Original Article

Survey of substance use among high school students in Taipei: Web-based questionnaire versus paper-and-pencil questionnaire

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Abstract

Purpose: To evaluate, using a randomized trial, whether a web-based self-administered questionnaire (web SAQ) can improve the reporting rate of substance use in adolescents compared with a paper-and-pencil self-administered questionnaire (paper SAQ).

Methods: Students of junior high, senior high, and vocational high schools in Taipei City and County were selected by a stratified, two-stage, probability proportional to size, random sampling. For each class selected, half of the students were randomly assigned to paper SAQ ($n = 990$) and the other half to web SAQ ($n = 928$). The inverse of the sampling probability for each individual was then used as sampling weight in the estimation of prevalence and logistic regression analysis.

Results: For readily available substances, the lifetime prevalence in the web SAQ group was significantly higher for alcohol use and borderline higher for tobacco and betel nut use compared to those of the paper SAQ group. For illicit drug use, the lifetime prevalence for the web SAQ group was significantly higher for the use of amphetamines, and borderline higher for ketamine. In multiple logistic regression analysis, the differences between the two groups in the use of alcohol, tobacco, and amphetamines remained significant. Boys, as well as both junior-high and vocational high school students who responded using the web SAQ, were more likely to report alcohol or tobacco use than those using the paper SAQ.

Conclusions: Web SAQ leads to higher reporting rates of commonly used substances in adolescents compared with those of paper SAQ. © 2005 Society for Adolescent Medicine. All rights reserved.

Key words: Substance use; Adolescents; Web-based questionnaire; Paper-and-pencil questionnaire; School survey

Self-report surveys in school serve as a primary source of information on the rate of substance use among adolescents [1]. However, survey measurements of such highly sensitive or stigmatized behaviors may generate inaccurate reporting

and bias in survey estimates [2,3]. Respondents tend to underreport their socially disapproved or illegal behaviors, especially in a face-to-face interview. Several researchers have pointed out that insuring response anonymity during the interview increases respondents' willingness to report sensitive information [4,5].

Paper-and-pencil self-administered questionnaires (paper SAQs) have been one of the most frequently used methods of enhancing response privacy in surveys for substance use. However, use of complex branching is limited with paper SAQs, given the potential for data collection errors and item

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nonresponse. Moreover, because the respondents' identification numbers are recorded on their SAQs, some respondents remain doubtful about the anonymity of their responses. Since the early 1990s, several technologies of computer-assisted self-interviewing (CASI) [3] have been developed to improve the shortcomings of paper SAQs. Respondents using CASI read survey questions on a computer screen and directly enter their answers into the computers. Advantages of CASI over paper SAQs include: (1) automatic branching and consistency checking between questions based on the respondents' prior answers; (2) greater protection of confidentiality and conservation of resources because no written record exists; and (3) avoidance of data entry errors by automatically saving responses into a database [6–8]. Several studies have shown that CASI may increase the willingness of adolescent respondents to report sensitive behaviors, such as risky sexual behavior or drug use, compared to paper SAQs [9–14].

Although the advantages of CASI for collecting sensitive data have been demonstrated, the use of computers poses some limitations on survey measurements. Because CASI technology relies on the use of laptop computers, it can be administered to only one respondent at a time. This interview mode requires much time, labor, and money when used in a large-scale survey; therefore, the application of the CASI survey is limited to household-based surveys. Because school surveys are the most common method for large-scale surveys of substance use among adolescents in many countries, new computer survey technologies that can be applied in these settings are needed.

