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Mediation and Moderation of an Efficacious Theory-Based Abstinence-Only Intervention for African American Adolescents

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Abstract

Objective—This secondary data analysis sought to determine what mediated reductions in self-reported sexual initiation over the 24-month post-intervention period in early adolescents who received "Promoting Health among Teens," a theory-based, abstinence-only intervention (Jemmott, Jemmott, & Fong, 2010).

Methods—African American grade 6 and 7 students at inner-city public middle schools were randomized to one of five interventions grounded in social cognitive theory and the theory of reasoned action: 8-hour abstinence-only targeting reduced sexual intercourse; 8-hour safer-sex-only targeting increased condom use; 8-hour and 12-hour comprehensive interventions targeting sexual intercourse and condom use; 8-hour control intervention targeting physical activity and diet. Primary outcome was self-report of vaginal intercourse by 24 months post-intervention. Potential mediators, assessed immediately post-intervention, were theory-of-reasoned-action variables, including behavioral beliefs about positive consequences of abstinence and negative consequences of sex, intention to have sex, normative beliefs about sex, and HIV/STI knowledge. We tested single and serial mediation models using the product-of-coefficients approach.

Results—Of 509 students reporting never having vaginal intercourse at baseline (324 girls and 185 boys; mean age = 11.8 years; SD = 0.8), 500 or 98.2% were included in serial mediation analyses. Consistent with the theory of reasoned action, the abstinence-only intervention increased positive behavioral beliefs about abstinence, which reduced intention to have sex, which in turn reduced sexual initiation. Negative behavioral beliefs about sex, normative beliefs about sex, and HIV/STI knowledge were not mediators.

Conclusions—Abstinence-only interventions should stress the gains to be realized from abstinence rather than the deleterious consequences of sexual involvement.

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Keywords

Sexual behavior; HIV/STI risk-reduction intervention; Social cognitive theory; Theory of reasoned action; Adolescents; Mediation analysis

Sexually transmitted infections (STIs) and unintended pregnancies continue to have a disproportionate impact on young people. Nearly half of all STIs in the US are in people ages 15-24 years (Satterwhite et al., 2013), and more than 80% of the 305,000 pregnancies occurring annually in adolescents are unintended (Hamilton, Martin, & Ventura, 2013). Adolescents younger than age 13 years are less likely to report ever having sexual intercourse: Nationwide, 5.6% of adolescents report having sexual intercourse before age 13, but 64.1% report having sexual intercourse by grade 12 (Kann et al., 2014). Evidence suggesting that STIs are acquired rapidly after sexual debut (Forhan et al., 2009) highlights the need for sexual-risk reduction interventions in early adolescence, before or just after children become sexually active to educate them about safer-sex practices before they establish habitual patterns of unsafe behavior (Jemmott, Jemmott, O'Leary, et al., 2010).

Sexual risk-reduction interventions targeting low-income African American adolescents are a high priority because African Americans report sexual initiation at younger ages. For instance, 14% of African American adolescents compared with 3.3% of White adolescents reported sexual debut before age 13 (Kann et al., 2014). In addition, chlamydia and gonorrhea rates are more than 5 times higher in African American compared with White adolescents (Satterwhite et al., 2013), and African Americans account for 60% of the diagnoses of HIV in people ages 13-24 (Centers for Disease Control and Prevention, 2013). Moreover, the unintended-pregnancy rate is especially high among low-income African Americans (Finer & Zolna, 2011).

Although research suggests that interventions can reduce adolescents' sexual-risk behaviors (Johnson, Scott-Sheldon, Huedo-Medina, & Carey, 2011), questions remain about the efficacy of abstinence-only interventions and, more generally, the mechanisms that underlie intervention-induced sexual-risk reduction. Unprotected intercourse, sex without a latex condom, increases the risk of STIs; reducing the frequency of intercourse or increasing the frequency of condom use, theoretically, would reduce unprotected intercourse. Interventions have employed one (e.g., abstinence-only interventions) or the other or both of these strategies to varying degrees (e.g., comprehensive interventions), but public health experts, educators, parents, and other advocates for youth have vigorously debated the appropriateness of abstinence-only versus comprehensive interventions for more than a decade.

To be sure, considerable evidence supports the efficacy of comprehensive interventions and little evidence supports the efficacy of abstinence-only interventions, but the debate cannot be settled easily because most abstinence-only interventions have not been rigorously evaluated (Chin et al., 2012). The methodology of abstinence-only intervention trials—the small samples, short follow-ups, and scant sexual initiation—and the content of abstinence-only interventions—the absence of theoretical grounding, the undermining of condom use,

and the support of gender stereotypes—have been criticized (Borawski, 2005; Santelli et al., 2006).

