Practice of Epidemiology

Palmtop-assisted Self-Interviewing for the Collection of Sensitive Behavioral Data: Randomized Trial with Drug Use Urine Testing

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Palmtop-assisted self-interviewing (PASI) may provide a cheaper and more mobile alternative to audio-computer–assisted self-interviewing (ACASI) for collecting sensitive behavioral data. To evaluate PASI, in late 2002 the authors enrolled 1,283 Thai students aged 15–21 years in a randomized trial. Data collection used PASI, ACASI, self-administered questionnaire, and face-to-face interview in combination with drug-use urine testing. By use of reported levels of behaviors and agreement between self-reports of smoking and urine test results, PASI and ACASI (alpha = 0.05) were compared for noninferiority, and PASI and interview were compared for superiority (alpha = 0.05). Noninferiority of PASI was demonstrated by use of self-reports of the most sensitive areas of sexual behavior (e.g., oral sex, sexual intercourse, commercial sex, history of genital ulcers, pregnancy), as well as self-reports of less sensitive behaviors (e.g., alcohol use, dietary behaviors, symptoms of depression). Data generally showed noninferiority of PASI, ACASI, and self-administered questionnaires when compared with each other and superiority of PASI, ACASI, and self-administered questionnaires when compared with interviews. PASI agreements between self-reports of tobacco smoking and presence of nicotine metabolites in urine were noninferior to ACASI and superior to interviews. The establishment of PASI noninferiority and superiority using behavioral and biologic measures suggests that PASI is a scientifically acceptable alternative for collecting sensitive behavioral data.

adolescent; computers, handheld; data collection; HIV; sexual behavior; substance abuse detection; substance-related disorders; Thailand

Abbreviations: ACASI, audio-computer–assisted self-interviewing; HIV, human immunodeficiency virus; PASI, palmtop-assisted self-interviewing.

Comprehensive assessment of human immunodeficiency virus (HIV) risk behaviors, such as sexual and drug-use histories, is vital to planning and evaluating HIV prevention programs. However, collection of these data continues to rely heavily on self-report through methods such as face-to-face interviews and self-administered questionnaires, particularly in field settings. Self-reported data on socially and legally proscribed behaviors suffer a number of chal-lenges in terms of their validity and reliability (1, 2). During an interview, respondents may feel uncomfortable providing truthful information regarding sensitive or stigmatized behaviors, and interviewer behavior may affect responses. For example, adolescents often are reticent about disclosing sexual or drug-use behavior to adult interviewers (3). Concerns about privacy and possible negative reactions from the interviewer may prompt respondents to withhold or distort

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information that they feel might meet with disapproval. Variation for the same interviewer or among multiple interviewers may further affect the reliability of data. In addition, interviews may be affected by social expectations and cultural norms, particularly when these differ for subpopulations or for different contexts. For example, disclosure of drug use may be affected by the severity of drug penalties or by the social acceptability of drug use in certain age groups, genders, or subcultures. When self-reports of drug use have been compared with laboratory analysis of hair and urine, findings have indicated underreporting of up to 80 percent (4, 5). Self-reports of sexual experience by men may be different from those by women, depending on different social norms about the preservation of virginity. In Thailand, for instance, young men are expected to be sexually experienced, whereas young women are not (6). Consequently, sexual behavior is often overreported by men and underreported by women, especially when face-to-face interviews are used (6).

Recently, a variety of computer-based interview technologies have become available, notably audio-computer–assisted self-interviewing (ACASI). Using this method, respondents hear questions through an earphone and can read them simultaneously on a computer screen, on which they are asked to click or type in their answers. A growing body of literature has provided evidence that ACASI yields more complete and accurate reporting of health risk behaviors than other methods do and that it is feasible in a variety of research designs and population groups (3, 7–9). ACASI has several advantages over interviews and questionnaires. It provides greater privacy for respondents than interviews do, and it permits the use of complicated skip patterns, which are particularly impractical in questionnaires and to some extent in interviews. Preprogrammed skip patterns in ACASI augment data consistency and decrease the amount of missing data. ACASI also allows the investigators to closely monitor the quality of data they collect on an ongoing basis and facilitates immediate data processing and analysis. It eliminates the need for laborious and expensive coding and data entry or transcription of data from paper to electronic database. Drawbacks of ACASI include the investigator-driven nature of the research (leaving no room for respondents to deviate from or elaborate on responses), the need for computer-literate respondents, expensive computer infrastructure (hardware and software), and problems in moving computer equipment from setting to setting. The use of laptop computers may mitigate some inconveniences; however, laptops are relatively expensive and cumbersome for remote field studies, especially with large samples. ACASI probably is most useful for repeated assessments in fixed settings (e.g., hospitals) but less so for collecting data in changing locations or in remote field sites.

