table 4). The mean communality was .46. The correlation between the factors was .49.

Maximum likelihood (ML) factor extraction was conducted on the 26-item pool using the tetrachoric correlation matrix. Again the matrix was non-positive definite, but it was resolved by removing two additional items that were closely worded (items 1, 59). The unrotated factor matrix was factorable (Kaiser–Meyer–Olkin Measure of Sampling Adequacy = .68) and

**Table 2** Eigenvalues of the Pearson correlation matrix of the large-scale test

| Factor | Initial eigenvalues | | | Extraction sum of square loadings | | |
|---|---|---|---|---|---|---|
| | Total | Percentage of variance | Cumulative percentage | Total | Percentage of variance | Cumulative percentage |
| 1 | 11.96 | 16.38 | 16.38 | 11.69 | 16.02 | 16.02 |
| 2 | 2.60 | 3.56 | 19.94 | 2.32 | 3.18 | 19.20 |
| 3 | 2.39 | 3.28 | 23.22 | 2.13 | 2.92 | 22.12 |
| 4 | 2.16 | 2.95 | 26.17 | 1.92 | 2.64 | 24.76 |
| 5 | 2.01 | 2.75 | 28.92 | 1.75 | 2.40 | 27.15 |
| 6 | 1.88 | 2.57 | 31.49 | 1.59 | 2.17 | 29.32 |
| 7 | 1.73 | 2.37 | 33.86 | 1.42 | 1.94 | 31.27 |
| 8 | 1.64 | 2.24 | 36.10 | 1.33 | 1.82 | 33.09 |
| 9 | 1.51 | 2.07 | 38.17 | 1.21 | 1.65 | 34.74 |
| 10 | 1.44 | 1.97 | 40.14 | 1.13 | 1.55 | 36.29 |
| 11 | 1.40 | 1.91 | 42.05 | 1.10 | 1.50 | 37.79 |
| 12 | 1.38 | 1.88 | 43.94 | 1.07 | 1.47 | 39.26 |
| 13 | 1.34 | 1.84 | 45.77 | 1.00 | 1.37 | 40.63 |
| 14 | 1.29 | 1.77 | 47.54 | .97 | 1.33 | 41.96 |
| 15 | 1.25 | 1.72 | 49.26 | .92 | 1.27 | 43.23 |
| 16 | 1.21 | 1.65 | 50.91 | .89 | 1.22 | 44.45 |
| 17 | 1.17 | 1.61 | 52.52 | .87 | 1.19 | 45.64 |
| 18 | 1.11 | 1.52 | 54.04 | .82 | 1.12 | 46.75 |
| 19 | 1.09 | 1.49 | 55.54 | .79 | 1.09 | 47.84 |
| 20 | 1.09 | 1.49 | 57.03 | .77 | 1.06 | 48.90 |
| 21 | 1.06 | 1.46 | 58.48 | .73 | 1.00 | 49.89 |
| 22 | 1.03 | 1.41 | 59.89 | .71 | 1.00 | 50.86 |
| 23 | 1.00 | 1.37 | 61.26 | .68 | .93 | 51.79 |

*Note*. Only factors with eigenvalues ≥1.00 are displayed

**Table 3** Pattern matrix of Pearson correlations of the large-scale test

| Item No. | Item | Factor 1 | Factor 2 |
|---|---|---|---|
| 50. | A woman can tell by the way her body feels if she has a Sexually Transmitted Disease. | .641 | |
| 35. | Soon after infection with HIV a person develops open sores on his or her genitals (penis or vagina). | .625 | |
| 44. | A woman can look at her body and tell if she has Gonorrhea. | .529 | |
| 64. | If a person tests positive for HIV the test can tell how sick the person will become. | .528 | |
| 77. | A man can tell by the way his body feels if he has Hepatitis B. | .527 | |
| 75. | There is a vaccine that prevents a person from getting Chlamydia. | .504 | |
| 83. | A man can protect himself from getting Genital Warts by washing his genitals after sex. | .487 | |
| 65. | There is a vaccine available to prevent a person from getting Gonorrhea. | .482 | |
| 47. | The same virus causes all of the Sexually Transmitted Diseases. | .451 | |
| 57. | Sexually Transmitted Diseases can lead to health problems that are usually more serious for men than women. | .451 | |
| 6. | Frequent urinary infections can cause Chlamydia. | .441 | |
| 4. | Genital Herpes is caused by the same virus as HIV. | .423 | |
| 82. | If a person had Gonorrhea in the past he or she is immune (protected) from getting it again. | .410 | |
| 56. | A man must have vaginal sex to get Genital Warts. | .406 | |
| 62. | A woman can tell that she has Chlamydia if she has a bad smelling odor from her vagina. | .404 | |
| 48. | A woman who has HIV can be cured if treated soon after she gets it. | .400 | |
| 38. | There is a cure for Chlamydia. | | .567 |
| 51. | Human Papillomavirus (HPV) can cause Genital Warts. | | .542 |
| 28. | Human Papillomavirus (HPV) is caused by the same virus that causes HIV. | | .511 |
| 54. | Human Papillomavirus (HPV) can lead to cancer in women. | | .509 |
| 31. | Human Papillomavirus (HPV) can cause HIV. | | .488 |
| 59. | The cause of Genital Warts is unknown. | | .441 |
| 9. | There is a cure for Gonorrhea. | | .440 |
| 36. | The cause of Genital Herpes is unknown. | | .421 |
| 1. | The cause of Chlamydia is unknown. | | .420 |
| 66. | A man who has Gonorrhea may have a discharge (pus) from his penis. | | .408 |