However, a randomized controlled trial (RCT) of the Promoting Health among Teens (PHAT) abstinence-only intervention addressed these issues (Jemmott, Jemmott, & Fong, 2010). Power analysis ensured a sufficiently large sample, a 24-month follow-up was employed, and the intervention, grounded in behavior-change theories, did not disparage condom use or support gender stereotypes. The intervention reduced self-reported sexual initiation among African American grade 6 and 7 adolescents compared with an attention-matched control group. The percentage reporting sexual debut was 33.5% in the abstinence-only intervention and 48.5% in the control group. Although the abstinence-only intervention did not affect reports of multiple partnerships or consistent condom use, it did reduce reported sexual intercourse in the past 3 months (i.e., recent sexual activity as opposed to sexual initiation). However, why this abstinence-only intervention was efficacious in reducing self-reported sexual initiation is an unanswered question.

Mediation analysis (Baron & Kenny, 1986) can clarify which aspects of an intervention are responsible for efficacy. However, to our knowledge, only five mediation analyses of HIV risk-reduction interventions for adolescents have been published (Coyle, Kirby, Marin, Gomez, & Gregorich, 2004; O'Leary et al., 2012; Sales et al., 2012; Sanderson & Jemmott, 1996; Schmiege, Broaddus, Levin, & Bryan, 2009), but none examined an abstinence-only intervention. Here we report secondary analyses of the PHAT trial (Jemmott, Jemmott, & Fong, 2010) to understand the mediation of the abstinence-only intervention's efficacy in reducing sexual debut.

A secondary objective was, effect-moderation, whether in subgroups of adolescents, the intervention was differentially efficacious in influencing sexual initiation and recent sexual intercourse (as opposed to sexual initiation), multiple partnerships, and consistent condom use in the past 3 months. The potential moderators were variables that have been associated with adolescents' sexual behavior or have moderated the efficacy of HIV/STI risk-reduction interventions, including gender (O'Leary et al., 2012), religiosity (Hull et al., 2011; O'Leary et al., 2012), hopelessness (Bolland, 2003), and sensation-seeking (Donohew et al., 2000).

Theoretical Framework and Hypotheses

The PHAT abstinence-only intervention was based on the social cognitive theory (Bandura, 1986) and the theory of reasoned action (Ajzen & Fishbein, 1980), theories used in tandem in several efficacious interventions (Jemmott, Jemmott, & Fong, 1998; Jemmott, Jemmott, Fong, & McCaffree, 1999; Kamb et al., 1998). These theories have some variables in common. For instance, the social-cognitive-theory variable of outcome expectancy, the perceived consequences of engaging in the behavior of interest, is the same as the theory-of-reasoned-action variable of behavioral beliefs. Similarly, the theory-of-reasoned-action variable of normative beliefs, beliefs about whether important referents would approve of the person engaging in the behavior of interest, is, in the social cognitive theory, expected approval of important referents, a type of outcome expectancy.

The social cognitive theory proffers strategies to increase the skills required to perform a behavior, including guided practice with performance accomplishments providing reward and observational learning or vicarious experience, for instance, through role-playing and observing role-playing. The theory of reasoned action specifies a structural model of how theoretical variables relate to each other: namely, intention is the primary determinant of behavior and the effects of all other variables on behavior are mediated through intention. For example, the theory would hold that behavioral and normative beliefs do not directly affect behavior, but affect behavior indirectly through intention. Accordingly, we drew upon the social cognitive theory to build behavioral skills and the theory of reasoned action for the mediation model.

We hypothesized that behavioral beliefs and intention to have sexual intercourse would mediate the intervention's effect in reducing sexual debut and that intention would mediate the effects of the other theoretical variables on sexual debut, that no other theoretical variable would have a direct effect on it. We considered two types of behavioral beliefs: behavioral beliefs about the positive consequences of abstinence and behavioral beliefs about the negative consequences of sexual intercourse. Programs to promote abstinence could target either or both of these beliefs. For instance, Department of Health and Human Services guidelines for abstinence-only-until-marriage programs include "teaching the social, psychological, and health gains to be realized by abstaining from sexual activity" and "teaching that sexual activity outside of marriage is likely to have harmful psychological and physical effects" (Committee on Government Reform–Minority Staff, 2004). Increasing HIV risk-reduction knowledge is a goal of most sexual risk-reduction interventions for young adolescents, including abstinence-only interventions; therefore, we considered it also a potential mediator. Although not targeted by the intervention, normative belief is a key theory-of-reasoned-action variable and predicts adolescents' behavior (Dolcini et al., 2013; Kinsman, Romer, Furstenberg, & Schwarz, 1998); therefore, we included it in the mediation analysis.

Methods

Procedures

This article reports findings from a secondary analysis of the PHAT trial; details of the trial's methods and interventions are reported elsewhere (Jemmott, Jemmott, & Fong, 2010). The appropriate institutional review boards at the University of Pennsylvania and the University of Waterloo approved the study. Recruited via announcements in assemblies, classrooms, and lunchrooms at 4 urban public middle schools serving low-income African American communities, the participants were grade 6 and 7 African American students who at baseline reported never having vaginal intercourse (Figure 1).

