Prev Sci (2008) 9:311–321
DOI 10.1007/s11121-008-0103-z

Substance Use and Sexual Risk Prevention in Cape Town, South Africa: An Evaluation of the HealthWise Program

Edward A. Smith · Lori-Ann Palen · Linda L. Caldwell · Alan J. Flisher · John W. Graham · Catherine Mathews · Lisa Wegner · Tania Vergnani

Published online: 7 October 2008
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Abstract Sexual behavior and substance use represent major threats to the health and well-being of South African adolescents, especially in light of the high prevalence of HIV infection in this population. However, there is currently a lack of evidence-based school programs designed to address health risk behaviors. The current study details the evaluation of HealthWise South Africa, a leisure, life skills, and sexuality education intervention for eighth and ninth grade students. We hypothesized that, compared to controls, HealthWise participants would have delayed sexual initiation, reduced rates of current sexual activity, increased use of and perceived access to condoms, and lower rates of lifetime and past use of multiple substances. Longitudinal data were analyzed using logistic regression of multiply imputed data. Results indicate that HealthWise was effective in increasing the perception of condom availability for both genders (OR=1.6). As compared to HealthWise participants, control participants also had steeper increases in recent and heavy use of alcohol (OR=1.4 [95% C.I.=1.1–1.8], 1.6 [1.2–2.2], respectively) and recent and heavy cigarette use (OR=1.4 [1.1–1.7], 1.4 [1.1–1.8], respectively). There were also several significant gender by treatment interactions, which are discussed. These results suggest that HealthWise is a promising approach to reducing multiple health risk behaviors among the population of school-going South African adolescents.

Keywords Adolescence · Intervention · Sexual behavior · South Africa · Substance use · Adolescent substance use · Adolescent sexual behavior · HIV prevention

E. A. Smith · L.-A. Palen · L. L. Caldwell · J. W. Graham
The Pennsylvania State University,
State College, PA, USA

A. J. Flisher · C. Mathews
University of Cape Town,
Cape Town, South Africa

A. J. Flisher
University of Bergen,
Bergen, Norway

L. Wegner · T. Vergnani
University of the Western Cape,
Cape Town, South Africa

E. A. Smith (✉)
S-109 Henderson Building,
University Park, PA 16802, USA
e-mail: eas8@psu.edu

Throughout the world there is a pressing need to implement effective, evidence-based programs that can reduce the incidence of adolescent HIV infection and substance use. South Africa, with the world's highest number of HIV infections (UNAIDS 2007), is in particular need of such programs. However, infection is not uniformly distributed across demographic subgroups. Both the incidence of HIV and the availability of treatment are intertwined with poverty, gender, and the social and historical context of apartheid. A recent study of seroprevalence rates (Shisana et al. 2005) underscores the impact of these three risk factors on the prevalence of HIV/AIDS in South Africa. As reported in that study, the prevalence of HIV infection among young people aged 15–24 years in economically deprived informal urban settlements was almost three times higher than among those living in less deprived communities. Among females aged 20–24 years, the prevalence was 23.9% compared to 6.0% for males. Furthermore, in South Africa, where race has been a critical factor in the social and historical context, there are large differences between

groups, with the prevalence among black South Africans being 13.3% compared to 2.0% among the remainder of the population (Shisana et al. 2005).

Effective prevention efforts that target young people at high risk of HIV/AIDS may help to reduce the overall prevalence and the differential infection rates noted above. In addition, such efforts should directly address the primary mode of transmission among youth, namely heterosexual behavior (Shisana et al. 2005). In South Africa, more than half of 11th grade students have engaged in intercourse, nearly one in ten sexually-active 11th grade students reports having had a sexually transmitted infection, and 13% report having either been pregnant or made someone else pregnant (Reddy et al. 2003). Although these rates are comparable to those reported in studies of adolescents in the USA and a number of other countries (Darroch et al. 2001; Singh et al. 2000), the higher prevalence of HIV in this population dramatically increases the health risks and negative consequences of unprotected sexual behavior.

The prevention of adolescent substance use, and its potential link with sexual risk behavior, constitutes a similarly pressing challenge. According to the 2002 South African Youth Risk Behavior Survey, one in eight high school students begins drinking alcohol before the age of 13 years, and nearly one-quarter of students in grades 8 through 11 have engaged in binge drinking in the previous month (Reddy et al. 2003). About 13% of students in these grades have tried marijuana, with the majority of those having also used it in the past month. Approximately 30% of 8th through 11th graders have smoked cigarettes in their lifetime, with 21% of youth having smoked in the past month and nearly 7% having smoked on 20 or more days in the past month. Again, while these use rates are not that different from the US, the linkage between substance use and sexual risk underscores the need for prevention.