*Note*. Only items with loadings ≥.40 are displayed

**Table 4** Communalities based on Pearson correlations of the large-scale test

| Item No. | Item | Factor 1 | Factor 2 |
|---|---|---|---|
| 50. | A woman can tell by the way her body feels if she has a Sexually Transmitted Disease. | .451 | |
| 35. | Soon after infection with HIV a person develops open sores on his or her genitals (penis or vagina). | .445 | |
| 44. | A woman can look at her body and tell if she has Gonorrhea. | .456 | |
| 64. | If a person tests positive for HIV the test can tell how sick the person will become. | .308 | |
| 77. | A man can tell by the way his body feels if he has Hepatitis B. | .450 | |
| 75. | There is a vaccine that prevents a person from getting Chlamydia. | .595 | |
| 83. | A man can protect himself from getting Genital Warts by washing his genitals after sex. | .385 | |
| 65. | There is a vaccine available to prevent a person from getting Gonorrhea. | .568 | |
| 47. | The same virus causes all of the Sexually Transmitted Diseases. | .368 | |
| 57. | Sexually Transmitted Diseases can lead to health problems that are usually more serious for men than women. | .327 | |
| 6. | Frequent urinary infections can cause Chlamydia. | .458 | |
| 4. | Genital Herpes is caused by the same virus as HIV. | .468 | |
| 82. | If a person had Gonorrhea in the past he or she is immune (protected) from getting it again. | .397 | |
| 56. | A man must have vaginal sex to get Genital Warts. | .378 | |
| 62. | A woman can tell that she has Chlamydia if she has a bad smelling odor from her vagina. | .337 | |
| 48. | A woman who has HIV can be cured if treated soon after she gets it. | .340 | |
| 38. | There is a cure for Chlamydia. | | .567 |
| 51. | Human Papillomavirus (HPV) can cause Genital Warts. | | .452 |
| 28. | Human Papillomavirus (HPV) is caused by the same virus that causes HIV. | | .608 |
| 54. | Human Papillomavirus (HPV) can lead to cancer in women. | | .483 |
| 31. | Human Papillomavirus (HPV) can cause HIV. | | .624 |
| 59. | The cause of Genital Warts is unknown. | | .548 |
| 9. | There is a cure for Gonorrhea. | | .421 |
| 36. | The cause of Genital Herpes is unknown. | | .540 |
| 1. | The cause of Chlamydia is unknown. | | .459 |
| 66. | A man who has Gonorrhea may have a discharge (pus) from his penis. | | .484 |

**Table 5** Eigenvalues of the tetrachoric correlation matrix of the large-scale test

| Factor | Initial eigenvalues | | | Extraction sum of square loadings | | |
|---|---|---|---|---|---|---|
| | Total | Percentage of variance | Cumulative percentage | Total | Percentage of variance | Cumulative percentage |
| 1 | 9.30 | 38.73 | 38.73 | 5.74 | 23.93 | 23.93 |
| 2 | 2.35 | 9.80 | 48.51 | 3.91 | 16.29 | 40.22 |
| 3 | 1.72 | 7.18 | 55.69 | 2.08 | 8.67 | 48.89 |
| 4 | 1.38 | 5.74 | 61.43 | 1.30 | 5.43 | 54.31 |
| 5 | 1.08 | 4.51 | 65.93 | .95 | 3.98 | 58.29 |

*Note*. Only factors with eigenvalues ≥1.00 are displayed

produced five factors with eigenvalues than met the Kaiser–Guttman criterion with one large factor (9.30) and the remaining factors with eigenvalues 2.35 and below, which accounted for 66% of the variance (see Table 5). The scree plot (not shown) revealed slope changes at factors 2 and 5. Thus, a series of ML analyses with direct oblimin rotation (i.e., oblique) were conducted with 2–5 factors. The pattern matrices were examined for the number and magnitude of the factor loadings, the direction of the loadings, and the presence of crossloadings. The factor correlation matrices were also examined to verify the presence of correlated factors.

The 2-factor solution with a minimum of .40 factor loadings on the designated factors fit the data (see Table 6). Approximately 44% of the variance was explained by the two factors and all the loadings were positive and without crossloadings. The first factor was labeled a *Cause/Cure* factor. The second factor was labeled a *General Knowledge* factor that included items concerning symptoms, consequences, transmission, prevention and detection and testing. The solution reduced the item pool to 21 items. The mean squared multiple correlation was .74, indicating that the factors were well-defined by the variables. The correlation between the factors was .58 (see Table 7).

*Confirmatory factor analyses* were performed in EQS (Bentler, 2005) on the 21-item questionnaire. The hypothesized model is presented in Fig. 1. Squares represent latent variables whereas rectangles represent measured variables. A 2-factor model of STD knowledge, a Cause/Cure factor and a General Knowledge factor, was hypothesized. Variables 1–9 (items 4, 6, 9, 28, 31, 38, 47, 51, 54) serve as indicators of the Cause/Cure factor and variables 10–21 (items 82, 44, 65, 75, 62, 77, 64, 50, 35, 83, 56, 57) serve as indictors of the General Knowledge factor. The two factors were hypothesized to covary with each other.