Adolescents providing assent and parent or guardian consent were randomly assigned to 1 of 5 interventions developed based on the social cognitive theory (Bandura, 1986) and the theory of reasoned action (Ajzen & Fishbein, 1980) integrated with extensive formative research with the target population (Wainberg et al., 2007). Four involved eight 1-hour modules implemented during two sessions; one involved twelve 1-hour modules implemented over three sessions; each included group discussions, videos, games,

brainstorming, and skill-building activities. Each was implemented in mixed-gender groups of 6 to 8 adolescents led by an adult facilitator.

The PHAT 8-hour abstinence-only intervention, encouraging abstinence to eliminate risk of pregnancy and STIs, including HIV, was designed to increase HIV/STI risk-reduction knowledge, strengthen behavioral beliefs supporting abstinence, weaken behavioral beliefs supporting sexual intercourse, and strengthen skills and self-efficacy to negotiate abstinence. An 8-hour safer sex-only intervention, not addressing abstinence, encouraged condom use to reduce the risk of pregnancy and STIs, including HIV. Two comprehensive interventions, one lasting 8 hours and one lasting 12 hours, combined the abstinence and safer-sex interventions. The attention-control group was an 8-hour health-promotion intervention focusing on physical activity and healthy diet. Besides randomizing participants to interventions, we randomized them to receive or not receive an intervention-maintenance component designed to increase the duration of their intervention's efficacy.

Measures

Participants completed questionnaires pre-intervention, immediately post-intervention, and 3, 6, 12, 18, and 24 months post-intervention. Pre-intervention and follow-up questionnaires assessed sexual behaviors, theoretical variables, and sociodemographic and personality variables. The immediate post-intervention questionnaire assessed theoretical variables.

The outcome was self-report of ever having vaginal intercourse by 24-month follow-up. Potential mediators were from the immediately post-intervention assessment. Behavioral beliefs were rated on scales from 1 (*disagree strongly*) to 5 (*agree strongly*). Supplemental Table S1 presents the items. We measured behavioral beliefs about the positive consequences of abstinence with a 4-item scale (α = .84). In baseline data from a previous study (Jemmott & Jemmott), inner-city African American middle school students scoring higher on this measure had lower odds of reporting ever having sex (OR = 0.48, 95% CI, 0.40-0.58) compared with their peers. We measured behavioral beliefs about the negative consequences of sexual intercourse with a 7-item scale (α = .76). In baseline data from a previous study (Jemmott & Jemmott), inner-city African American middle school students scoring higher on this measure had a lower odds of reporting ever having sex (OR = 0.63, 95% CI, 0.49-0.81) than did their peers.

Normative beliefs about sex was measured with a 4-item scale (α = .80) concerning adolescents' beliefs about whether four referents (their father, mother, friends, and sexual partner) would approve of their having sex rated on a scale from 1 (*disapprove strongly*) to 5 (*approve strongly*). In baseline data from a previous study (Jemmott & Jemmott), African American inner-city middle school students scoring higher in normative beliefs about sex were more likely to report ever having sex (OR = 4.02, 95% CI, 2.99-5.41). To assess the intention to have sex, participants were asked: "How likely is it that you will decide to have sexual intercourse in the next 3 months?" Ratings could range from 1 (*very unlikely*) to 5 (*very likely*). In a RCT with inner-city African American middle school students, an abstinence-based intervention reduced scores on this measure compared with a control group (Jemmott et al., 1998). We assessed HIV/STI risk-reduction knowledge with a 24 true-false item index in which the score was the number of correctly answered questions. It was a

shortened version of an index used in a previous RCT in which HIV risk-reduction interventions increased scores on the index compared with the control group (Jemmott et al., 1998). The shorten version is highly correlated with the long version, r (N = 638) = .91, p < .001.

In addition to gender, the following baseline factors were examined for moderation effects on the abstinence-only intervention. Religiosity was assessed with a 4-item scale asking how often the students performed four religious activities (O'Leary et al., 2012): attending church, worship services, or other religious activities; reading the Bible or other religious works; saying grace before eating; and praying before going to sleep. Responses ranged from 1 (Never) to 5 (Once a week or more). Items were averaged to create the scale (α = 0.65). We assessed hopelessness using the Children's Hopelessness Scale (Kazdin, French, Unis, Esveldt-Dawson, & Sherick, 1983). Scores could range from 0 to 17 (α = 0.67) with higher scores indicating hopelessness. The Brief Sensation Seeking Scale (Stephenson, Hoyle, Palmgreen, & Slater, 2003) assessed sensation seeking, participants' tendency to seek novel experiences and willingness to take risks to achieve these experiences. Responses ranged from 1 (Disagree strongly) to 5 (Agree strongly). Items were averaged to create the scale (α = 0.64).