A large body of research suggests that sexual risk behaviors and substance use often occur in combination with one another (Botvin et al. 1995; Halpern-Felsher et al. 1996; Kaiser Family Foundation 2002; Schrier et al. 1996; Tapert et al. 2001). Tobacco, alcohol, and drug use continue to emerge as individual-level risk factors of adolescent sexual behavior, use of contraception, and teen pregnancy (Kirby 2001). Teens report that using alcohol or drugs influences what they do sexually, and makes them feel more comfortable with a sexual partner and less likely to practice safe sex (Kaiser Family Foundation 2002). Guo et al. (2002) concluded that to prevent risky sexual behavior among young adults, interventions should focus on binge drinking and marijuana use.

Several studies have also demonstrated associations between substance use and sexual risk behavior specifically in the South African context. Our current work in South Africa suggests that lifetime use of alcohol or marijuana is associated with higher odds of lifetime sexual intercourse (Palen et al. 2006). Similar associations were found in a different sample of Cape Town youth, with those who had initiated sexual intercourse being more likely to be current smokers, recent binge drinkers, and lifetime marijuana users (Flisher et al. 1996). Simbayi et al. (2005) also found that male lifetime marijuana users tended to exhibit more sexual behaviors that were associated with HIV risk, as compared to non-using men. Among high school students in the KwaZulu-Natal province, those who used alcohol or smoked cigarettes were two to three times more likely to be sexually active (Taylor et al. 2003).

The reasons underlying the covariation of sexual behavior and substance use are unclear. It is possible that the association is causal, which is supported by event-level data in which some students endorse statements that substances influenced their decision to have sex or that they used substances in order to feel more comfortable with a sexual partner (Palen et al. 2006). However, another possibility is that both types of risk behavior have their origins in a common set of underlying causes (e.g., Jessor 1987). Thus, although the relationship between sexual risk and substance use in adolescence is not completely understood, the risk that each imposes, either alone or in combination, suggests that effective prevention is needed that targets both risk factors in relation to each other.

The challenge of developing and evaluating programs that address sexual behavior and substance use among adolescents in South Africa is complicated by the social and contextual conditions of risk mentioned above (Statistics South Africa 2007; United Nations Development Programme 2006). In addition to these broader influences, a number of multi-level factors (personal, interpersonal, environmental) combine to cause some youth to be at heightened levels of risk (e.g., Blum et al. 2002; Flay 2002). Given that the specific mechanisms of how these factors combine are not well understood, researchers advocate a comprehensive strategy, aimed at both prevention and health promotion, to address multiple potential levels and contexts of influence (Blum et al. 2002; Flay 2002; Flay et al. 2001).

One context of adolescents' lives that is often overlooked in comprehensive prevention programs is leisure or free time. As the Carnegie Council on Adolescent Development (1992) underscored well over a decade ago, leisure time is context of both risk and opportunity. Ten years later, Irby and Tolman (2002) stated that leisure is a "key context for education and learning, for health care and the decisions that impact young people's health…" (p. 3). This line of thinking, coupled with previous research in the area of leisure, risk prevention and health promotion led to the development of TimeWise: Taking Charge of Leisure Time (Caldwell 2004; Caldwell et al. 2004). TimeWise is a key component of HealthWise, the intervention discussed in

this paper. It is a school-based intervention that combines knowledge from youth development, developmental psychology, leisure studies, and prevention. The approach employed in this program is consistent with the family of contemporary human development theories that highlight the role of "multi-directional influences" and "developmental systems" (Ford and Lerner 1992; Larson 2000; Lerner et al. 2001; Silbereisen and Todt 1994). TimeWise helps youth understand benefits of leisure, avoid boredom and develop interests; teaches youth leisure skills (such as how to plan for leisure and overcome constraints); and encourages them to take personal responsibility around making healthy, meaningful, and developmentally productive choices in one's free time.

Both TimeWise and HealthWise are school-based interventions. Schools present an important setting in which to provide comprehensive programs and thus have a unique role in combating health risks, including substance use and HIV prevention. In the South African context, as in the US, community, sexual values often constrain open discussion between adults and teenagers about both sexual risk factors (e.g., contraceptive use and sexual partnering) and non-sexual health risk factors (e.g., substance abuse; Gilbert and Walker 2002). Furthermore, adults are often perceived by teenagers as less than adequate role models in terms of their health-related behaviors (Gilbert and Walker 2002). Given that schools have a captive audience of a large proportion of adolescents and are generally viewed as sources of credible information, schools are an excellent setting in which to offer comprehensive approaches.