We propose a new computer-based technology, a web-based self-administered questionnaire (web SAQ), to improve the shortcomings of the CASI. The web SAQ is a computer-assisted self-interview mode that is very similar to the CASI in that respondents read and answer survey questions via computers. The main difference between the web SAQ and CASI is that the data from the web SAQ are stored on a server through an Internet connection. Thus, the web SAQ allows all students of a class to participate in a survey at the same time in the computer classroom. The web SAQ retains almost all of the strengths of the CASI, including automatic data entry, branching patterns of questions, automatic dimming of irrelevant probing questions and checking for missing response, and the protection of respondents' privacy. In the current format, the survey questions in the web SAQ are not presented interactively (i.e., one question on the screen at one time and the subsequent item displayed depends on the respondent's answer to the question) due to the concern over the processing capacity of computer servers. Nevertheless, it may help improve the response tendencies on sensitive questions, as does CASI.

The web SAQ used in this study is not the same as a wide variety of "web survey" methods used in previous studies [15]. Although the online data collection procedures were similar between the two approaches, those web surveys

were typically administered on an individual basis. In most web surveys, letters or electronic mails (emails) were sent to invite subjects to participate in the surveys. The participants would complete the survey questionnaire individually on the web in places with Internet connection. In contrast, the web SAQ in our study was group administrated in schools. This may help to avoid high nonresponse rate, which is a major deficiency of web surveys [15].

The objective of the present study was to compare the estimates of substance use obtained in web SAQ versus paper SAQ in a randomized trial of a school survey. Our results may be useful for investigators attempting to develop computer-assisted school survey methods and for researchers interested in school surveys of risk behaviors.

Methods

Participants

Subjects in this study were adolescent students who participated in a 2003 cross-sectional survey of substance use in Taipei City and County. The participants consisted of students selected from three types of school: junior high (approximately 13–15-years-old), senior high (approximately 16–18-years-old), and vocational high schools (approximately 16–18-years-old). A stratified, two-stage, cluster sampling procedure was used for the selection of participants. On the basis of cluster analysis using the population density and the educational levels of each district involved, Taipei City and County were stratified into metropolitan area and suburban or township area. In the first stage, a total of 20 schools were selected using a probability proportional to size (PPS) method from each type of school within each stratum: 9 of 128 junior high, 3 of 86 senior high, and 3 of 48 vocational high schools for the metropolitan area, and 3 of 49 junior high, 1 of 18 senior high, and 1 of 13 vocational high schools for the suburban or township area. In the second stage, one class from each grade (three grades in each type of schools) within the sampled schools was randomly selected. Every high school in Taipei has at least one computer classroom with sufficient computers connected to the Internet, owing to the government's promotion of computer education in recent years. All students of the selected classes were eligible for this study. Data collection proceeded from September to December 2003. Because the respondents' answers were anonymous, parental permission was not sought. Before the test, all students of each class went to a computer classroom together, where the procedures were explained by trained survey staff members. After written informed consent was obtained, the participants were randomly assigned at a ratio of 1:1 to complete either a web-based SAQ or a paper-and-pencil SAQ in the same computer classroom. During the test, the teachers of the sampled classes left the computer room after introducing the survey staff members to the

class. The study was approved by the Institutional Review Board of the College of Public Health, National Taiwan University.

Of the 2068 enlisted students, 1954 (94.5%) students agreed to participate in the survey, in which 956 were assigned to web SAQ and 998 to paper SAQ. Participants with missing data on the variables of major interest, i.e., experiences of substance use, were excluded from the subsequent analyses (27 for web SAQ, all due to the failure of data transmission for a whole page to the server when the bandwidth of the school's network was not sufficient, and 8 for paper SAQ, with missing items ranging from 2 to 13 for each individual). In addition, one participant who reported the use of a "bogus pipeline" drug was also excluded. The final sample was 1918, which resulted in an overall completion rate of 92.7% (90.1% for the web SAQ and 95.4% for the paper SAQ).

Measures

The self-administered instruments contained 91 questions with items on demographic characteristics, exposure to courses on risk behavior prevention, truancy, sexual behaviors, and substance use. The content of the questionnaire was identical across the two modes of administration. The average length of time required for completion was similar in the two modes (about 30 minutes).