The use of a hand-held minicomputer or palmtop may help to overcome some of these disadvantages while retaining the strengths of computer-assisted interviewing. Palmtop technology is hand held, requires less computer literacy (i.e., simplified keyboard or use of a stylus to key in responses), has greater flexibility and mobility, and is relatively inexpensive. It is increasingly used in field investigations and in medical settings (10, 11). However, it is unknown to what extent palmtop-assisted self-interviewing (PASI) is feasible for use in populations at risk for HIV infection and whether the degree of accuracy and completeness of data is the same as with ACASI or other data collections measures, such as self-administered questionnaires and interviews. The small size of PASI equipment and limited display may place constraints on questions that can be asked and the convenience (and accuracy) of responses. In general, few studies have evaluated PASI technology for research data collection; those that have mostly evaluated it as an alternative for self-administered questionnaires using pen and paper (12–14).

To date, no studies have compared PASI with ACASI or with interviews. In this study, we compared the accuracy and completeness of data collected by PASI with those collected by ACASI, self-administered questionnaires, and interviews. Urine testing for drug use was used to validate self-reports.

MATERIALS AND METHODS

Study population

A total of 1,283 male and female students, aged 15–21 years, attending two vocational schools in Chiang Rai, Thailand, were enrolled (83.4 percent of 1,531 eligible students). Students were given an explanation of the study in classroom-based sessions and were asked for informed consent. Once enrolled, all consenting participants completed their survey instrument and provided a urine sample. The study protocol was approved by the Scientific Research in Human Subjects Committee of the Thailand Ministry of Public Health and by an institutional review board of the US Centers for Disease Control and Prevention.

Research design and data collection methods

The research design was a quasi-experimental, randomized, cross-sectional study in which students completed one of four survey instruments. Randomization occurred at the level of individual students, who were randomly assigned to PASI, ACASI, self-administered questionnaire, or interview as the method for completing the survey. Once assigned, they were escorted to a designated area of the school where their particular method was administered. Questions asked about demographics, sexual and drug-use behaviors, dietary habits, depressive symptoms, and suicidal ideation. The content drew from other survey items that had been used in this population (15); the mix of items was chosen to help assess the different data collection methods in relation to sensitive behaviors (e.g., sexual behavior, sexual health, drug use, suicidal ideation), as well as less sensitive behaviors (e.g., smoking and dietary practices). Because previous research suggests that people are more likely to disclose sensitive behaviors in more remote periods of time (16), questions were repeated for different time periods (e.g., the past week, the past 3 months, the past year, and ever).

All interviews were conducted in the central Thai language. Interviews took about 45 minutes to complete, and PASI, ACASI, and self-administered questionnaires each

took about 30 minutes. In addition, PASI and ACASI required another 10 minutes for explaining the use of the equipment (i.e., stylus and screen, keyboard, mouse, and screen). Interviews were conducted by trained interviewers aged 21–25 years, who were matched to the gender of the interviewee. Self-administered questionnaires were answered by use of pen and paper. PASI and ACASI responses were downloaded to one computer after each administration, while questionnaires and interviews were coded and then double entered into a computer by use of a standard database program. Urine specimens were collected from participants immediately after they completed their survey instrument.

Sample size and statistical methods

The sample size was determined by use of Power and Precision software (Biostat, Englewood, New Jersey). We evaluated sample size in terms of detection of differences in levels of self-reported sensitive behaviors among the different methods. We tested for noninferiority when we expected a method not to yield lower levels of reported behaviors (e.g., PASI vs. ACASI) and for superiority when we expected a method to yield higher levels of reported behaviors (e.g., PASI vs. interviews). To evaluate noninferiority with an effect size of 10 percent in reports of a sensitive behavior that has a prevalence of 20 percent, a 95 percent degree of assurance (one tailed), and a power of 80 percent, we needed 200 participants per data collection method. To evaluate superiority with an effect size of 10 percent in reports of a sensitive behavior that has a prevalence of 20 percent, a 95 percent degree of assurance (two tailed), and a power of 80 percent, we needed 315 subjects per method. Hence, the total sample size for our study population was determined to be 4×315 or 1,260.

