Tobacco Use by Black and White Adolescents: The Validity of Self-Reports

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A B S T R A C T

Objectives. Previous studies concluded that Black adolescents use tobacco and other drugs less than White adolescents. The Black–White differences typically were attributed to variations in background and life-style. The objective of the research reported in this paper was to determine whether the presumed difference in tobacco use is due to Black–White differences in the validity of self-reports.

Methods. We used biochemical measures to compare the validity of self-reports of tobacco use by 1823 Black and White adolescents and to assess the contribution of variation in validity to Black–White differences in reported tobacco use.

Results. The sensitivity of Blacks' reports was significantly less than the sensitivity of Whites' reports. The specificity of Whites' reports was significantly less than the specificity of Blacks' reports. Much of the Black–White differences in reports of cigarette smoking and tobacco use were due to Black–White differences in validity.

Conclusions. Studies of Black–White differences should adjust for the invalidity of reports or acknowledge that much of the difference may be due to measurement error. (*Am J Public Health.* 1994;84:394–398)

Introduction

Studies consistently show that Black adolescents are less likely than White adolescents to use drugs.[1–10] This difference typically is attributed to differences in background and life-style. For example, differential vulnerability to models of drug behavior[8] and the substantial impact on youth of Black churches' fundamentalist orientation[9] have been offered as explanations for relatively low drug use by Black adolescents.

All prior studies of Black–White differences in adolescent drug use have relied entirely on self-reports of drug use. Therefore a very different type of explanation for the difference is that Blacks underreport their drug use more than Whites and Whites overreport their drug use more than Blacks. Although this possibility is sometimes acknowledged, it is more often ignored or dismissed as unlikely.[1,9] Only one study has empirically addressed the possibility that Black adolescents might underreport their drug use more than White adolescents. Mensch and Kandel[11] found that among youths who had reported in 1980 that they had used drugs, more Blacks than Whites reported in 1984 that they had never used drugs. The one study of young adults that compared Blacks and Whites concluded that Blacks underreported smoking more than Whites.[12]

In this paper we compare the validity of self-reports of tobacco use by Black and White adolescents and examine the contribution of invalidity to the Black–White difference in self-reported use. We use biochemical indicators as the standards for self-reports, with full recognition that researchers sometimes use self-reports as the standards for biochemical measures and that the biochemical measures we used are not perfect indicators of tobacco use.[13,14]

Methods

The data were gathered for baseline measures to study the influence of mass media campaigns to prevent smoking. Probability samples of households were identified in 10 standard metropolitan statistical areas of the southeastern United States and screened for adolescents aged 12 through 14 years. From April 1, 1985, through October 13, 1985, interviewers attempted to gather data from all eligible adolescents in these households. When more than one adolescent aged 12 through 14 years resided in a household, one was randomly selected to serve as a subject. Of the 2534 adolescent subjects estimated to be eligible for study, 2102 (83%) participated by completing questionnaires in their homes. Subjects averaged 1 hour to complete the self-administered questionnaire and provide biochemical specimens to measure cigarette smoking and tobacco use. Subjects who were not Black or White and subjects who had missing information on any variable were eliminated from these analyses. More detail on the study methodology is available elsewhere.[15]

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Race was determined by interviewer observation when possible and by interview when necessary. The use of observation as the primary procedure to classify Blacks and Whites was intended to reduce measurement error by minimizing reading and recording errors and by eliminating missing information. In nearly all cases, Whites and Blacks could be readily distinguished by interviewer observation. When the distinction between Blacks and Whites was not obvious the interviewer asked the subject to indicate his or her race, using standard categories. Asking subjects to indicate their race from a range of choices is a widely used research procedure because race determination sometimes is not straightforward. Interviewers received 3 days' training and were closely supervised throughout data collection. We received no reports during our many discussions with interviewers that this procedure produced error.

The percentages of girls among Whites (47.9%) and Blacks (50.6%) were not significantly different ($\chi^2 = 1.1$, $P = .296$, n = 1823). Similarly, the average ages of Whites (mean = 13.1 years) and Blacks (mean = 13.0) were not significantly different ($t = 1.0$, $P = .348$, n = 1823). Parent education was a six-category variable ranging from less than high school graduate to more than 4 years of college education. The education of White and Black parents differed ($\chi^2 = 72.7$, $P = .0001$, n = 1564); White parents were more likely than Black parents to have graduated from high school (81.7% vs 62.8%) and from college (19.0% vs 10.1%).