In 2001, the South African Department of Education prioritized goals of health promotion through their adoption of a "life orientation" component as part of the general education curriculum (Kelly et al. 2001). This policy requires that all secondary schools in South Africa provide instruction to eighth and ninth grade students in areas including substance use, sexuality, socio-emotional development, preparation for the work force, and knowledge of world religions. While curriculum guidelines and learning objectives have been developed, few schools place priority on teaching in this arena, and teachers often address the Life Orientation objectives in an individualized fashion. In some instances non-governmental organizations fulfill part of the objectives, but rarely in a systematic manner. The HealthWise program was specifically designed to fit relevant objectives of the Life Orientation curriculum using a manualized curriculum.

The HealthWise Program

The implementation of the HealthWise program as part of an evaluation trial was the outgrowth of 3 years of pilot work and extensive process evaluation (see Caldwell et al. 2004; Wegner et al. 2007). Following a conference on adolescent problem behaviors co-sponsored by the US National Institute on Drug Abuse in South Africa in March 2000, the first version of HealthWise was piloted in an urban setting near Cape Town in 2001–2002, through a partnership with the University of the Western Cape and the University of Cape Town. This program, which combines elements of Botvin's Life Skills Training (Botvin et al. 1995), Caldwell's (2004) TimeWise: Taking Charge of Leisure Time curriculum, as well as lessons drawn from effective sexual risk prevention curricula, was subject to extensive process evaluation during the initial pilot year (Wegner et al. 2007). Teacher, administrator, and student input resulted in a revised version of the program that has been used in the current trial. In addition to modifications made to the curriculum, the program hired two Youth Development Specialists to serve as liaisons between the schools and the local communities. Ongoing process evaluation indicates that HealthWise is well received by all parties in its current format.

The program consists of 12 lessons in grade 8, followed by 6 booster lessons in grade 9. Each lesson requires two to three class periods to deliver (see Caldwell et al. 2004 for a further description). Lessons cover topics typical to most social-emotional skills programs (e.g., anxiety and anger management, decision making, self-awareness) but also target the positive use of free time (e.g., beating boredom, overcoming leisure constraints, leisure motivation). These lessons are complemented by specific lessons on attitudes, knowledge, and skills surrounding substance use and sexual risk (e.g., relationships and sexual behavior, condom use, realities and myths of drug use). The curriculum is provided in either English or Afrikaans.

Hypotheses

The overall goals of the HealthWise curriculum are to (1) reduce the rate of transmission of HIV/AIDS and other STIs, (2) reduce drug use, and (3) increase the types of leisure experiences that are conducive to healthy development. We theorized that increased positive use and experience of leisure time would translate into program effects on the longer-term outcomes. The focus of this paper was to assess the efficacy of HealthWise on the first two goals; we hypothesized that compared to the non-treatment group, adolescents in the HealthWise group would:

(1) Have reduced sexual risk in the form of delayed onset of sexual intercourse and a higher perception of condom availability, and, among those who have initiated intercourse at some point in the past, a

decreased rate of current sexual intercourse and increased rate of condom use.

(2) Have reduced onset of tobacco, alcohol, and marijuana use, lower rates of current use, and lower quantity of use.

Given the gender differences in the prevalence rates of sexual activity and substance use, all hypotheses were examined for each gender.

Method

Study Design

Beginning in 2003, an efficacy trial was conducted with nine schools. The same four schools ($n_{\text{Time }1}$=901) that participated in the pilot phase became the treatment schools in this trial. These schools and the control schools were selected in the following manner: Of the 25 high schools in the Mitchell's Plain area, 6 were excluded from consideration for the pilot phase due to concerns about their ability to functionally participate. Of the remaining 19 schools, 4 were randomly selected and recruited to pilot the intervention; none refused to participate. During the efficacy trial four additional schools were subjectively matched to the four treatment schools, and one other school served as a back-up to one of the control schools ($n_{\text{Time }1}$= 1,275). This resulted in five control schools, all of which agreed to participate. Information collected by HealthWise research staff at the control schools indicate that the Life Orientation curricula taught in those schools was neither systematic nor extensive, and thus they served as a minimal intervention comparison condition. The research design included three cohorts with multiple waves of data collected at approximately 6-month intervals. For this paper we examine the first cohort across its first five waves of data collection.