To reduce the tendency of students to minimize or exaggerate, we stressed the importance of responding honestly, informing them that their responses would be used to create programs for other African American students like themselves and that we could do so only if they answered honestly. We assured them that their responses would be confidential (Thrall et al., 2000) and that we would use code numbers rather than names on the questionnaires. In addition, students signed an agreement pledging to answer the questions honestly, a procedure that has been shown to yield more truthful self-reports (Shu, Mazar, Gino, Ariely, & Bazerman, 2012).

Statistical Analysis

We performed two sets of mediation analyses using the product-of-coefficients approach (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002): single mediator analyses on each potential mediator and serial multiple mediator analyses on all the potential mediators simultaneously. The predictor was a dummy variable contrasting the abstinence-only intervention with the health-promotion attention-control intervention; the outcome was a binary variable, self-report of ever having sexual intercourse by the 24-month follow-up. All models were adjusted for baseline values of the potential mediators, effects of the other three interventions (one dummy variable for each of them), maintenance condition, gender, and age.

In the single mediator analyses, we report estimated unstandardized coefficients for α paths, the abstinence-only intervention's effects on the potential mediators at the immediate post-intervention assessment, based on linear regression and for β paths, the effects of the potential mediators on self-reported sexual initiation by 24-month follow-up, adjusting for the intervention, based on logistic regression. The $\alpha\beta$ product quantifies the indirect or mediated effect of the abstinence-only intervention; mediation is determined by testing whether the $\alpha\beta$ product differs from zero. We report the products and corresponding

asymmetric 95% confidence intervals (ACIs) calculated using the bias-corrected bootstrap method, which does not make the unwarranted assumption that the sampling distribution of αβ products is normal (MacKinnon, Lockwood, & Williams, 2004).

We used structural equation modeling (SEM) to test serial multiple mediation models. Because the models include a mixture of variable types, continuous and binary, we used weighted least squares with mean and variance adjustment estimators (WLSMV), which are robust to deviations from model assumptions (Muthén & Muthén, 2012). WLSMV uses all available data under the assumption that, conditional on covariates, data are missing completely at random and non-informative (Little, 1995). To assess model fit, we used the root mean square error of approximation (RMSEA), comparative fit index (CFI), and Tucker-Lewis fit index (TLI). Models are considered to have good fit if the RMSEA is < 0.06 and the CFI and TLI are > 0.95 and considered a poor fit if TLI is < 0.90 (Hu & Bentler, 1999; Kenny & McCoach, 2003). We used the chi-square difference test (Asparouhov, Muthén, & Muthén, 2006) to compare the fit of different models.

We performed the single mediator analyses using SPSS (version 19.0) with the PROCESS macro for Windows (Hayes, 2013). We performed SEM using Mplus Version 7 for Windows (Muthén & Muthén, 2012). The significance criterion was $p < .05$, 2-tailed, and 5,000 samples were used for bias-corrected bootstrap confidence intervals. We assessed moderation of the abstinence-only intervention's effect by testing the Potential-Moderator × Abstinence-only Intervention interactions on the sexual behavior outcomes, applying a Type-1 error adjustment because they were secondary, exploratory analyses. There are four potential moderator variables (gender, religiosity, sensation seeking, and hopelessness); we therefore divided the $p = .05$ significance criterion by 4 to yield a significance criterion of $p = .013$. We applied the intention to treat approach in all analyses, using all available information from the 509 participants without sexual experience at baseline regardless of the number of intervention or data collection sessions they attended.

Results

Figure 1 shows the flow of participants through the trial, including the number of participants enrolled and retained in each intervention. Of the 762 eligible students, 100 (13.1%) declined participation, and 662 were randomized. We do not have data on the characteristics of the eligible non-participants. Table 1 presents the baseline characteristics of the sample for the present analyses, the 509 randomized students, 324 girls and 185 boys, reporting no sexual experience at baseline.

All participants attended intervention session 1; attendance at session 2 was high: 102 or 95.3% in the abstinence-only intervention, 97 or 97.0% in the comprehensive long intervention, 104 or 98.1% in the comprehensive short intervention, 94 or 97.0% in the safer-sex-only intervention, and 97 or 98.0% in the control intervention, with no significant difference among interventions. Only the 12-hour comprehensive intervention had a session 3, and all 100 participants attended it.

Supplemental Table S2 provides the numbers and percentages of missing data for each variable used in the analytical models. The serial mediation analyses using all available data included 500 participants with baseline data on all the mediators, who did not have missing data on the outcome and all of the theoretical variables at the immediate post. The percentage completing the immediate post-intervention assessment (97.6%), the percentage providing data on sexual initiation (89.8%), and the percentage included in the serial mediation analyses (98.2%) did not differ significantly by intervention, maintenance condition, sex, age, or whether the participants lived with both of their parents. Supplemental information contains baseline correlates of sexual initiation by 24-month follow-up.