The primary self-report measure of cigarette smoking was a single questionnaire item that was agreed on for use by investigators funded by the National Cancer Institute[16] and validated by earlier research.[17] The question was "Which statement below BEST describes YOUR current cigarette smoking behavior?" The 13 response categories ranged from "I have never smoked" to "I smoke two packs or more each day." Subjects who said they usually smoked one or more cigarettes per week were considered to be smokers. Supplementary analyses used a question to measure recent smoking ("How long has it been since you last even puffed on a cigarette?"), with eight response categories ranging from "less than 3 hours ago" to "more than 15 hours ago." Smoking within the previous 9 hours was considered recent smoking. The 12 Black subjects and 18 White subjects who reported that they had used marijuana, cigars, or pipes within the previous 9 hours were excluded to preclude their influence on the alveolar carbon monoxide measure described below. Subjects were also asked, "When did you last use chewing tobacco or snuff?" The nine response categories ranged from "never used" to "7 or more days ago." Smokers and any subjects who reported that they had used chewing tobacco or snuff within the previous 3 days were considered to be tobacco users.

TABLE 1—Self-Reported Cigarette and Tobacco Use by Black and White Adolescents

	% Reporting Use				
	Black (n = 530)	White (n = 1293)	χ^2	*C*	*P*
Cigarettes	.4	4.6	20.8	.11	<.0001
Tobacco	1.7	9.9	36.4	.14	<.0001

Note. *C* = contingency coefficient.

Carbon monoxide is a major measurable chemical in tobacco smoke. Each subject provided an alveolar breath sample by taking a deep breath, holding the breath for 20 seconds, blowing half of the breath into the open air, and blowing the remainder of the breath into a bag. The breath was analyzed for level of carbon monoxide, and subjects with levels of 9 ppm or higher were considered to be smokers.[18]

Cotinine is used to indicate nicotine exposure. Each subject deposited 1.5 mL of saliva into a vial. The saliva was frozen on the day of collection, stored until analysis, and analyzed for cotinine by radioimmunoassay. Subjects with cotinine levels of 10 ng/mL or higher were considered to be users of tobacco.[18]

All subjects were told before completing the questionnaires that the biochemical measures would be used to check their reports of cigarette smoking. Earlier studies suggest that such a disclosure enhances the validity of self-reports.[19,20]

Carbon monoxide is used as the standard for self-report of cigarette smoking and cotinine is used as the standard for self-report of tobacco use. Sensitivity is the number of self-reported users per 100 users according to the standard. Specificity is the number of self-reported nonusers per 100 nonusers according to the standard. Underreports and overreports are said to occur when biochemical and self-report measures are incongruent; underreports are self-reports of nonuse when the biochemical measure is positive and overreports are self-reports of use when the biochemical measure is negative. Considerations that must accompany these definitions are addressed in the first part of the discussion section of this paper.

Results

As other studies have shown, Whites are more likely than Blacks to report that they smoke cigarettes and use tobacco (Table 1).

Table 2 shows the sensitivities and specificities for self-reports of cigarette smoking and tobacco use. Blacks were more likely than Whites to underreport use of these substances. Whites were more likely than Blacks to overreport use. The Black–White difference in sensitivity is much larger than the Black–White difference in specificity. Because the vast majority of subjects are not users, however, the small Black–White difference in specificity can contribute to the Black–White difference in self-reported use. The greater use reported by Whites than by Blacks appears to be influenced both by Black underreports and by White overreports.