Participants

The 2,383 participants were from Mitchell's Plain, a low-income, densely populated urban setting near Cape Town that was established as a township during apartheid. The mean age of all participants at baseline was 14.0 (SD=0.86) years. Fifty-one percent of the sample was female. Most participants identified themselves as "colored" (mix of Asian, European, and African ancestry; 86%), with the rest of the students identifying as black (9%), white (4%), and Indian or other (<1%). At baseline, 5% of eligible participants (n=130) were absent for the survey administration. Another 3% of eligible participants (n=81) either did not provide assent or had parents who denied consent for participation.

Missing Data

Participants were missing very little data within individual survey assessments (about 1% of responses; Palen et al. 2008), but an average of about 10% of the target population was lost to attrition between each wave ($N_{\text{Time }1}$=2,176; $N_{\text{Time }5}$=1,350). Recent work has shown that attrition rates even as high as 50% or more do not necessarily threaten the internal validity of a study, provided modern missing data procedures such as multiple imputation are used (Collins et al. 2001). Given the patterns of attrition observed in the present study, attrition bias would be low enough not to be of concern (based on Collins et al. 2001), unless the association between attrition and outcomes of interest varied systematically by treatment group. Although precise knowledge of this association is not possible because the outcome data are sometimes missing, modeling the outcomes over the five waves of measurement for those with and those without data for the final wave (see Hedeker and Gibbons 1997) reduces uncertainty in this regard (Graham, in press). In the HealthWise data, these patterns of outcome data over the five waves look very similar for program and control groups. Thus we conclude that attrition is very likely to produce acceptably small levels of estimation bias in the present study.

We used multiple imputation to handle missing data for most of the variables of interest (Graham et al. 2003; Schafer and Graham 2002). In addition to the values for substance use and sexual behavior variables at each of the five assessments, each imputed dataset also included dummy codes for gender, race (colored, black, white, other), and school at baseline. Given that we were interested in testing interactions with treatment status, we imputed data sets separately by treatment group.

The skip patterns in our survey presented some complications for the use of multiple imputation. In our raw data set, certain groups of participants were all missing certain items because the skip patterns did not present them with the opportunity to answer some questions. This situation leads to unstable imputation estimates. However, the responses to certain items can be logically substituted for those participants who were not eligible to receive the item, thereby leading to stable estimates when subjected to multiple imputation. For example, a participant who indicated no lifetime alcohol use would not receive the follow-up item about past-month alcohol use. However, we can assume that a participant who has not used alcohol in his or her lifetime has also not used in the past month and substitute accordingly.

For the follow-up items related to sexual intercourse (e.g., time since last intercourse, typical condom usage), substitution was often not possible. Therefore, multiple imputation was not used.

Procedure

Self-administered survey data were collected by the use of personal digital assistants (PDAs) near the beginning and end of each school year. Using PDAs was a highly effective way to gather data from these students and allowed for complex skip patterns to be administered with little to no confusion on the part of the students. The survey was available in either English or Afrikaans. The assessments used in this study were from the beginning and ends of both eighth and ninth grades, as well as the beginning of tenth grade.

Measures

Sexual behavior and condoms All participants responded "true" or "false" to the statement: "I can get condoms." They also responded to one item about whether they had ever had vaginal sexual intercourse (yes/no). Participants who either answered affirmatively or declined to answer this item were presented with a series of follow-up items regarding details of their sexual behavior. These items included the amount of time since they last had sex and how often they used condoms. These items were recoded into two dichotomous variables: whether or not participants had had sex in the month preceding the survey and whether or not they used condoms every time they had sex.

Substance use Participants responded to questions about their use of alcohol, cigarettes, and marijuana. Semi-continuous lifetime use items were recoded as dichotomous indicators. Responses of "none, or only sips in church services," "none, or a few puffs of one cigarette," and "never" (to the alcohol, cigarette, and marijuana items, respectively) were coded as no lifetime use; all other responses were coded as lifetime use.

Participants who indicated that they had used a given substance in their lifetime (or who declined to answer this item) were presented with two additional items about use of that same substance in the past 4 weeks (yes/no) and frequency of use in the past 4 weeks. The frequency variables were collapsed into dichotomous indicators of heavy use of alcohol and cigarettes. The highest-frequency response options (four or more drinks, ten or more cigarettes) were considered to be heavy use; all other frequencies were coded to indicate light use.