Noninferiority of PASI vs. ACASI was evaluated by comparing levels of reported behavior with two-sample tests by use of StatXact software (Cytel Software Corporation, Cambridge, Massachusetts); superiority was evaluated by comparing levels of reported behavior with two-sample Pearson's χ^2 tests by use of SPSS, version 11.0.1 for Windows, software (SPSS, Inc., Chicago, Illinois). Both noninferiority and superiority are reflected in the presence of $p < 0.05$. Because the sensitivity of behaviors may differ for men and women, noninferiority and superiority comparisons were repeated for each gender separately.

Agreement between self-reports (use of amphetamine-type substances and smoking) and urine test results was assessed by use of Cohen's kappa statistic (17) with SAS, version 8.2, software (SAS Institute, Inc., Cary, North Carolina). The completeness and consistency of collected data (e.g., proportions of missing and inconsistent data) were compared across the four data collection methods.

Urine specimen collection and laboratory analysis

Immediately after completion of their survey instrument, students were asked to provide 30 ml of a first-catch urine specimen. They were given clean plastic urine collection cups fitted with a temperature indicator to detect cold urine

(i.e., possible adulteration) and asked to collect their urine in a private restroom. A Rapid Drug Screen card (Craig Medical, Vista, California) was used to test urine for the presence of amphetamine-type substances (e.g., amphetamine, methamphetamine, and methylenedioxymethamphetamine or ecstasy), nicotine (cotinine), and their metabolites. The Rapid Drug Screen card is a lateral-flow, one-step immunoassay using cutoff concentration levels established by the US Food and Drug Administration. According to the manufacturer, sensitivity (93 percent) and specificity (100 percent) of this drug assay are high. To rule out cross-reactivity from ephedrine and other stimulants commonly found in over-the-counter and prescription drugs, reactive urine specimens were retested using gas chromatography/mass spectrometry to confirm the presence of amphetamine-type substances (Department of Clinical Pathology, Thanyarak Institute of Drug Abuse, Pathumthani, Thailand).

RESULTS

Participant characteristics and results of randomization

Among the 1,283 students enrolled, 49.9 percent were men, 60.4 percent were between 16 and 19 years of age, 67.0 percent lived with their parents, and 77.1 percent had parents who were married. The monthly income of most parents (58.2 percent) was less than 7,000 Thai bahts (~US \$170). These variables did not differ significantly among the four data collection methods, which indicated successful randomization (table 1).

Evaluation of PASI

Table 2 summarizes, by method, the frequencies with which sensitive behaviors were answered affirmatively. The reporting of almost all sensitive behaviors indicated noninferiority of PASI and ACASI compared with self-administered questionnaires and superiority of PASI, ACASI, and self-administered questionnaires compared with interviews. For reasons of parsimony and to focus on the evaluation of PASI, we will present in detail only the noninferiority comparisons between PASI and ACASI and the superiority comparisons between PASI and interviews.

Comparison of self-reported methods: sexual risk behavior

Noninferiority of PASI versus ACASI. PASI was found to be noninferior to ACASI regarding responses to questions about sexual intercourse experience (defined as anal or vaginal penetration), including whether intercourse had occurred "today" or "yesterday" and whether a contraceptive was used during the most recent episode of intercourse. PASI also was noninferior to ACASI with respect to reporting a history of buying and selling sex, having had a genital ulcer, and having been pregnant (table 2).

Among men, PASI was noninferior to ACASI for all questions where noninferiority was found in the full sample. Among women, noninferiority was present for questions about sexual intercourse experience (44.2 percent for PASI,

TABLE 1.   Demographic characteristics of 1,283 vocational school students in Chiang Rai, Thailand, 2002

Characteristic	Method (%)				p value
	PASI* (n = 328)	ACASI* (n = 325)	Self-administered questionnaire (n = 313)	Interview (n = 317)	
Male	50.3	49.5	51.1	48.6	NS*
Aged 16–19 years	59.1	58.8	59.5	58.7	NS
Live with parents	66.2	68.9	67.5	65.6	NS
Parents married	77.7	77.5	78.1	74.8	NS
Income of ≤7,000 B*	63.1	55.4	57.2	59.7	NS

* PASI, palmtop-assisted self-interviewing; ACASI, audio-computer–assisted self-interviewing; NS, not significant; B, Thai baht(s) (41.14 bahts = US $1.00).