Mediation

Supplemental Table S3 presents the correlations among the potential mediators. As the significant αβ products in Table 2 indicate, the abstinence-only intervention had indirect effects on self-reported sexual initiation through positive behavioral beliefs about abstinence and intention to have sex. Although the abstinence-only intervention increased negative behavioral beliefs and HIV/STI risk-reduction knowledge, these variables did not predict sexual initiation and did not mediate the intervention's efficacy. In addition, although normative belief about sex predicted decreased self-reported sexual initiation, it was unaffected by the intervention and did not mediate the intervention's efficacy.

We tested three serial multiple mediator models. Positive beliefs, negative beliefs, normative beliefs, and knowledge were allowed to intercorrelate. Model 1, based on the theory of reasoned action, had paths from the intervention to positive and negative behavioral beliefs, normative beliefs, and HIV/STI knowledge, a path from each of them to intention, a path from intention to sexual initiation, and direct paths from the intervention to intention and sexual initiation. The fit was good, RMSEA = 0.04, 90% CI: 0.03, 0.06; CFI = 0.97, and TLI = 0.92. Model 2 added direct paths from positive and negative beliefs, normative beliefs, and knowledge to sexual initiation. The fit was good, RMSEA = 0.04, 90% CI: 0.02, 0.06; CFI = 0.98, and TLI = 0.93. Model 2 fitted the data better than did Model 1, chi-square = 12.02, $df = 4$, $p = 0.017$.

Model 2 revealed that positive behavioral beliefs about abstinence had a direct relation (unmediated by intention) to sexual initiation, whereas the other three theoretical variables, negative beliefs, normative beliefs, and knowledge, did not. Model 3 eliminated the direct paths from negative beliefs, normative beliefs, and knowledge, to sexual initiation. The fit was good, RMSEA = 0.04, 90% CI: 0.02, 0.06; CFI = 0.98, TLI = 0.93. Model 2 with more predicting variables did not fit the data better than Model 3, chi-square = 6.26, $df = 3$, $p = 0.100$; thus we selected Model 3 as the best fitted model.

Figure 2 illustrates Model 3. The intervention significantly increased participants' positive behavioral beliefs about abstinence, which was associated with reduced intention to have sexual intercourse, which then was associated with decreased probability of reporting ever having sexual intercourse. In addition, positive behavioral belief about abstinence was directly associated with decreased probability of sexual initiation. The product of the three coefficients on the path from the intervention to positive behavioral beliefs, from positive

behavioral beliefs to intention, and from intention to sexual initiation was significant, −0.022 (95% ACI: −.050, −.007), indicating the intervention reduced sexual initiation through increasing positive behavioral beliefs, which increased intention. The product of the two coefficients on the path from the intervention to positive behavioral beliefs to sexual initiation was also significant, −0.073 (95% ACI: −.180, −.004). The products of coefficients for the other three paths (i.e., negative behavioral beliefs, normative beliefs, and knowledge) were nonsignificant. The intervention did not have significant direct (unmediated) effects on either intention or sexual initiation. To examine whether Model 3 had complete mediation, we further constrained the direct effect from the intervention to sexual initiation as 0 (Rucker, Preacher, Tormala, & Petty, 2011). Allowing a direct path from the intervention to sexual initiation did increase model fit, chi-square = 2.18, $df = 1$, $p = 0.14$, suggesting complete mediation in Model 3.

Moderation Analyses

None of the Potential-Moderator × Abstinence-only Intervention interactions was significant on any of the sexual behavior outcomes. Thus, the abstinence-only intervention's effect on self-reported sexual initiation, recent sexual intercourse, multiple partnerships, and consistent condom did not differ by participants' gender, religiosity, hopelessness, or sensation seeking.

Discussion

The PHAT abstinence-only intervention, grounded in social cognitive theory and the theory of reasoned action, decreased self-reported sexual initiation during the 24 months post-intervention, a decrease mediated by two theoretical variables, intention to have sex and positive behavioral beliefs about abstinence. As the most direct determinant of behavior, according to the theory of reasoned action (Ajzen & Fishbein, 1980), it is not surprising that intention was a mediator of the intervention's efficacy, a finding consistent with studies showing intention mediated intervention effects on adolescents' condom use (Sanderson & Jemmott, 1996; Schmiege et al., 2009). More interesting is the mediating role of positive behavioral beliefs about abstinence. In contrast, negative behavioral belief about sex was not a significant mediator: the intervention increased it, but it did not predict self-reported sexual initiation.