Analytic Strategy

We divided our analyses into changes in sexual behavior (Table 2) and changes in substance use (Table 3). Within each analyses there were two strategies used to examine the outcomes. The first set of analyses examined the impact of the HealthWise program on substance use and sexual behavior of the whole sample at wave 5. These analyses used multiple imputation (SAS PROC MI) and logistic regression models (SAS PROC LOGISTIC) that controlled for baseline scores of the outcomes of interest. Given previously-demonstrated differences in risk behavior prevalence by race (e.g., Reddy et al. 2003), race was also controlled in all regression models. Treatment status (HealthWise or control) was included as a predictor in these initial models, and the resultant odds ratios in Tables 2 and 3 reflect overall treatment effects. Gender and a gender by treatment interaction term were then added to determine if treatment effects differed for boys and girls (see Table 4).

A second set of analyses examined program effects at wave 5 for subgroups of participants who had not engaged in a given behavior at baseline. HealthWise was structured as a risk-behavior primary *prevention* program, and it is unclear what effect the program would have on students who had already initiated substance use or sexual behavior. It is possible that the inclusion of these students may mask the program's effects for other youth. Alternatively, many prevention programs have found their strongest results among somewhat higher-risk individuals. Given that baseline scores on the outcome of interest were the same (zero) for this subgroup, it was not necessary to include baseline score in the statistical models. Otherwise, the approach for these analyses was the same as that described above: an initial logistic regression model testing for treatment effects, followed by one testing for potential gender effects. The significance level for treatment main effects was set at $p<0.05$. Given that there was comparatively lower power to detect interaction effects (Selvin 1996), the significance level for gender by treatment interactions was set at $p<0.10$.

In Table 2, we also present a separate analysis with non-imputed data for two of the follow-up sexual behavior items which were asked only of those who were sexually active. These analyses focus on changes that were hypothesized to occur after wave 4, given that the delivery of sexually-related program components occurred mostly between waves 3 and 4. In these analyses we employ a prevalence difference approach, as described in Sahai and Khurshid (1996). We then calculated a 95% confidence interval for this prevalence difference using the Taylor series method. For analyses of these sexual outcomes only, a significant change in prevalence over time is indicated by a confidence interval that does not encompass zero. When comparing two groups, overlapping confidence intervals indicate that the groups are statistically equivalent in the ways that they changed.

Results

Baseline Demographic Characteristics and Behavior

Baseline statistics for the wave 1 participants (n=2,176)[1] appear in Table 1. The HealthWise and control groups differed in racial composition, with the HealthWise group having comparatively fewer mixed race students and comparatively more black students. In both groups, however, over 80% were of mixed race. The groups also differed in their sexual behavior at baseline, with HealthWise participants more likely to have engaged in sexual intercourse in their lifetime. Students in the two conditions did not differ in gender composition, nor in any other substance use or sexual behaviors of interest.

Sexual Behavior

Table 2 indicates that there were no significant overall differences between the two groups in the onset of sexual activity among those who were not sexually active at baseline. However, the gender by treatment interaction was significant (see Table 4). An examination of group-level prevalences at wave 5 indicated that, as compared to control group participants of the same gender, HealthWise boys were somewhat less likely to become sexually active and HealthWise girls were more likely to become sexually active. Among those who reported sexual intercourse at both waves 4 and 5, there were no differences in the proportion who had sex in the month prior to the survey or who used condoms consistently. Among all students, regardless of sexual activity, those exposed to the HealthWise intervention reported a significantly larger increase in the proportion indicating that they were able to get condoms. The gender by treatment interaction was not significant.

Table 1 Descriptive statistics at baseline by treatment status

Variable	Control group (%)[a] N=1,275	HealthWise (%)[a] N=901	χ^2
Gender			0.2
Male	49	48	
Female	51	52	
Race			
Mixed race	90	83	37.9***
Black	6	13	
White	3	3	
Indian	< 1	< 1	
Other	< 1	1	
Survey language			0.8
English	63	61	
Afrikaans	37	39	
Sexual intercourse in lifetime	10	14	10.2**
Sexual intercourse in past month[b]	30	32	0.1
Can get condoms	78	75	2.3
Always use condoms[b]	52	50	0.1
Alcohol use in lifetime	44	41	2.4
Alcohol use in past month	15	16	0.7
Heavy alcohol use	7	8	2.6
Cigarette use in lifetime	35	36	0.0
Cigarette use in past month	24	25	0.0
Heavy cigarette use	14	14	0.2
Marijuana use in lifetime	16	18	0.8
Marijuana use in past month	6	7	1.8

** p<0.01; *** p<0.001

[a] Percentage of participants in respective treatment group

[b] Among sexually active participants

Substance Use

As shown in Table 3, there were no differences between the groups in the initiation of alcohol use. Analysis of alcohol use in the past month among all participants indicates that there was a significant gender by treatment interaction (Table 4); while both genders showed positive treatment effects of HealthWise on past-month drinking, the effect was especially strong for girls. Among the subsample of baseline non-drinkers, HealthWise girls showed a positive treatment effect but there was no effect for HealthWise boys (Table 4).