**Table 6** Pattern matrix of tetrachoric correlations of the large-scale test

| Item No. | Item | Factor 1 | Factor 2 |
|---|---|---|---|
| 28. | Human Papillomavirus (HPV) is caused by the same virus that causes HIV. | .990 | |
| 31. | Human Papillomavirus (HPV) can cause HIV. | .973 | |
| 51. | Human Papillomavirus (HPV) can cause Genital Warts. | .771 | |
| 54. | Human Papillomavirus (HPV) can lead to cancer in women. | .639 | |
| 4. | Genital Herpes is caused by the same virus as HIV. | .479 | |
| 38. | There is a cure for Chlamydia. | .472 | |
| 47. | The same virus causes all of the Sexually Transmitted Diseases. | .448 | |
| 9. | There is a cure for Gonorrhea. | .421 | |
| 6. | Frequent urinary infections can cause Chlamydia. | .409 | |
| 82. | If a person had Gonorrhea in the past he or she is immune (protected) from getting it again. | | .745 |
| 44. | A woman can look at her body and tell if she has Gonorrhea. | | .718 |
| 65. | There is a vaccine available to prevent a person from getting Gonorrhea. | | .715 |
| 75. | There is a vaccine that prevents a person from getting Chlamydia. | | .708 |
| 62. | A woman can tell that she has Chlamydia if she has a bad smelling odor from her vagina. | | .697 |
| 77. | A man can tell by the way his body feels if he has Hepatitis B. | | .654 |
| 64. | If a person tests positive for HIV the test can tell how sick the person will become. | | .650 |
| 50. | A woman can tell by the way her body feels if she has a Sexually Transmitted Disease. | | .627 |
| 35. | Soon after infection with HIV a person develops open sores on his or her genitals (penis or vagina). | | .606 |
| 83. | A man can protect himself from getting Genital Warts by washing his genitals after sex. | | .523 |
| 56. | A man must have vaginal sex to get Genital Warts. | | .498 |
| 57. | Sexually Transmitted Diseases can lead to health problems that are usually more serious for men than women. | | .454 |

*Note*. Only items with loadings ≥.40 are displayed

**Table 7** Communalities based on tetrachoric correlations of the large-scale test

| Item No. | Item | Factor 1 | Factor 2 |
|---|---|---|---|
| 28. | Human Papillomavirus (HPV) is caused by the same virus that causes HIV. | .950 | |
| 31. | Human Papillomavirus (HPV) can cause HIV. | .947 | |
| 51. | Human Papillomavirus (HPV) can cause Genital Warts. | .743 | |
| 54. | Human Papillomavirus (HPV) can lead to cancer in women. | .760 | |
| 4. | Genital Herpes is caused by the same virus as HIV. | .774 | |
| 38. | There is a cure for Chlamydia. | .676 | |
| 47. | The same virus causes all of the Sexually Transmitted Diseases. | .729 | |
| 9. | There is a cure for Gonorrhea. | .702 | |
| 6. | Frequent urinary infections can cause Chlamydia. | .876 | |
| 82. | If a person had Gonorrhea in the past he or she is immune (protected) from getting it again. | | .810 |
| 44. | A woman can look at her body and tell if she has Gonorrhea. | | .840 |
| 65. | There is a vaccine available to prevent a person from getting Gonorrhea. | | .876 |
| 75. | There is a vaccine that prevents a person from getting Chlamydia. | | .872 |
| 62. | A woman can tell that she has Chlamydia if she has a bad smelling odor from her vagina. | | .642 |
| 77. | A man can tell by the way his body feels if he has Hepatitis B. | | .752 |
| 64. | If a person tests positive for HIV the test can tell how sick the person will become. | | .603 |
| 50. | A woman can tell by the way her body feels if she has a Sexually Transmitted Disease. | | .767 |
| 35. | Soon after infection with HIV a person develops open sores on his or her genitals (penis or vagina). | | .755 |
| 83. | A man can protect himself from getting Genital Warts by washing his genitals after sex. | | .675 |
| 56. | A man must have vaginal sex to get Genital Warts. | | .453 |

Robust ML estimation, which adjusts the standard errors and provides the Satorra–Bentler scaled chi-square, was used on the non-normal (categorical) data (i.e., polychoric correlations in EQS) (Olsson, 1979) to estimate the model (Bentler, 2005; Satorra & Bentler, 1990). CFA, based on Pearson correlations, was not used because the underlying normality and scaling assumptions cannot be met with the present data (West, Finch, & Curran, 1995). The independence model, which tests the hypothesis that all of the variables are uncorrelated, was rejected, $\chi^2(210, N = 391) = 6348.02$, $p < .01$. The hypothesized model was then tested using the Satorra–Bentler scaled chi-square test statistic, $\chi^2(188, N = 391) = 525.46$, $p < .01$, and the *comparative* fit index (CFI), CFI = .86, which provided marginal support for the model. Figure 2 shows the hypothesized model with significant, standardized coefficients.