Do Black–White differences in validity of reports contribute much to the Black–White differences in smoking and tobacco use? To address this question directly, we compared the ratios of White-to-Black use from self-report and biochemical measures. For this comparison we assumed that most if not all of the difference in ratios is attributable to the invalidity of self-reports. Table 3 shows the percentages of cigarette and tobacco users according to self-report and biochemical measures for Blacks and

TABLE 2—Sensitivity and Specificity of Black and White Adolescents' Self-Reports of Cigarette and Tobacco Use

	Black	White	C	P[a]
Cigarettes				
Sensitivity, %	0	62.5	.37	.002
Reported use, no.	0	35		
CO ≥ 9 ppm, no.	7	56		
Specificity, %	99.6	98.0	.06	.009
Reported nonuse, no.	521	1212		
CO < 9 ppm, no.	523	1237		
Tobacco				
Sensitivity, %	12.5	55.8	.25	.001
Reported use, no.	2	82		
Cotinine ≥ 10 ng/ml, no.	16	147		
Specificity, %	98.6	96.0	.07	.004
Reported nonuse, no.	507	1100		
Cotinine < 10 ng/ml, no.	514	1146		

Note. C = contingency coefficient; CO = carbon monoxide.
[a]From Fisher's Exact Test.

TABLE 3—Unadjusted Rates of Tobacco Use by Black and White Adolescents According to Self-Report and Biochemical Measures

	Use, %		Ratio of White to Black Use
	White	Black	
Cigarettes			
Self-report	4.6	.4	11.5
Carbon monoxide	4.3	1.3	3.3
Tobacco			
Self-report	9.9	1.7	5.8
Continine	11.4	3.0	3.8

Whites. The ratios of the White to Black percentages are shown in the right column. Of particular interest is that the ratios of White to Black use are substantially smaller for biochemical measures than for self-reports, suggesting that Black–White differences in cigarette and tobacco use are substantially increased by Black–White differences in invalid self-reports.

Another way to describe the contribution of invalidity to the difference in Black and White-self-reports is to first adjust the self-reports of Blacks for the sensitivity and specificity of Whites and then compare the White-to-Black ratio of unadjusted rates to the ratio of White unadjusted to Black adjusted rates. The extent to which the first ratio is larger than the second reflects the contribution of invalidity to Black–White differences in self-reports. Parallel comparisons can be made with White self-reports adjusted for Black sensitivity and specificity.

The procedures for calculating the adjusted rates are as follows. Sensitivity and specificity, expressed as percentages in Table 2, are converted to proportions by dividing by 100. To derive the number of Blacks who smoke under the conditions of White sensitivity and specificity, we summed two products: (1) White sensitivity times the number of Blacks with carbon monoxide levels of 9 ppm or higher (.625 × 7 = 4.375) and (2) 1.00 minus white specificity (1.00 − 0.98 = 0.02) times the number of Blacks with carbon monoxide levels of less than 9 ppm (0.02 × 523 = 10.460). The adjusted percentage of self-reported Black smokers is the above sum (4.375 + 10.460 = 14.835) per 100 Black subjects (14.835/530 × 100 = 2.8). The same procedure was used to derive a rate of 5.6% of Black self-reported tobacco users adjusted for the sensitivity and specificity of Whites. We used the same procedure to derive rates for Whites that were adjusted for Black sensitivity and specificity. The percentages of White self-reported cigarette and tobacco users, adjusted for Black sensitivity and specificity, are 0.4 and 2.7, respectively.

The unadjusted White-to-Black ratio of 11.5 for cigarette use (Table 3) is much larger than the 1.6 ratio of White unadjusted to Black adjusted rates (4.6: 2.8) and the 1.0 ratio of White adjusted to Black unadjusted rates (0.4:0.4). For tobacco use, the unadjusted White-to-Black ratio of 5.8 is substantially larger than the 1.8 ratio of White unadjusted to Black adjusted rates (9.9:5.6) and the 1.6 ratio of White adjusted to Black unadjusted rates (2.7:1.7). These comparisons, like those presented earlier that compared the ratios of White to Black use from self-report and biochemical measures (Table 3), suggest that a substantial portion of the Black–White difference in self-reported use is due to Black–White differences in the validity of self-reports.