43.3 percent for ACASI; $p < 0.023$), contraceptive use during the latest intercourse (54.2 percent for PASI, 49.3 percent for ACASI; $p < 0.037$), selling sex (4.3 percent for PASI, 4.3 percent for ACASI; $p < 0.001$), and self-report of having had a genital ulcer (8.7 percent for PASI, 6.1 percent for ACASI; $p < 0.001$) (data not shown).

Superiority of PASI versus interview. Interview respondents were significantly more likely than PASI respondents to answer affirmatively when asked if they ever had had sexual contact (sexual stimulation, without penetration, by another person) (table 2). However, when subsequently asked whether this sexual contact involved oral sex, PASI respondents were significantly more likely to affirm this (table 2). Interview respondents were also significantly more likely than PASI respondents to affirm that they had used contraceptives during their latest sexual intercourse. PASI was found to be superior for reports of sexual intercourse "today" or "yesterday," selling and buying sex, reports of a genital ulcer, and history of pregnancy. Interviews among men showed the same response patterns of PASI as found in the overall sample. However, among women, PASI was found to be superior for reports of sexual intercourse "today" or "yesterday" (20.8 percent for PASI, 3.0 percent for interview; $p < 0.001$) and history of pregnancy (10.4 percent for PASI, 3.1 percent for interview; $p < 0.05$) (data not shown).

Comparison of self-reported methods: substance use, dietary behavior, and depression/suicide

Noninferiority of PASI versus ACASI. PASI appeared to be noninferior regarding responses to questions about alcohol use and smoking in the past 3 months and in the past week. Noninferiority of PASI was also found regarding responses to questions about most dietary behaviors and most symptoms of depression and suicide (table 2). Noninferiority of PASI could not be demonstrated regarding reports of ever having smoked, amphetamine-type substance use, attempts to lose or maintain weight, and pessimistic feelings.

Among men, the pattern of PASI noninferiority to ACASI was generally similar to that for the full sample. Noninferiority was not present for alcohol use "today or yesterday," which was more often reported during the interview. The

use of diet pills, laxatives, and purging was too infrequent among men to evaluate. Among women, noninferiority of PASI could not be demonstrated regarding questions about alcohol use during the past 3 months, fasting, and most symptoms of depression. Noninferiority was present for pessimism (11.7 percent for PASI, 14.6 percent for ACASI; $p < 0.033$) and for current efforts to gain or lose weight (71.2 percent for PASI, 71.3 percent for ACASI; $p < 0.024$) (data not shown).

Superiority of PASI versus interview. PASI was superior regarding disclosure of driving after drinking alcohol, considering oneself overweight, and having taken diet pills in the past 30 days. PASI was not found to be superior regarding other questions about alcohol use; smoking tobacco; use of amphetamine-type substances; and most questions about dieting, depressive symptoms, and suicide (table 2).

Among men, interview respondents were significantly more likely to describe themselves as overweight (20.6 percent for PASI, 33.8 percent for interviews; $p < 0.004$) or to disclose alcohol use "today" or "yesterday" (31.8 percent for PASI, 43.7 percent for interviews; $p < 0.035$). PASI was superior for disclosures of feeling lonely (14.5 percent for PASI, 3.9 percent for interviews; $p < 0.001$) and having seriously considered suicide (12.7 percent for PASI, 5.2 percent for interviews; $p < 0.001$). Levels of reports of other behaviors among men were similar to the levels found in the full sample.

Among women, PASI respondents mirrored the full sample, except that interview respondents were more likely to disclose feeling bored (3.7 percent for PASI, 9.8 percent for interviews; $p < 0.027$) (data not shown).