Among all participants, control group students also had a significantly larger increase in rates of heavy past-month alcohol use. Among the subsample who had not tried alcohol prior to the study, the main effect (Table 3) indicates a positive effect of HealthWise on past-month heavy drinking; the gender interaction was not significant.

There were significant program effects on several cigarette-related outcomes, with two significant gender by treatment interactions among baseline non-smokers (Table 4). HealthWise girls were significantly less likely to have initiated smoking and to have smoked in the past month, as compared to control group girls. However, there were no treatment effects among baseline non-smoking boys on these two outcomes.

Among the full sample (both baseline smokers and non-smokers), increases in past-month and heavy smoking were also larger for the control group. Heavy smoking was also lower among the HealthWise subsample who had not smoked prior to wave 1.

There were no significant effects of HealthWise on past-month marijuana use among the entire sample or among those who had not used marijuana prior to wave 1. However, there was one significant gender by treatment interaction among those who had not used marijuana prior to wave 1. As compared to control group participants of

Table 2 Treatment status predicting wave 5 sexual behavior

Outcome	Sample	Prevalence in imputed data (%)				$N_{wave\ 4}$	$N_{wave\ 5}$	Odds ratio (95% C. I.) Treatment main effect	Δ prevalence wave 4 → wave 5 (95% C.I.)
		Wave 1		Wave 5					
		Control	HW	Control	HW				
Sexual intercourse in lifetime[a]	Not sexually active at wave 1[b]	0	0	21	22	–	–	1.0 (0.8–1.3)[c]	–
Can get condoms[a]	All participants[b]	77	74	92	95	–	–	1.6 (1.03–2.4)[c]	–
Sexual intercourse in past month	Control group	–	–	–	–	184	173	–	−2 (−12, +8)
	HealthWise	–	–	–	–	134	120	–	−6 (−19, +6)
Always use condoms	Control group	–	–	–	–	184	175	–	+2 (−9, +12)
	HealthWise	–	–	–	–	133	119	–	0 (−12, +12)

[a] Race was controlled in this analysis
[b] Analysis was based on imputed data for 2,383 students
[c] Control group students were the reference group for this analysis

their same gender, HealthWise boys were slightly more likely to initiate marijuana use and HealthWise girls were less likely to initiate use.

Discussion

Overall, these results indicate that HealthWise has had a moderate positive effect on the substance use of high school adolescents in this study, particularly among girls. No other longitudinal studies in South Africa with this population have shown comparable effects on these outcomes. In the arena of sexual behavior, the only significant main effect reported here was on the perception of condom availability; HealthWise students were more likely to report that they could get condoms. Separate analyses with these data (Coffman et al. 2008) also indicate that there was a positive effect on both perceived condom self-efficacy and the knowledge of how to properly use a condom among the students in the HealthWise group.

The significant gender by treatment interaction for sexual onset suggests a program effect that reduces sexual onset among boys but increases onset among girls. This statistical interaction, however, along with the interaction on marijuana initiation, should be viewed with caution, especially in light of the lower significance levels used. In both instances the significance is a function of the two genders going in opposite directions when compared to their respective