Post hoc model modifications were conducted to improve model fit. The Lagrange multiplier test (LM test) was performed to detect additional paths that could improve the model's fit (cf. MacCallum, 1986). Because Type I error rates increase with the addition of parameters, a conservative probability value ($p < .01$) was set for adding paths. Informed by results of the LM test and conceptual relevance, three paths were added between E3 and E4, E6 and E8, and E12 and E13. The resultant, final model had adequate fit, $\chi^2(185, N = 391) = 390.73$, $p < .01$, CFI = .91. Because post hoc model modifications were conducted, a correlation was calculated between the hypothesized model parameter estimates and the parameter estimates for the final model, $r = .95$, $p < .01$. Figure 3 shows the final model with significant, standardized coefficients.

*Final Review and Reliability* Following modification of the questionnaire, the content and internal consistency of the questionnaire was evaluated. Although all of the fundamental STD knowledge types were present, six items, which had previously been deleted, were included in the final questionnaire (items 14, 33, 41, 52, 67, 79) because they contain important public health information. Four items concern transmission and 2 items concern prevention. The final STD-KQ contains 27 items (see Table 8). The balance of 19 incorrect and 8 correct items, and internal consistency as measured by Cronbach's $\alpha = .86$, were both acceptable.

## Study 4: Test–retest Reliability and Sensitivity to Change

In Study 4, two groups participated to provide evidence of the sensitivity of the STD-KQ to an STD educational program. The wait-list control group (Group B) also served as the test–retest sample and secondary intervention group to measure within-group change.

### Method

Participants ($n = 80$) were mostly female (85%) with a mean age of 26 (range = 18–74). Thirty-one percent

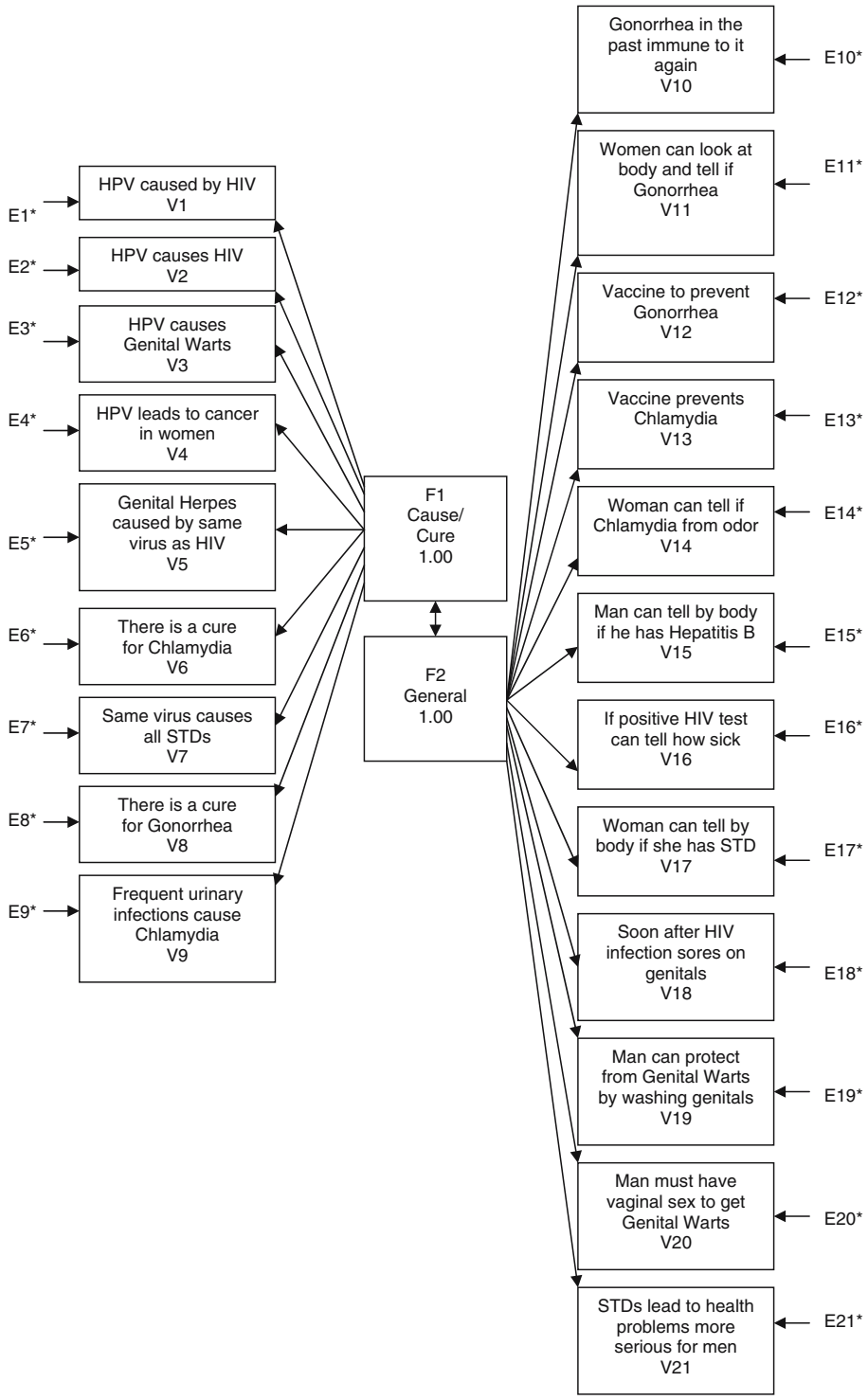


**Fig. 1** Hypothesized CFA model

of participants reported their ethnicity as Hispanic. Participants described themselves as African-American (13%), White (44%), Asian/Pacific Islander (5%), American Indian or Alaska Native (1%), Mixed/Multiracial (8%) or Other (30%). Most participants were exclusively or predominately heterosexual (98%).