Agreement between self-reports and laboratory test results

Use of amphetamine-type substances (table 3). The prevalence of recent use of amphetamine-type substances, determined by urine test, was 2.8 percent (36/1,283). The kappa value for self-reports of use of amphetamine-type substances during the past week and the presence of metabolites in urine was fair ($\kappa = 0.43$). Cell sizes were too small to evaluate noninferiority and superiority regarding

TABLE 2.   Frequencies of responses to questions among 1,283 vocational school students in Chiang Rai, Thailand, 2002

Affirmative response	PASI (n = 328)		ACASI (n = 325)		Self-administered questionnaire (n = 313)		Interview (n = 317)		Noninferiority (PASI* vs. ACASI*) (p value)	Superiority (PASI vs. interviews) (p value)
	No.	%	No.	%	No.	%	No.	%		
Sexual behavior and sexual health										
Ever had sexual contact†	142	43.3	175	53.8	129	41.2	205	64.7	0.557	0.0001‡
If ever, sexual contact involved oral sex	53	37.3	75	42.9	55	42.6	27	13.2	0.208	0.0001
Ever had sexual intercourse	192	58.5	183	55.8	159	50.8	180	56.8	0.0007	0.686
If ever, sexual intercourse today or yesterday	37	19.3	40	21.9	31	19.5	11	6.1	0.039	0.0002
If ever, used contraception for latest sexual intercourse	90	46.9	66	36.1	72	45.3	133	73.9	0.0001	0.0001‡
Ever sold sex	22	6.7	18	5.5	24	7.7	3	0.9	0.0001	0.0002
Ever bought sex	27	8.2	23	7.1	11	3.5	8	2.5	0.0001	0.0014
Ever had genital sore or ulcer	22	6.7	26	8.0	18	5.8	8	2.5	0.0001	0.0063
Partner or self ever been pregnant	36	11.0	38	11.7	30	9.6	24	7.6	0.0002	0.137
Alcohol and substance use										
Ever used alcohol in past 3 months	275	83.8	278	85.5	262	83.7	263	83.0	0.002	0.765
If ever, used alcohol today or yesterday	80	29.1	87	31.3	69	26.3	84	32.0	0.023	0.473
If ever, drove after three drinks or more	209	76.0	208	74.8	175	66.8	170	65.0	0.005	0.017
Ever smoked tobacco	125	38.1	145	44.6	122	39.0	113	35.6	0.180	0.517
If ever, smoked in past 3 months	82	65.6	91	62.8	74	61.2	84	74.3	0.014	0.143
If ever in past 3 months, smoked in past week	79	96.3	81	89.0	66	89.2	71	84.5	0.002	0.976
Ever used amphetamine-type substance	66	20.1	81	24.9	65	21.0	69	21.8	0.056	0.608
If ever, used in past 3 months	20	30.3	2	28.4	12	18.8	14	20.3	0.055	0.180
If ever in past 3 months, used in past week	10	52.6	16	69.6	5	45.5	5	38.5	0.700	0.430
Dietary behavior										
Consider self underweight	81	24.7	74	22.8	78	25.0	63	19.9	0.0002	0.142
Consider self overweight	111	33.8	118	36.3	113	36.1	137	43.2	0.021	0.007‡
Currently trying to lose or stay same weight	174	53.0	196	60.3	169	54.0	166	52.4	0.239	0.862
If yes, ever fasted for 24 hours in past 30 days	41	23.6	43	21.9	32	18.9	30	18.1	0.004	0.224
If yes, ever took weight-loss pills in past 30 days	25	14.4	14	7.1	13	7.8	8	4.8	0.0001	0.003
If yes, ever induced vomiting or used laxatives in past 30 days	32	18.4	34	17.3	22	13.2	22	13.3	0.003	0.203
Depressive symptoms, suicide ideation, and suicide attempt										
For at least 2 weeks in the past 3 months										
Felt lack of energy	80	24.4	61	18.7	55	18.1	67	24.3	0.0001	0.976
Felt depressed	25	7.6	39	12.0	24	7.7	32	10.1	0.01	0.269
Felt bored	12	3.7	24	7.4	25	8.0	19	6.0	0.001	0.166
Felt pessimistic	31	9.5	56	17.2	59	18.8	43	13.6	0.200	0.101
Felt lonely	51	15.5	55	16.9	47	15.0	33	10.4	0.002	0.054
Ever seriously considered suicide	44	13.4	35	10.8	36	11.5	33	10.4	0.0001	0.239
Ever tried suicide	14	4.3	21	6.5	14	4.5	13	4.1	0.0001	0.956

* PASI, palmtop-assisted self-interviewing; ACASI, audio-computer–assisted self-interviewing.
† Sexual stimulation, without penetration by another person.
‡ Indicating superiority of the interview over PASI.