Questions about four risk behavior prevention courses taken by students, which served as neutral information to test our hypothesis that the two modes of administration would elicit similar response propensity for neutral experiences, included courses on anti-smoking, anti-drug, prevention of acquired immunodeficiency syndrome (AIDS), and safe sexual behavior. The maximum truancy days were assessed with a multichoice question: ≤ 1 day, 2 days, or ≥ 3 days, which was based on the educational regulation in Taiwan that a junior-high school student having three consecutive days or more absence without a reasonable cause is regarded as a dropout. The lifetime number of sexual partners was also assessed with a multichoice question. The onset age of both truancy and sexual behavior were each inquired with open-ended questions.

According to the Tobacco Control Act passed in 1997 and its related law in Taiwan, selling tobacco or alcohol beverages to adolescents 18 years old or younger is prohibited, although the enforcement of this regulation varies. Participants were asked whether they had ever used any several readily available substances (alcohol, tobacco, and betel nut) and illicit drugs (ecstasy, ketamine, marijuana, flunitrazepam or so-called FM2, heroin, and glue). Betel nut (or areca nut) is a mild central nervous system stimulant widely used in Asia. Its active principle is the alkaloid arecoline, which stimulates both the parasympathetic and sympathetic nervous systems as dose-dependent responses [16]. For each substance or drug use endorsed, respondents

were further asked about the total times of use (from 1 = "only once" to 5 = "more than 15 times"), frequency (from 1 = "only once" to 6 = "more than 5 times a month"), and onset age of the use. Alcohol use was defined in our questionnaire as consuming a cup of alcoholic drink (e.g., about 100 mL beer) at least once. Moreover, a "bogus pipeline" drug was added to test the validity of self-reported substance use. In a two-week test-retest reliability study of the paper SAQ used for this study with 67 junior-high school students, the kappas for the items on the use of readily available substances were excellent (.81 for alcohol drinking, .93 for tobacco smoking, and 1.0 for betel nut chewing) and the percent of agreement was close to 100% for the items on illicit drugs.

Statistical analysis

To account for the different probabilities of sample selection and subsequent nonresponse, a sampling weight for each participant was computed. Thus, all analyses were based on weighted data. We used both the "svyprop" and "svylogit" commands of the statistical software package STATA version 8.0 [17], which can incorporate the sampling weights and adjust for the clustered sampling, for all analyses. Therefore, our statistical inferences were intended to represent the entire population of school-attending adolescents in Taipei City and County.

To evaluate the degree of difference between behaviors reported by the two interview modes, both univariate and multiple logistic regression analyses were applied. Because of the random assignment to web-based and paper-and-pencil SAQ modes, no differences in demographic characteristics across the two administration groups were anticipated. Thus, the crude odds ratio (OR) of reporting a particular behavior measures the mode effect of web SAQ on the reports relative to the paper SAQ. Multiple logistic regression analysis was performed to adjust for covariates that were associated with the mode effect with a p value of $< .2$ [18] as a way to control for residual confounding, including gender, types of school, single-parent family, and working. These four variables were selected to adjust for potential differences among subpopulations for our target behaviors.

Results

Sample demographic features

According to our sampling design, most participants were selected from the schools in the metropolitan area (Table 1). In addition, 59% of respondents were junior-high school students. This percentage is similar to that of the student population in Taipei (57%). However, the ratio of boys to girls in our sample (1.47) was higher than that of the student population in Taipei (1.06), mainly due to some sampled schools (especially vocational high schools) being

Table 1
Social and demographic characteristics among participants by using different methods of questioning