Participants were randomly assigned to one of two conditions. Those who had been assigned to Group A first watched a 30-min educational videotape that was based on a previously evaluated STD-risk reduction program (Jaworski & Carey, 2001). This program was broadened to include information relevant to both male and female college students

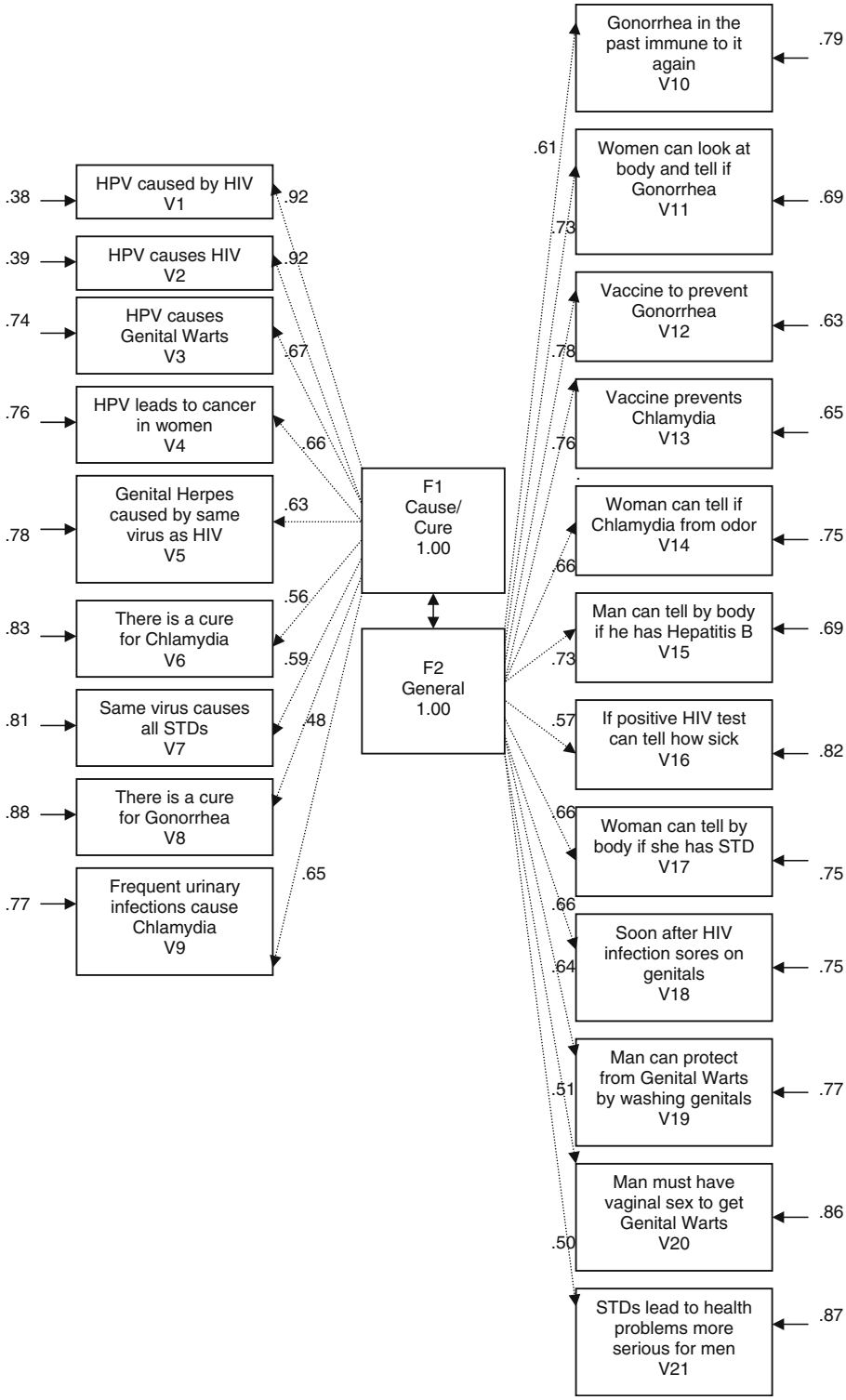


**Fig. 2** Hypothesized CFA model with standardized coefficients

and updated to reflect the current state of the science. The program was presented with a videorecording to ensure treatment integrity. Immediately following the videotape viewing, Group A participants completed the post-test survey that included the STD-KQ. When participants in Group B (waitlist control group) returned to the lab, they first completed the first post-test survey, and then viewed the 30-min educational videotape. They then completed a second post-test survey.