Positive behavioral beliefs imply potential gains from performing a behavior, whereas negative behavioral beliefs imply potential losses. According to prospect theory, for relatively low-risk behaviors, including preventive health behaviors, beliefs about gains resulting from adhering to recommended behaviors are more motivating than are beliefs about losses resulting from not adhering (Kahneman & Tversky, 1979). From this perspective, our results are consistent with previous work suggesting that emphasizing potential benefits of condom use may be a more effective way to increase condom use than emphasizing the costs of not using condoms (Rothman & Salovey, 1997).

The mediation analyses also revealed that normative beliefs about sex did not mediate the intervention's efficacy. Although normative beliefs about sex predicted self-reported sexual initiation—indeed, it was the strongest predictor—the intervention did not influence it, a

finding suggesting that involving participants' parents or friends might strengthen the intervention's efficacy by reducing expectations for normative approval of sexual involvement. HIV/STI risk-reduction knowledge also did not mediate intervention efficacy. Although the intervention increased participants' HIV/STI knowledge, knowledge was not associated with reduced self-reported sexual initiation, a finding consistent with previous research (O'Leary et al., 2012).

The SEM analyses provided mixed support for the theory of reasoned action model of mediation. According to the theory, intentions are the direct determinant of behavior and the effects of all other variables are mediated through intentions (Ajzen & Fishbein, 1980). We implemented analyses of three alternative models that built upon this basic premise of the theory of reasoned action. The best-fitted model concurred with the theory of reasoned action except that positive behavioral beliefs directly affected sexual initiation without a mediation process through intention. Why this contradiction of the theory occurred is unclear, but it underscores the importance of positive behavioral beliefs regarding abstinence in reducing sexual initiation.

In secondary analyses, gender, religiosity, hopelessness, and sensation seeking did not moderate the intervention's effects on self-reported sexual initiation or any other sexual behavior, suggesting that the intervention's effects are robust across these variables.

Limitations

The limitations of the study should be considered. We relied on self-reported sexual behavior as the primary outcome, which can be inaccurate because of the failure of memory or socially desirable responding. This study did not assess self-efficacy, which has been a mediator in other studies (O'Leary et al., 2012; Schmiege et al., 2009). The mediation models did not allow for measurement error in the potential mediators. Our use of linear regression to test the significance of the α paths in the single mediator models assumed a normal distribution in the theoretical variables. However, linear regression is robust to violations of this assumption (Cohen & Cohen, 1983; Winer, Brown, & Michels, 1991), and there are no assumptions regarding the computation or interpretation of the regression coefficients used in testing the indirect effects. The WLSMV model assumes multivariate normality. However, in analyses not shown, we tested Model 3 using maximum likelihood estimation with robust standard errors (MLR), an analytic approach that is robust to non-normality. The results using MLR were the same as the results using WLSMV. We also used heteoscedasticity-consistent standard errors in PROCESS (Hayes, 2013) and WLSMV in Mplus (White, 1980), which can provide some assurance that the validity of our inference is not compromised by the potential violation of the homoscedasticity assumption. There are also assumptions about causal ordering in mediation analysis, for instance, that the putative mediator should not cause the independent variable (Baron & Kenny, 1986). However, this study established temporal precedence in a longitudinal RCT in which we manipulated the independent variable and assessed the putative mediators after the manipulation but before we assessed the outcome. Still, the mediation analyses are ultimately correlational; evidence from factorial experiments manipulating intervention components and putative mediators would be more cogent. Finally, the findings may not generalize to all African American

adolescents; accordingly, future research assess generalizability by testing the intervention's efficacy and mediation in other adolescent populations and settings.

Implications

Despite the limitations, this study's findings have implications for clinical practice and heath policy. For more than a decade, public health experts, educators, parents, and other advocates for youth have vigorously debated the role of abstinence-only interventions in efforts to reduce adolescents' sexual risks. Few rigorous studies have evaluated such interventions; thus, scant evidence supports their efficacy. The PHAT trial raised the possibility that by drawing upon behavior-change theories an abstinence-only intervention could delay sexual initiation. This article provides more specific information, suggesting that emphasizing the gains to be realized from practicing abstinence rather than the deleterious consequences of sexual involvement might be a way to develop more efficacious abstinence-only interventions. Furthermore, including adolescents' parents or friends in abstinence-only interventions, enlisting normative support for abstinence, may be a particularly powerful way to increase the impact of such interventions. By discussing sexual issues with their parents, adolescents may get to know their parents' level of approval of sexual behaviors, which was a significant predictor of abstaining from sex in this study and in a previous study (O'Leary et al., 2012). Similarly, if an adolescent's friends are included in the intervention, the friends' behavioral beliefs supporting abstinence could be strengthened, increasing the likelihood that they will support the adolescent's decision to abstain.