TABLE 3. Agreement between self-report, by method, of use of amphetamine-type substances in the past week and urine test results among 1,283 vocational school students in Chiang Rai, Thailand, 2002

Self-report of methamphetamine use	Urine test result		Total (no.)	Kappa*
	Negative (no.)	Positive (no.)		
PASI†				
No	312	6	318	0.38
Yes	6	4	10	
ACASI†				
No	305	4	309	0.44
Yes	10	6	16	
Self-administered questionnaire				
No	300	5	305	0.32
Yes	3	2	5	
Interview				
No	311	1	312	0.66
Yes	2	3	5	
Total‡	1,249	31	1,280	0.44

* χ^2 for differences between kappa values = 2.1; $p < 0.55$.
† PASI, palmtop-assisted self-interviewing; ACASI, audio-computer–assisted self-interviewing.
‡ Total does not add up to 1,283 because of missing values among self-administered questionnaire respondents.

TABLE 4. Agreement between self-report of smoking (today) and presence of cotinine (nicotine) in urine among 1,283 vocational school students in Chiang Rai, Thailand, 2002

Self-report of smoking	Urine test result		Total (no.)	Kappa*
	Negative (no.)	Positive (no.)		
PASI†				
Yes	284	11	295	0.61
No	12	21	33	
ACASI†				
Yes	275	14	289	0.68
No	8	28	36	
Self-administered questionnaire				
Yes	260	14	274	0.49
No	19	20	39	
Interview				
Yes	272	29	301	0.38
No	4	12	16	
Total	1,134	149	1,283	0.56

* χ^2 for differences between kappa values = 9.7; $p < 0.02$.
† PASI, palmtop-assisted self-interviewing; ACASI, audio-computer–assisted self-interviewing.

agreements between self-reports and urine test results among the four data collection methods.

Smoking (table 4). The prevalence of cotinine (nicotine) in urine was 11.6 percent (149/1,283). The kappa value for self-reports of having smoked tobacco "today" and the presence of cotinine in urine was fair ($\kappa = 0.56$). The kappa value for PASI responses ($\kappa = 0.61$) was noninferior to that for ACASI responses ($\kappa = 0.68$) ($\chi^2 = 0.55$; $p < 0.46$) and superior to interview responses ($\kappa = 0.38$) ($\chi^2 = 4.3$; $p < 0.038$).

Data quality

Missing data (at least one item with missing data) or data inconsistencies (disagreements between answers to questions on the same topic) were found for 80 percent of the questionnaire respondents and for 14 percent of interview respondents. No missing data or inconsistencies were found for PASI and ACASI respondents.

DISCUSSION

Our findings suggest that, for the collection of sensitive behavioral data, PASI is a scientifically acceptable and a generally noninferior alternative to ACASI and self-administered questionnaires, as well as a superior alternative to interviews. Noninferiority of PASI was demonstrated by use of self-reports of the most sensitive areas of sexual behavior (e.g., sexual intercourse experience, buying and selling sex, history of genital ulcers, pregnancy), as well as self-reports of less sensitive behaviors (e.g., alcohol use, dietary behaviors, symptoms of depression). For the sake of brevity, we did not report on comparisons with self-administered questionnaires or comparisons between ACASI and interviews; however, our data generally showed noninferiority of PASI, ACASI, and self-administered questionnaires when compared with each other and superiority of PASI, ACASI, and self-administered questionnaires when compared with interviews. Noninferiority or equivalence of ACASI compared with self-administered questionnaires has been established in other studies (13, 14, 18), but none has evaluated PASI and other data-collection methods simultaneously. PASI agreements between self-reports of recent tobacco smoking and the presence of nicotine metabolites in urine were noninferior to those of ACASI and superior to those of interviews. The establishment of PASI noninferiority and superiority using biologic measures strengthens our conclusions regarding the validity and suitability of PASI for the collection of sensitive behavioral data.