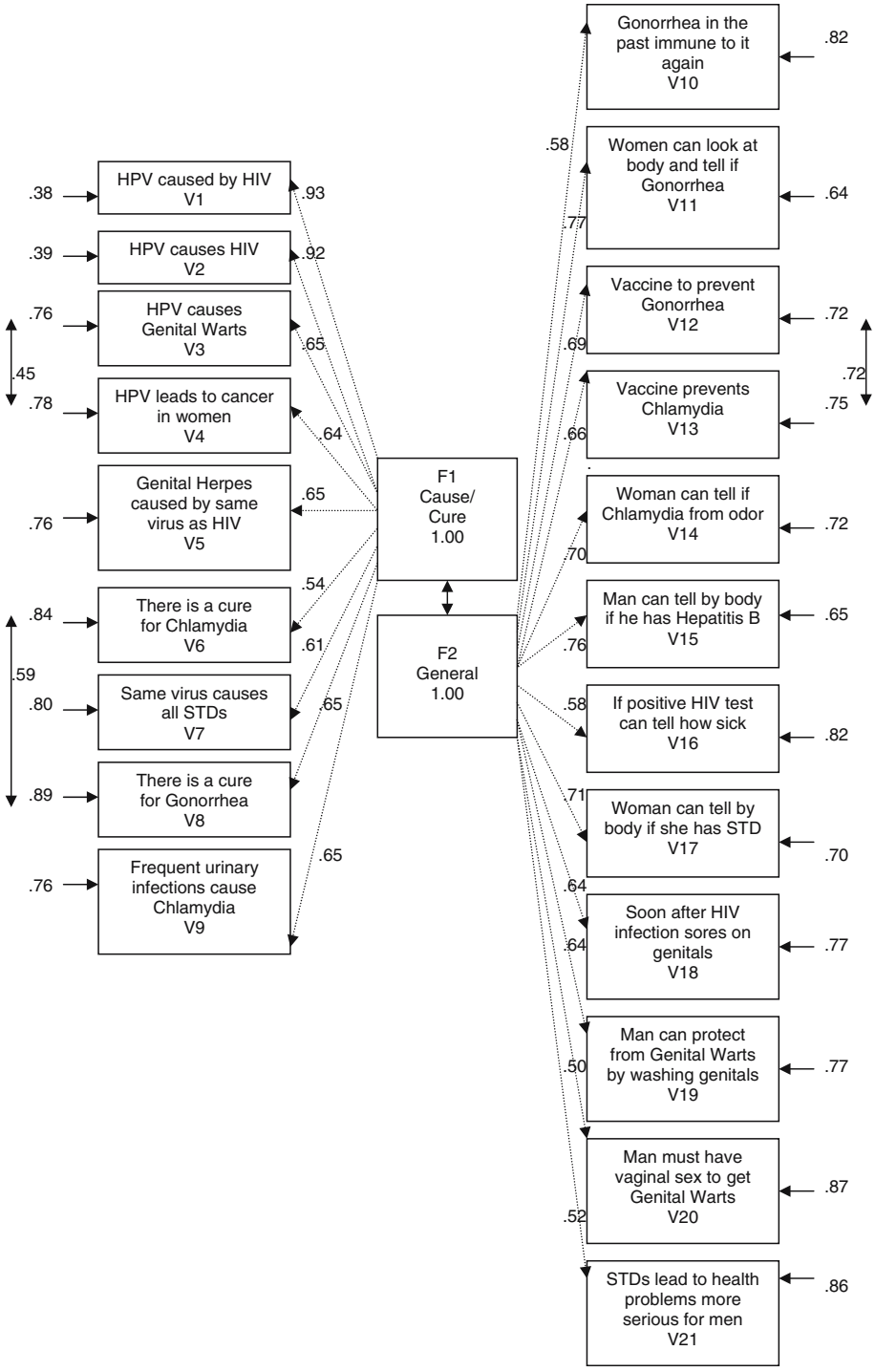


**Fig. 3** Final CFA model with standardized coefficients

## Results

Test–retest reliability of the 27-item STD-KQ was determined by calculating the Pearson product-moment correlation coefficient. The pre-intervention score ($n$ = 40) of the wait-list control group (Group B) was compared to the first post-test ($n$ = 40) two weeks later. Test–retest reliability was $r$ = .88, $p < .01$.

A series of analyses were performed to assess the sensitivity of the 27-item STD-KQ to the educational program. An ANOVA confirmed the equivalency of the groups on the STD-KQ at pre-intervention, $F(1, 78) = 2.75$, *ns*. A one-way ANCOVA, using the pre-intervention score as the covariate, showed a main effect for group, $F(1, 78) = 155.67$, $p < .01$. Group A scored higher ($M$ = 23.10) than Group B ($M$ = 15.20).