More broadly, there are implications that stem from the high rates of sexual initiation observed in this study. The Youth Risk Behavior Survey (Centers for Disease Control and Prevention, 2008) has revealed a prevalence of ever having sexual intercourse in grade 9 students of about 33% compared with the 43% of the adolescents in this study who reported ever having sexual intercourse at 24-month follow-up, when they would have been in grade 8 or 9. This difference underscores the higher rates of early sexual debut among African American adolescents, the accompanying high risk for unintended pregnancy and STI, including HIV, and the urgent need for efficacious sexual risk-reduction interventions for this population.

Conclusion

In conclusion, although many HIV/STI risk-reduction interventions have been based on behavior-change theories, few studies have examined whether the targeted theoretical variables mediated the interventions' effects on sexual-risk behavior. This study reveals that PHAT, a theory-based abstinence-only intervention, mainly worked through behavioral beliefs about the positive consequences of abstinence but not the negative consequences of sex. In addition, adolescents' normative belief about sex was a significant predictor of sexual initiation, a finding that raises the possibility that interventions focusing on adolescents with their parents and close friends might change beliefs in expected approval, which, in turn, might delay sexual initiation. Clinicians, health educators, and others who would increase abstinence or other healthful behaviors among adolescents should pay attention to the efficacious theoretical components of interventions, explore reasons why some components

are not, and, more generally, focus on the psychological mechanisms underlying behavior change. Efforts along these lines might reduce the risks that young people face as they navigate adolescence.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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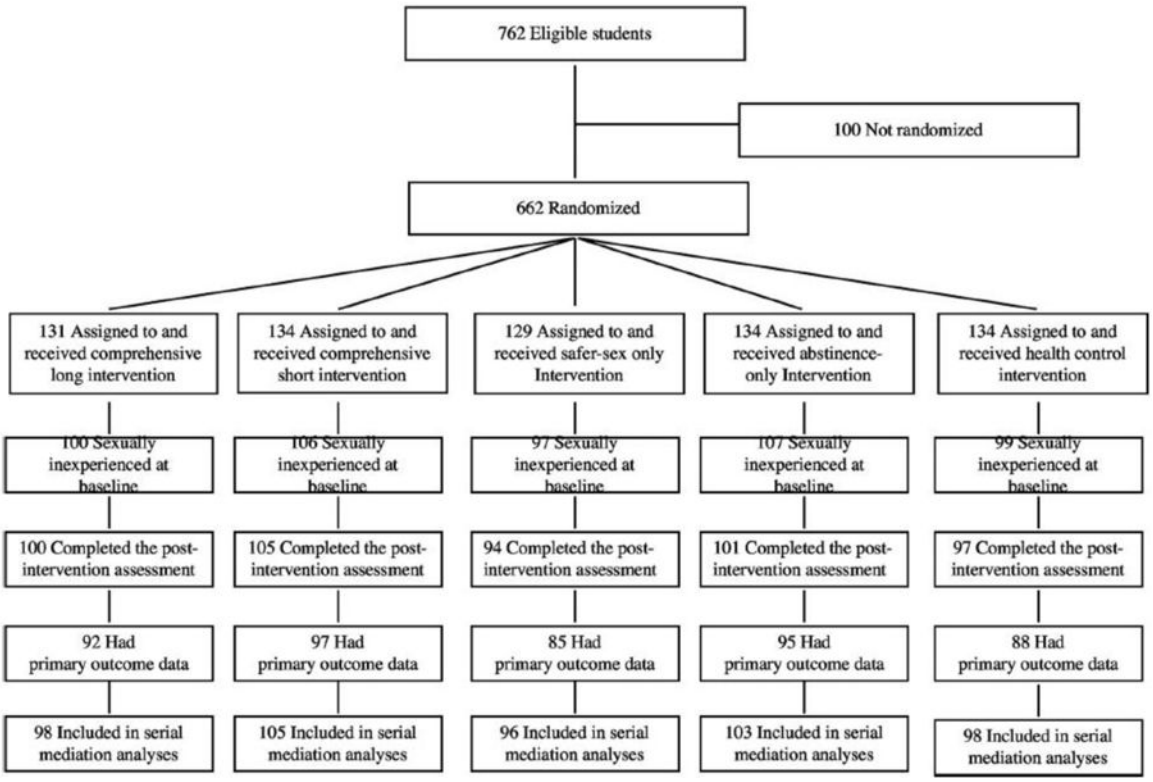

Figure 1.
Flow of participants through the Promoting Health among Teens (PHAT) trial.