Superiority of PASI (and of ACASI and self-administered questionnaires) compared with interviews was found regarding self-reports of the most sensitive areas of sexual behavior (e.g., history of oral sex, having had sexual intercourse "today" or "yesterday," buying and selling sex) and in less sensitive areas of behavior (e.g., driving after drinking alcohol, having recently taken diet pills (for women), feelings of loneliness and suicide ideation (for men)). Interviews appeared to be superior to PASI for reports of some behaviors, especially those that were socially more desirable

(e.g., being sexually experienced), more acceptable (e.g., depressive symptoms among women), or more verifiable (e.g., being overweight among men). Interestingly, if an affirmative answer regarding sexual experience was followed up with a question about whether this experience included oral sex or sexual intercourse "today" or "yesterday," superiority reversed from interviews to PASI. This confirms our hypothesis that the more intimate or recent the sensitive behavior, the more likely the respondent is to deny this in a face-to-face interview but to answer affirmatively when using a self-completed data collection method.

Patterns of noninferiority and superiority differed when we stratified by gender. For both genders, potentially socially undesirable responses were more commonly elicited by PASI than by interview, and for most questions, regardless of social desirability, PASI was noninferior to ACASI. Hence, our data suggest that, for both men and women, PASI is an acceptable alternative to ACASI, self-administered questionnaires, and interviews. Nevertheless, in our study, affirmative responses to questions about sexual behavior were more commonly reported by men than by women. Whether this is due to a higher prevalence of the underlying behavior, increased disclosure, or overreporting among men, compared with women, is not clear. Thai sexual norms expect young men to be sexually experienced and proscribe discussion of sexuality by young women. Hence, further evaluation of possible effects of gender on levels of reported behaviors is desirable because of the relative rarity of some responses and the limited statistical power for evaluating gender and method interactions of our study.

Agreement between self-reports of smoking and urine cotinine test results was fair, and self-administered methods showed higher agreement than did interviews. Agreement between self-reports and laboratory measures of drug use tends to be imperfect and to vary widely (5, 9, 16). The kappa calculations were nonconditional; hence, neither urine test results nor questionnaire responses were used as the reference standard. Both methods have significant sources of error. Recall bias, inaccurate memorization, and social desirability may affect the accuracy and completeness of self-reports, while frequency, dose, inhalation, passive exposure, and individual metabolism may affect the detectability of cotinine in urine. The prevalence of metabolites of amphetamine-type substances in urine from our study participants (2.8 percent) was too low to draw any conclusions. A higher prevalence had been expected according to previous research in this population, in which 28.9 percent of students reported ever use and 10.3 percent of urine tests were reactive for amphetamine-type substance use (15). The decline in self-reports and the prevalence of positive urine tests is likely the result of the Thai government's strong campaign against drug use during the past 5 years.

PASI enables many of the data collection efficiencies of ACASI to be transferred to field settings. Careful programming of skip patterns can eliminate missing data and data inconsistency problems that plague self-administered questionnaires; data integrity was greatest in PASI and ACASI and poorest in self-administered questionnaires. The absence of coding and data entry steps with PASI and ACASI eliminates additional sources of error and allows field data

to be analyzed shortly after collection. The portability and hand use of PASI may make it particularly useful in remote settings where desktop or laptop computers, self-administered questionnaires, and interviews are cumbersome. Similarly, PASI may have wide application in cultural settings in which HIV and other health risk behaviors are difficult to discuss openly and need to be assessed in the most private manner possible.

One may view PASI as a variation on computer-assisted self-interviewing (without audio), which sometimes has been associated with lower levels of disclosure than with ACASI (3), although some investigators have found rather modest or mixed results in terms of differences between these methods (19). We found few differences, and it may be that for some respondents the audio was somewhat distracting, while for others it may have been helpful because of the limited readability of the PASI displays. However, since the time of our data collection, the storage capacity of PASI devices has increased, and it is now feasible to include audio files in PASI assessments, making this method more comparable with ACASI. This would also allow PASI to be used for more qualitative and less investigator-driven types of research, for which the data can be analyzed by using qualitative software. In addition, future applications may include using PASI for collection of diary data, with prompting of participants to report sexual activity and drug use or other HIV risk behaviors at regular intervals, and adding audio files and voice recognition. These features may eliminate some of the small areas of difference (i.e., areas where noninferiority or superiority did not occur) that were seen in this investigation. Future studies of PASI should therefore evaluate whether the addition of these innovations will further the effectiveness of this method in the accurate and complete reporting of sensitive behaviors.

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