**Table 8** The Sexually Transmitted Disease Knowledge Questionnaire (STD-KQ). For each statement below, please circle true (T), false (F), or I don't know (DK). If you don't know, please do not guess; instead, please circle DK

| | True | False | Don't Know |
|---|---|---|---|
| 1. Genital Herpes is caused by the same virus as HIV. | T | F | DK |
| 2. Frequent urinary infections can cause Chlamydia. | T | F | DK |
| 3. There is a cure for Gonorrhea. | T | F | DK |
| 4. It is easier to get HIV if a person has another Sexually Transmitted Disease. | T | F | DK |
| 5. Human Papillomavirus (HPV) is caused by the same virus that causes HIV. | T | F | DK |
| 6. Having anal sex increases a person's risk of getting Hepatitis B. | T | F | DK |
| 7. Soon after infection with HIV a person develops open sores on his or her genitals (penis or vagina). | T | F | DK |
| 8. There is a cure for Chlamydia. | T | F | DK |
| 9. A woman who has Genital Herpes can pass the infection to her baby during childbirth. | T | F | DK |
| 10. A woman can look at her body and tell if she has Gonorrhea. | T | F | DK |
| 11. The same virus causes all of the Sexually Transmitted Diseases. | T | F | DK |
| 12. Human Papillomavirus (HPV) can cause Genital Warts. | T | F | DK |
| 13. Using a natural skin (lambskin) condom can protect a person from getting HIV. | T | F | DK |
| 14. Human Papillomavirus (HPV) can lead to cancer in women. | T | F | DK |
| 15. A man must have vaginal sex to get Genital Warts. | T | F | DK |
| 16. Sexually Transmitted Diseases can lead to health problems that are usually more serious for men than women. | T | F | DK |
| 17. A woman can tell that she has Chlamydia if she has a bad smelling odor from her vagina. | T | F | DK |
| 18. If a person tests positive for HIV the test can tell how sick the person will become. | T | F | DK |
| 19. There is a vaccine available to prevent a person from getting Gonorrhea. | T | F | DK |
| 20. A woman can tell by the way her body feels if she has a Sexually Transmitted Disease. | T | F | DK |
| 21. A person who has Genital Herpes must have open sores to give the infection to his or her sexual partner. | T | F | DK |
| 22. There is a vaccine that prevents a person from getting Chlamydia. | T | F | DK |
| 23. A man can tell by the way his body feels if he has Hepatitis B. | T | F | DK |
| 24. If a person had Gonorrhea in the past he or she is immune (protected) from getting it again. | T | F | DK |
| 25. Human Papillomavirus (HPV) can cause HIV. | T | F | DK |
| 26. A man can protect himself from getting Genital Warts by washing his genitals after sex. | T | F | DK |
| 27. There is a vaccine that can protect a person from getting Hepatitis B. | T | F | DK |

To score, award one point for each correct answer. ''True'' is the correct answer to items 3, 4, 6, 8, 9, 12, and 14. ''False'' is the correct answer to items 1, 2, 5, 7, 10, 11, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, and 26. Incorrect and ''Don't Know'' responses are scored 0

To evaluate the effect of the intervention within Group B, one-tailed t-tests compared the change scores between (a) the pre-intervention and second post-test, and (b) the first post-test and second post-test assessments. Group B participants scored significantly higher on the second post-test ($M = 23.30$) compared to the pre-intervention ($M = 14.62$), $t(39) = 11.39$, $p < .01$. They also scored significantly higher on the second post-test ($M = 23.30$) compared to the first post-test ($M = 15.20$), $t(39) = 12.62$, $p < .01$.

## Study 5: Convergent Evidence for the Validity of the STD-KQ

The purpose of Study 5 was to obtain evidence of the convergent validity of the STD-KQ through a correlational analysis with an established measure of HIV knowledge. A moderate relationship between the two instruments was expected.

### Method

The participants were 208 undergraduates (79% female; age range: 19 to 68, M = 27), 35% of whom reported their ethnicity as Hispanic. They described themselves as African-American (14%), White (41%), Asian/Pacific Islander (7%), American Indian or Alaska Native (1%), Mixed/Multiracial (11%) or Other (26%). The vast majority (98%) described themselves as heterosexual and 2% as homosexual; 26% reported no sexual partners in the last 6 months, 58% reported one partner, and 16% reported two or more partners.

Interested students attended group survey sessions where they received a detailed explanation of the study and provided written informed consent. In addition to the demographic survey and the STD-KQ, this study also used the HIV Knowledge Questionnaire (HIV-KQ-18; Carey & Schroder, 2002), an 18-item inventory that assesses knowledge of HIV transmission, risk

reduction, consequences of infection, and testing. The HIV-KQ-18 is internally consistent, stable, and highly correlated with the 45-item version (Carey, Morrison-Beedy, & Johnson, 1997); treatment outcome sensitivity of the latter is well-established (Carey, Maisto et al., 1997; Carey et al., 2000, 2004).

Results

The convergent validity of the STD-KQ was assessed though a correlational analysis with the HIV-KQ-18. Participants' scores on the instruments correlated using the Pearson product-moment correlation coefficient, $r = .64$, $p < .01$.

## Discussion

This study developed and evaluated a STD knowledge questionnaire that measures young adults' knowledge of six STDs (i.e., chlamydia, genital herpes, gonorrhea, hepatitis B, HIV and HPV) that pose the greatest health threat to the population (CDC, 2003; Miller et al., 2004). A systematic approach to item development was employed, including identification of test objectives, generation of item content based on prior research, and qualitative inquiry. These processes resulted in 93 items that were reviewed by STD experts who assured their accuracy and evaluated their congruence with the test objectives. Item-objective congruence was 100%. From these processes, the item pool was reduced to 85 items.