Variable	Total		Paper SAQ		Web SAQ	
	N	Weighted percent ^a	N	Weighted percent ^a	N	Weighted percent ^a
Gender						
Male	1189	59.48	617	60.84	572	58.06
Female	729	40.52	373	39.16	356	41.94
Type of school						
Junior high	1083	59.02	579	61.36	504	56.58
Senior high	417	19.01	184	15.74	233	22.42
Vocational high	418	21.97	227	22.90	191	21.00
Living area						
Metropolitan	1429	83.68	752	83.30	677	84.09
Suburban and township	489	16.32	238	16.70	251	15.91
Single-parent family	222	11.77	110	11.39	112	12.16
Not living with family	51	1.81	27	2.04	24	1.58
Working	113	5.60	61	6.21	52	4.96
Unweighted N	1918		990		928	

^a Estimates are weighted to adjust for unequal probabilities of sample selection and nonresponse.

boys-only. The proportions of participants who did not live with family or were working were low, reflecting that the majority of these schools' students were still dependent on their families. Meanwhile, the proportion of the students with single-parent families was as high as 11.77%, likely a reflection of the current social structure in Taiwan's society.

Effects of administration mode

For both groups (web SAQ vs. paper SAQ), the distribution of all demographic characteristics (Table 1) and

reports of preventive courses were similar (Table 2). For the three risk behaviors, the mode of administration made little difference in the estimates of the prevalence, except that of truancy. Respondents were slightly more likely to report truancy experience in the web SAQ than in the paper SAQ.

Similarly, the web SAQ was more likely than the paper SAQ to elicit higher prevalence of readily available substances, especially for the alcohol and tobacco use (Table 2). The adjusted odds ratios varied from 1.30 to 1.49. For reports of illicit drug use, the prevalence of each drug was

Table 2
Educational courses, risk behaviors, and lifetime prevalence of substance use among adolescent students by using different methods of questioning

Variable	Weighted prevalence ^a		Crude OR (95% CI)	Adjusted OR ^b (95% CI)
	Paper SAQ	Web SAQ		
Educational courses				
Anti-smoking	75.16	79.99	1.32 (.93, 1.88)	1.28 (.92, 1.80)
Anti-drug	81.29	84.14	1.22 (.85, 1.76)	1.16 (.83, 1.62)
Prevention of AIDS	72.32	75.38	1.17 (.86, 1.60)	1.09 (.87, 1.38)
Safe sexual behavior	85.33	86.56	1.11 (.89, 1.38)	1.08 (.86, 1.36)
Risk behaviors				
Running away from home	6.65	6.43	.96 (.57, 1.65)	1.02 (.60, 1.73)
Sexual behavior	7.36	7.25	.98 (.48, 2.01)	1.00 (.49, 2.08)
Truancy	20.65	25.18	1.29 (.94, 1.78)	1.33 (1.01, 1.74)*
Readily available substances				
Alcohol	29.85	38.31	1.46 (1.29, 1.65)***	1.49 (1.31, 1.69)***
Tobacco	18.47	21.36	1.20 (.99, 1.45)	1.30 (1.08, 1.55)**
Betel nut	4.73	6.05	1.30 (.91, 1.85)	1.36 (.91, 2.04)
Illicit drugs				
Ecstasy	.63	.77	1.22 (.42, 3.58)	1.24 (.42, 3.68)
Ketamine	.14	.72	5.35 (.60, 47.69)	5.40 (.56, 51.66)
Marijuana	.32	.59	1.84 (.25, 13.75)	2.36 (.38, 14.59)
Amphetamine	.01	.35	30.3 (1.6, 570.5)*	26.94 (1.40, 518.35)*
Ever used (≥ 1) illicit drug ^c	1.21	1.48	1.23 (.43, 3.49)	1.33 (.47, 3.77)

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$, two-tailed.

^a Estimates are weighted to adjust for unequal probabilities of sample selection and nonresponse.

^b Odds ratio is adjusted for covariates, including gender, types of school, single-parent family, and working.

^c Including glue, FM2, and heroin, in addition to those drugs listed in the table.