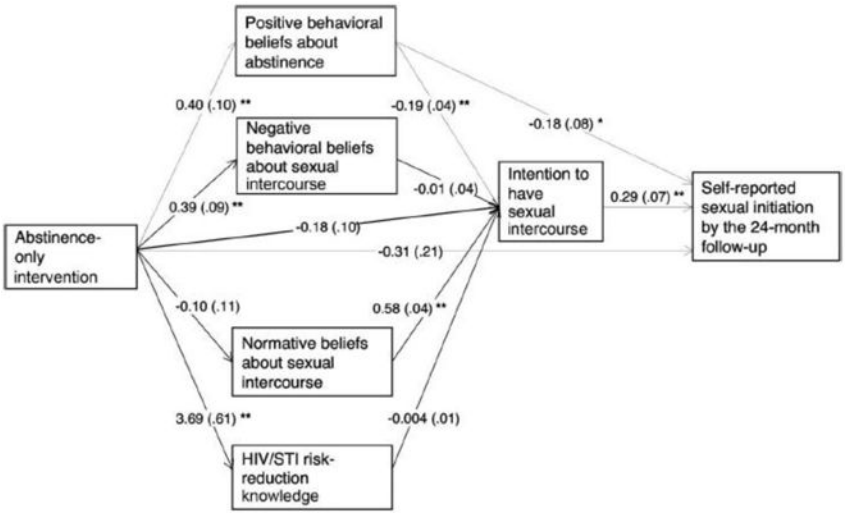

Figure 2.

Serial mediation model of the effect of the abstinence-only intervention on theoretical variables and self-reported sexual initiation by the 24-month follow-up among African American adolescents estimated using structural equation modeling. All paths to self-reported sexual initiation are unstandardized coefficients (SE) from probit regression; all other paths are unstandardized coefficients (SE) from linear regression. *$p < .05$, **$p < .0001$.

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Table 1

Baseline characteristics and reports of ever having sexual intercourse by 24-month follow-up of participating African American adolescents by intervention condition.

Characteristics	Total	12-h Comprehensive	8-h Comprehensive	Safer Sex Only	Abstinence Only	Health Control
Sample size (N)	509	100	106	97	107	99
Female[a]	324/509 (63.65)	66/100 (66.00)	67/106 (63.21)	60/97 (61.86)	66/107 (61.68)	65/99 (65.67)
Age[b]	11.84 (0.77)	11.73 (0.72)	11.74 (0.73)	11.96 (0.80)	11.91 (0.84)	11.87 (0.74)
Living with both parents[a]	175/503 (34.79)	36/99 (36.36)	36/105 (34.29)	31/95 (32.63)	34/106 (32.08)	38/98 (38.78)
Intervention maintenance[a]	264/509 (51.87)	53/100 (53.00)	53/106 (50.00)	52/97 (53.61)	55/107 (51.40)	51/99 (51.52)
Had sexual intercourse by 24-month follow-up[a]	195/457 (42.67)	39/92 (42.39)	44/85 (51.76)	31/95 (32.63)	31/95 (32.63)	41/88 (46.59)

Notes.

[a] n/N (%) on binary variables (gender, living with both parents, randomization to intervention maintenance, and self-report of ever having sexual intercourse).

[b] Mean (SD) on continuous variables (age).

Table 2

Single mediator analyses of the effects of the abstinence-only intervention compared with health-promotion control intervention on self-report of ever having sexual intercourse by the 24-month follow-up among African American adolescents.

	Effect of the intervention on the potential mediator			Effect of the potential mediator on sexual initiation			Indirect effect of the potential mediator on sexual initiation	
Potential mediator	**α path (SE)**	**95% CI**	**P value**	**β path (SE)**	**95% CI**	**P value**	**αβ**	**95% ACI**
Positive behavioral beliefs about abstinence	0.41 (0.12)	(0.17, 0.65)	< .001	−0.33 (0.14)	(−0.60, −0.06)	.019	−0.14	(−0.32, −0.03)
Negative behavioral beliefs about sexual intercourse	0.42 (0.11)	(0.20, 0.64)	< .001	−0.10 (0.15)	(−0.39, 0.19)	.507	−0.04	(−0.21, 0.08)
Normative beliefs about sexual intercourse	−0.13 (0.11)	(−0.35, 0.09)	.232	0.52 (0.14)	(0.25, 0.79)	< .001	−0.07	(−0.22, 0.03)
Intention to have sexual intercourse	−0.34 (0.13)	(−0.59, −0.09)	.010	0.50 (0.13)	(0.25, 0.75)	< .001	−0.17	(−0.37, −0.05)
HIV/STI risk-reduction knowledge	3.66 (0.63)	(2.43, 4.89)	< .001	−0.002 (0.03)	(−0.06, 0.06)	.930	−0.01	(−0.19, 0.18)

Notes. The α path is the abstinence-only intervention's effect on each potential mediator. The β path is each potential mediator's relation to the outcome, controlling for the intervention effect. The αβ product is the indirect or mediated effect of the abstinence-only intervention on sexual initiation via each specific potential mediator. ACI is asymmetric confidence interval based on Bootstrap bias-corrected method with 5,000 replicates. The mediation analyses were adjusted for effects of the other three interventions, attending an intervention-maintenance program, gender, age, and baseline value of the mediator.