Initial analyses of these 85 items with a pilot sample identified confusing or easy items, which were deleted. Test-level analyses of the remaining 73 items included measurement of central tendency and variability of the questionnaire and evaluation of its internal consistency. The questionnaire had a good range of responses with sufficient variability that demonstrated the questionnaire's sensitivity to differences in individuals' levels of STD knowledge. Overall, STD knowledge was relatively low with half of participants scoring 50% or below. The questionnaire had excellent internal consistency ($\alpha = .92$).

Exploratory factor analyses using Pearson correlations were used and resulted in a substantial reduction in the number of items. A 2-factor solution from a series of PAF analyses with direct oblimin rotation produced the best solution. Factor 1, ''General Knowledge,'' and Factor 2, ''Cause/Cure'' accounted for 18% of the variance. Twenty-six out of the 73 items were retained in the solution. The factors were moderately correlated.

EFA of the tetrachoric correlation matrix was conducted on the surviving 26 items. ML factor extraction with direct oblimin rotation produced a 2-factor solution that represented the best fit and most parsimonious explanation of the data. The two factors labeled in the previous solution were replicated. The Cause/Cure factor contained items concerning the causes of the different STDs and whether the STDs could be cured whereas the General Knowledge factor contained items concerning symptoms, consequences, transmission, prevention and detection and testing. As expected, factoring the tetrachoric correlations resulted in a substantial increase in percentage of explained variance (44%). Twenty-one out of the 26 items were retained in the solution. The factors were internally consistent (i.e., Factor 1 $\alpha = .89$ and Factor 2 $\alpha = .82$), well defined by the items and moderately correlated, which suggested that the factors represented related, yet distinct aspects of STD knowledge.

Confirmatory factor analyses further tested the two-factor model of STD knowledge. The final CFA model supported the two-factor model of STD knowledge. The high correlation between the parameter estimates of the hypothesized model and the final model indicated that the relationships within the model remain (Ullman, 2001). A final review evaluated the public health value and content coverage. Six items that had performed well in the item analyses but had been eliminated during the factor analyses were returned to the questionnaire to provide broader coverage of the content area and strengthen the questionnaire's utility. Kelly, Lawrence, Hood, and Brasfield (1989) had also retained previously dropped items with the same rationale.

Results of the internal consistency and test–retest provided strong support for the reliability of the final 27-item STD-KQ. The STD-KQ has excellent internal consistency ($r = .86$), which compares favorably to other HIV-specific, single STD and multiple STD questionnaires (e.g., Brown, 2000; Carey, Morrison-Beedy et al., 1997; Jaworski & Carey, 2001). The STD-KQ was also stable over a brief (2-week) retest period ($r = .88$). Over similar intervals, the STD-KQ compares favorably to other questionnaires (e.g., Carey, Morrison-Beedy et al., 1997; Kelly et al., 1989). Preliminary evidence of the STD-KQ's temporal stability suggests that it can be used in risk reduction programs that employ a pre-test–post-test design.

Participants' responses on the STD-KQ following a brief video-based educational program provided preliminary evidence of the questionnaire's ability to detect change. Participants in both the primary group and secondary intervention groups demonstrated improvements in STD knowledge without a restricted

range. The overall level of improvement in STD knowledge was similar to a previous study (Jaworski & Carey, 2001).

Evidence for the construct validity of the STD-KQ was obtained from several sources. Item development followed an explicit plan that encompassed input from research, STD experts, and the target population. Items were developed with attention to content and technical quality. To reduce respondent burden and increase the internal validity of the questionnaire, a true/false/don't know response format was used. Factor analyses established and validated the questionnaire's two-factor structure. Both the internal consistency and test–retest reliability of the final 27-item STD-KQ were excellent. Finally, the STD-KQ demonstrated treatment outcome sensitivity in response to a brief educational program.

Following one of Campbell and Fiske's (1959) recommendations for evaluating of the validity of a new questionnaire, the STD-KQ was compared to a previously validated measure. Because no other validated STD knowledge questionnaire was available, an HIV-specific knowledge questionnaire (Carey & Schroder, 2002) was used. The moderate correlation between the STD-KQ and HIV-KQ supports the validity of the STD-KQ, even acknowledging that shared method variance may account for some of the covariation (DeVellis, 2003).

There are four limitations that should be addressed in future research. First, the test–retest interval was relatively brief; research should test the stability of the STD-KQ over a longer interval. Second, we used a videotaped intervention to evaluate the sensitivity of the STD-KQ. Research to test the sensitivity of the STD-KQ in other contexts (e.g., counseling) is encouraged. Third, we did not obtain evidence of discriminant validity. Campbell and Fiske (1959) called for both convergent and discriminant evidence of new questionnaires. Research might compare results on the STD-KQ with other constructs and other methods. Finally, the STD-KQ should be evaluated with a larger sample of males and in settings where it may prove most useful.

In summary, through a series of studies, we developed and evaluated an up-to-date, comprehensive STD knowledge questionnaire. The STD-KQ is a brief, internally consistent, and stable measure that is sensitive to an educational intervention and moderately correlated with an established measure of HIV-related knowledge. Although continued evaluation of its generalizability is warranted, the STD-KQ can be used to identify knowledge deficits, evaluate risk reduction programs, assess treatment response in research and applied settings, and serve as a measure of knowledge in basic research. Collectively, these activities can help to advance the goal of increasing STD knowledge and reducing sexual risk behavior among college students.

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