Table 3 Treatment status predicting wave 5 substance use, controlling for race

Behavior	Sample[a]	Prevalence in imputed data (%)				Odds ratio (95% C. I.) Treatment main effect[b]
		Wave 1		Wave 5		
		Control	HW	Control	HW	
Alcohol use in lifetime	Non-drinkers at wave 1	0	0	60	62	0.9 (0.7–1.2)
Alcohol use in past month	All participants	15	17	39	32	1.4 (1.1–1.8)
Heavy alcohol use	All participants	6	8	19	13	1.6 (1.2–2.2)
Alcohol use in past month	Non-drinkers at wave 1	0	0	29	22	1.4 (0.99–2.0)
Heavy alcohol use	Non-drinkers at wave 1	0	0	12	8	1.7 (1.04–2.6)
Cigarette use in lifetime	Non-smokers at wave 1	0	0	45	39	1.2 (0.9–1.6)
Cigarette use in past month	All participants	25	25	48	41	1.4 (1.1–1.7)
Heavy cigarette use	All participants	13	14	28	22	1.4 (1.1–1.8)
Cigarette use in past month	Non-smokers at wave 1	0	0	35	28	1.4 (1.04–1.8)
Heavy cigarette use	Non-smokers at wave 1	0	0	17	13	1.4 (0.9–1.9)
Marijuana use in lifetime	Non-users at wave 1	0	0	45	45	1.0 (0.8–1.2)
Marijuana use in past month	All participants	5	7	18	22	0.8 (0.6–1.1)
Marijuana use in past month	Non-users at wave 1	0	0	15	18	0.8 (0.6–1.1)

[a] Analyses were based on imputed data for 2,383 students
[b] HealthWise students are the reference group

Table 4 Group-level prevalences in imputed data (N=2,383) and gender by treatment interactions, controlling for race

Behavior	Sample	Control				HealthWise				Odds ratio (90% C. I.) Gender x treatment interaction[a]
		Boys		Girls		Boys		Girls		
		Wave 1	Wave 5	Wave 1	Wave 5	Wave 1	Wave 5	Wave 1	Wave 5	
Sexual intercourse in lifetime	Not sexually active at wave 1	0	29	0	14	0	26	0	19	0.6 (0.4–0.99)
Can get condoms	All participants	79	92	75	93	75	94	73	95	0.1 (0.5–2.2)
Alcohol use in lifetime	Non-drinkers at wave 1	0	58	0	62	0	66	0	59	1.5 (0.95–2.3)
Alcohol use in past month	All participants	17	39	13	39	22	38	11	26	1.6 (1.1–2.4)
Heavy alcohol use	All participants	6	18	6	19	10	15	6	11	1.5 (0.9–2.4)
Alcohol use in past month	Non-drinkers at wave 1	0	28	0	29	0	28	0	17	1.9 (1.1–3.3)
Heavy alcohol use	Non-drinkers at wave 1	0	12	0	12	0	10	0	6	1.6 (0.8–3.5)
Cigarette use in lifetime	Non-smokers at wave 1	0	42	0	48	0	42	0	37	1.5 (1.03–2.3)
Cigarette use in past month	All participants	25	47	24	49	28	42	22	39	1.2 (0.8–1.7)
Heavy cigarette use	All participants	14	27	12	28	16	22	11	22	1.0 (0.7–1.4)
Cigarette use in past month	Non-smokers at wave 1	0	32	0	38	0	32	0	24	1.8 (1.2–2.8)
Heavy cigarette use	Non-smokers at wave 1	0	16	0	18	0	13	0	12	1.2 (0.7–2.1)
Marijuana use in lifetime	Non-users at wave 1	0	46	0	43	0	52	0	39	0.4 (1.1–2.2)
Marijuana use in past month	All participants	8	22	3	14	11	30	4	14	0.4 (0.99–2.5)
Marijuana use in past month	Non-users at wave 1	0	17	0	12	0	24	0	12	0.4 (0.9–2.5)

The baseline sample size is less than the full sample size (N=2,383) due to participant absence at wave 1 and participants transferring into participating schools after wave 1

[a] Gender was coded as 0=boy, 1=girl

control group. The actual percentage changes, within gender, do not constitute practical differences.

In general, the lack of strong effects on sexual onset, combined with the lack of effects among the sexually active students on either their sexual activity in the past month or consistent condom use, was disappointing. One potential explanation of these outcomes may be a product of the initial group differences. As reported in Table 1, the proportion of students who had already experienced sexual intercourse prior to the baseline survey was significantly higher among the HealthWise students. This group may be at higher risk of early onset, suggesting that the propensity of the two groups to engage in sexual activity may differ. Related to this initial difference, it also follows that the likelihood of engaging in sexual intercourse in the month prior to the wave 5 survey, or of the consistent use of condoms, may be more difficult to change among HealthWise students due to their longer history of sexual involvement. Ideally, we should do a separate analysis focusing on these two past-month outcomes with the subsample who initiate sexual activity after the baseline. However, the number who report sexual activity in the month prior to the survey is relatively small, and there was low statistical power to detect a significant change when all students who were sexually active at waves 4 and 5 were included.