The findings presented above use smoking within a week to identify self-reported smokers. Because carbon monoxide can be detected for about 9 hours, reports of smoking within the previous 9 hours might be more meaningful for determining sensitivity and specificity. However, sensitivity and specificity are changed only slightly when recency is substituted for smoking. Specifically, for Blacks, sensitivity for smoking and tobacco use were identical when the different self-reports of cigarette smoking were used, and specificity was 2.5% lower with the recency measure. When recency was substituted for smoking within a week for Whites, sensitivity of smoking decreased from 62.5% to 53.6% and sensitivity of tobacco use decreased from 55.8% to 50.3%; specificity decreased by 0.2% and 1.5% for smoking and tobacco use, respectively.

Discussion

In this paper we treat biochemical indicators as standards for self-reports of smoking and tobacco use. There are, however, no gold standards for these behaviors. Recent comprehensive reviews of the power, limitations, and range of interpretation of biochemical measures of smoking are available elsewhere.[13,14] Neither of the biochemical indicators has a point at which self-reported behaviors can be determined precisely. The amount of time carbon monoxide and cotinine remain detectable in body fluids varies somewhat by various characteristics,[18] and carbon monoxide level can be influenced by factors such as ambient tobacco smoke and automobile exhaust. We set our

cut-point for carbon monoxide where contribution from sources other than active smoking is unlikely, and the cut-points for both biochemical measures are those commonly used by other researchers. Different self-report measures of cigarette smoking produced sensitivity virtually identical to the values in our tables. Extensive research has failed to find substances other than tobacco that produce cotinine levels as high as those we used to indicate tobacco use, but such substances may be discovered in the future.

It is possible that Blacks and Whites have such large differences in carbon monoxide and cotinine levels for reasons other than smoking and tobacco use that those reasons, rather than the invalidity of self-reports, explain the Black–White difference in biochemical and self-report congruency. If this is the case, then what we consider to be Black–White differences in the validity of self-reports in our data are not differences in invalidity at all. Metabolism of nicotine or excretion of cotinine may vary by race in young adults and therefore in young adolescents, and may thereby influence estimates of sensitivity and specificity.[21] We assume that such factors are too weak to entirely explain the large Black–White differences in sensitivity in our data and the stability of estimates across self-report and biochemical measures. Until future research clarifies this point, however, it must be recognized that what appear to be large Black–White differences in the validity of self-reports may actually reflect something else.

We would have preferred to have more Black smokers and tobacco users available for estimating the sensitivity of self-reports. Indeed, of the 530 Black subjects, only 2 reported smoking and 7 reported tobacco use. Even with the small numerators, however, the differences between Blacks and Whites were statistically significant.

Invalidity may contribute even more to the difference between Black and White self-reports in studies that do not inform subjects that their self-reports will be compared with biochemical indicators. It is likely that in our study validity was increased, and perhaps the difference in invalidity between Blacks and Whites was reduced, because our subjects were told that their answers would be checked by the biochemical indicators.[19,20]

An advantage of the data used in this study is that they did not depend on school enrollment. Most studies of adolescent drug use are based on data collected in schools. The higher school dropout rate of Blacks and the high use of drugs reported by dropouts[22] and students with high absenteeism[23] complicate Black–White comparisons when school-based data are used.

Others have argued that self-reports obtained from adolescents in their homes are less valid than those gathered in schools.[23] The extent to which this is true could limit the generalizability of our findings because our data were collected in homes and many studies of adolescents use data collected in schools. However, the only examination of this possibility that used a true experimental design and thereby avoided many of the potential confounds, such as markedly different sample frames and instrumentation, found no difference in drug use between data gathered in homes and in schools.[24]

Our findings may not be generalizable to drugs other than tobacco. Drug behaviors are significantly correlated, however, and there are compelling reasons for subjects to underreport their use of other drugs in addition to tobacco. Our findings indicate that Black–White differences in invalidity should not be readily dismissed when Black–White comparisons are made.

Others have identified variables that need to be taken into account when attempting to explain Black–White differences in adolescent tobacco use. They include religion, vulnerability, parents' and friends' use, availability, and risk taking.[5,8,9] Our findings suggest that differential invalidity is one of the more important explanatory variables.

Conclusions

Future studies of Black–White differences in drug use that rely on self-reports should account for invalid measurement before proceeding to examine variables of more theoretical and practical interest, or they should give more credence to the possibility that the differences they attempt to explain may be due in large part to differential validity. □

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