Table 3

Adjusted OR^a of the reporting rate of web-based questionnaire versus paper-and-pencil questionnaire for substance use in subgroups of the sample

Type of substance use	Gender		Type of school		
	Boys	Girls	Junior-high school students	Senior-high school students	Vocational high school students
Alcohol use	1.50 (1.28, 1.77)***	1.41 (1.00, 2.00)	1.52 (1.30, 1.78)***	1.43 (.82, 2.49)	1.38 (1.18, 1.61)**
Tobacco use	1.31 (1.06, 1.62)*	1.18 (.77, 1.79)	1.31 (.94, 1.82)	1.18 (.50, 2.78)	1.24 (1.04, 1.48)*
Betel nut use	1.44 (.96, 2.17)	.95 (.30, 3.01)	1.12 (.57, 2.17)	1.02 (.61, 1.69)	1.71 (.69, 4.23)
Ever used (≥ 1) illicit drug	1.38 (.17, 11.22)	1.20 (.32, 4.55)	1.27 (.37, 4.31)	.66 (.01, 82.30)	1.52 (.16, 14.33)

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$, two-tailed.^a Odds ratios (ORs) are adjusted for covariates other than the stratification variable, such as gender, type of school, single-parent family, and working.

much lower than that of readily available substances. Because the prevalence rates of glue, FM2, and heroin were too low to calculate the OR, these three drugs were not shown individually. In general, there was a tendency of higher prevalence estimates in the web SAQ than in the paper SAQ; however, only that of amphetamine reached statistical significance. When the uses of all illicit drugs were pooled, the difference in the reporting between the two modes was not significant.

Mode effects among demographic subgroups

Because our exploratory analyses (data not shown) revealed that the respondents' gender and type of school were associated with substance use, we compared the OR of the reporting rate of web-based questionnaire versus paper-and-pencil questionnaire for substance use in subgroups across either gender or school type (Table 3). For boys, a response propensity in the web SAQ was seen for reports of alcohol and tobacco use behaviors, whereas for girls, no significant response propensity was seen for any substance use. No significant variation in mode effects between the two genders was found in reporting illicit drug use.

In terms of types of schools, there were response propensities in the web SAQ for alcohol use among the students of junior-high schools and vocational high schools, and for tobacco use among the students of vocational high schools. In contrast, no response propensity was found for the use of readily available substances among senior-high school students. No significant response propensity was found in any of the three subgroups by school type for the use of any illicit drug.

Discussion

This study was designed to investigate the effect of a new computer survey technology, i.e., the web SAQ, for self-reported data collection, with a focus on stigmatized behaviors such as substance use and illicit drug use. The equivalent distributions in both demographic characteristics and preventive course-taking reflect the adequacy of the randomization in our experiment. It also permits a relatively precise characterization of any differences in the reporting

of our targeted behaviors between the two administration groups. The robustness of the comparisons was further enhanced with the adjustment for potential confounders by using multiple logistic regression analyses. In general, the magnitudes of the adjusted ORs were not much different from those of the crude OR, a further indication that our randomization had rendered the two groups comparable in all the potential confounders.

The mode effect of the web SAQ versus paper SAQ in reporting substance use was mainly seen in use of alcohol, tobacco, and amphetamine, in which alcohol and tobacco were the most frequently used substances in adolescents. One caveat is that the effect for amphetamine use has a highly unstable OR, due to the extremely low prevalence. Taken together, the results of this experiment indicate that the use of web SAQ indeed leads to increased reporting for commonly used substances among adolescent respondents compared to paper SAQ. Although the format of the web SAQ was not exactly the same as the CASI used in prior research, this finding is consistent with those of previous CASI studies [2,3,14,19–24]. Namely, the web SAQ can encourage adolescents to report sensitive information in population-based surveys, as can other computer-assisted survey technologies. Moreover, the response rate of the web SAQ (90.1%) is much higher than those of the web surveys used in prior research varying from 15% to 56% [15]. Because nonresponse is one of the main challenges for web surveys, the web SAQ used in this study can help overcome this drawback. Because a computer room is becoming a common and essential facility in high schools, the web SAQ is not limited to the restricted population with ready web access. Hence, the web SAQ in school surveys can cover a more representative sample of adolescents than many other web surveys. Furthermore, instead of the repeated mailing to notify and urge the sampled individuals to find a convenient time to complete a web survey, the web SAQ may be more cost effective to administer. However, one limitation of the web SAQ is the insufficient bandwidth of the school's network in some rural areas. A portable server that can implement the web SAQ will greatly enhance the utility and feasibility of web SAQ assessment in a school-based survey.