The effects of HealthWise on cigarette and alcohol use are very encouraging. HealthWise males and females generally experienced a smaller increase in recent cigarette and alcohol use, including heavy use of these substances. Interestingly, program effects on alcohol and cigarette use for baseline non-users were stronger for girls. Another study using these data may provide an explanation for this finding. Consistent with aforementioned interactions, Palen and colleagues (manuscript in progress) found that HealthWise only prevented the onset of regular smoking among girls. However, that study also found that HealthWise

promoted smoking cessation among boys; this is consistent with the presently demonstrated effect on recent smoking among the full sample but is unable to be captured with the analyses of baseline non-users. This suggests that program main effects may be driven, in part, by effects on substance use cessation.

The gender by treatment interaction on marijuana initiation suggests a positive effect of HealthWise on girls and a negative effect on boys. As mentioned, this effect should not be overstated. Our summary is that there were no practical effects on marijuana use (referred to locally as dagga). However, other longitudinal analyses with these data (Patrick et al., in press) confirm that, similar to the pattern found in the USA, cigarettes and alcohol are the gateway drugs for this population. Therefore, we might anticipate indirect program effects on marijuana use to emerge at later assessments.

We have also conducted separate longitudinal analyses of these data showing that substance use may be a precursor to involvement in sexual behavior (Palen et al., submitted for publication). This suggests that substance use prevention could serve to lower sexual risk. This may be especially important among females, who have a later age at first intercourse than males in this sample.

The picture that emerges from these findings is that HealthWise is a potentially promising, efficacious program that may be helpful in reducing some risk behaviors among low-income adolescents in South Africa and perhaps elsewhere. Although a large number of prevention programs, both in and out of school, have been delivered to adolescents in South Africa, only one (Aarø et al. 2006) has been rigorously evaluated (Kaaya et al. 2002; Mukoma and Flisher 2007). Furthermore, among those that have been evaluated in any type of trial, there have been very few successes.

There are a number of limitations to these results. Because we did not anticipate using PDAs in time to change the instrument and receive IRB approval, the condom use measures we employed were those typically used in surveys in both the USA and South Africa. Recent research on condom use (Noar et al. 2006) has led to a series of suggestions about how to improve the measurement of this behavior. Included in these suggestions are measuring condom use in relation to specific types of sexual acts (vaginal, anal or oral sex), assessing use of birth control methods other than condoms, weighting proportion or frequency of condom use by the frequency of sexual contact, and including measures of social desirability in surveys of condom use behavior. While this entire list may be difficult to include in a paper-based evaluation, the use of PDAs, with the ability to program skip patterns, has the potential to improve our understanding of condom use in future work.

Another limitation to this study is that it was limited to a mostly mixed race population in one area of one city in South Africa. Our limited sample did not allow us to fully investigate potential program differences by racial classification. Although there have been rapid changes in the social fabric of this country since the dismantling of apartheid in 1994, race remains a central factor in health outcomes. As mentioned previously, there are large racial disparities in HIV incidence and there is the need to test this program with a more diverse group of South African adolescents. This is particularly relevant to our lack of results on sexual onset and condom use behavior. The mostly mixed-race sample in this study is not at as high a risk of HIV infection as are Black adolescents in South Africa. When we initiated this research with this low income population, we knew we had to limit our scope to something that was manageable and that had a promise of implementation success. Engaging four schools to implement HealthWise and five additional schools to participate as controls was a large task for all involved. The University of the Western Cape (UWC) has a long history of serving the Mitchell's Plain area and had extensive contacts throughout the community and public school system. We made the purposive decision to use UWC's success with the area as a start for this project. This decision has resulted in a successful implementation and research partnership with the school system. However, the ability to generalize our results to other contexts is limited.

Other limitations of the study include the following: (1) we did not account for school-level clustering, although the intraclass correlations for the variables in this study were very low; (2) we did not obtain data from students who had dropped out of school or were absent on the day of data collection; (3) we did not assign schools to treatment condition in a completely random manner; (4) the effect sizes tended to be small; and (5) we relied on self-reported behavior to assess change and did not use biological measures which may provide more valid data.

Throughout this trial, focus groups held with teachers and students reveal that these groups are very supportive of the HealthWise program, including both the curriculum and the engagement of community service providers with the schools. In addition, conversations with school principals and the curriculum specialists at the administrative district level indicate a strong desire to expand this program to other schools throughout the region (Wegner et al. 2007). This first trial suggests that improvements in some of the program components may help HealthWise improve the health outcomes of the students in this region.

Acknowledgements This research was funded by NIH Grants R01 DA01749 and T32 DA017629-01A1.

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