Our results further show that adolescent boys had greater response propensity than girls in reporting substance use (i.e., alcohol and tobacco use) on the web SAQ versus the paper SAQ. These gender-related differences in mode effect are consistent with the findings of Paperny et al [11], where adolescent boys reported significantly greater frequencies of alcohol and marijuana use in a CASI mode than in paper SAQ forms, whereas the reporting by girls did not significantly differ across the mode of interview. Two possible interpretations are that boys had much higher prevalence of substance use than girls, or that boys were more sensitive to questions of substance use. Further research is warranted to distinguish these two issues by posing questions regarding what information was perceived as “sensitive” to adolescents and their acceptability of the web SAQ.

On the other hand, the difference in response tendencies across respondents from the three types of school is also notable. For the reporting of substance use, the mode effect of the web SAQ was obvious in all participants except for senior-high school students. It is possible that the web SAQ might be a format more comprehensible to junior-high and vocational high school students, who might have lower literacy skills than senior-high school students. For example, the automated branching patterns in the web SAQ might reduce the difficulties for the respondents to follow the instructions to skip questions in the questionnaire. Although there were 27 cases in which web SAQ data were lost for a whole page due to transmission failure in this study, none of the remaining web SAQ had missing information on individual items. It appears that the automatic checking for missing response in the web SAQ could further prevent the respondent from illegitimate skipping. These features of the current format of the web SAQ might consequently help adolescents with lower literacy skills to report sensitive information.

Intriguingly, our results did not find a significant mode effect for the reporting of sexual experience. This is consistent with the findings of Webb et al [8] and Turner et al [14]. It appears that sexual experience may already be perceived as less “taboo” to adolescents than before. In contrast, the reporting of truancy was higher in the web SAQ group than in the paper SAQ group. One possible explanation is that the disclosure of truancy experiences was sensitive to adolescents when the survey was administered in schools.

There are some limitations in this study. First, we could not validate the self-reported data in either the web SAQ or paper SAQ. Although we attempted to test the validity of self-reported substance-use behaviors by using the “bogus pipeline” method, we did not employ a direct test, such as urinalysis, in our sample. Biological specimens are difficult to collect in population-based surveys. Moreover, validation of risk behaviors such as sexual behaviors would require an unacceptable invasion of privacy. Thus, this issue cannot be resolved in our study and requires further investigation.

Second, the observed increase in self-reported substance use is based on the assumption that respondents would either admit or deny but not over-report their socially undesirable behaviors. Although the possibility of false-positive reports could not be completely excluded, there appeared to be no obvious reason for the respondents to provide false-positive responses because our questionnaire was entirely anonymous. Intriguingly, the estimated prevalence of any illicit drug use (1.21% for paper SAQ and 1.48% for web SAQ) in this study is compatible with the prevalence derived from a series of yearly surveys from 1995 to 1999 in Taiwan (1.1% to 1.5%) [25]. To some extent, this indicates the comparability of the survey results.

In summary, the participants who were administered the web SAQ, especially boys and students of junior high and vocational high schools, were more likely to report stigmatized information such as substance use than participants who were administered the traditional paper SAQ. Our study suggests that the application of the web SAQ in school-based survey is feasible and acceptable, and can help improve the measurement of risk behaviors and sensitive information.

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