Pregnancy as a Window of Opportunity for HIV Prevention: Effects of an HIV Intervention Delivered Within Prenatal Care

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Objectives. We sought to determine whether an HIV prevention program bundled with group prenatal care reduced sexually transmitted infection (STI) incidence, repeat pregnancy, sexual risk behavior, and psychosocial risks.

Methods. We conducted a randomized controlled trial at 2 prenatal clinics. We assigned pregnant women aged 14 to 25 years (N=1047) to individual care, attention-matched group care, and group care with an integrated HIV component. We conducted structured interviews at baseline (second trimester), third trimester, and 6 and 12 months postpartum.

Results. Mean age of participants was 20.4 years; 80% were African American. According to intent-to-treat analyses, women assigned to the HIV-prevention group intervention were significantly less likely to have repeat pregnancy at 6 months postpartum than individual-care and attention-matched controls; they demonstrated increased condom use and decreased unprotected sexual intercourse compared with individual-care and attention-matched controls. Subanalyses showed that being in the HIV-prevention group reduced STI incidence among the subgroup of adolescents.

Conclusion. HIV prevention integrated with prenatal care resulted in reduced biological, behavioral, and psychosocial risks for HIV. (*Am J Public Health.* 2009; 99:2079–2086. doi:10.2105/AJPH.2008.154476)

Young pregnant women are at high risk for HIV and sexually transmitted infections (STIs).[1] In a systematic review of sexual risk behavior among pregnant or mothering adolescents, 19% to 39% had an STI during pregnancy, and 14% to 39% had an STI 6 to 10 months postpartum. Furthermore, young pregnant women were 5 times less likely to use condoms compared with nulliparous women.[2]

Despite the risks of STI and HIV infection among women of reproductive age, few HIV interventions have specifically targeted pregnant women. The Children's Health and Responsible Mothering project (Project CHARM), a school-based intervention of pregnant and mothering adolescents, found increases in condom-use intentions, but no difference in number of unprotected acts of sexual intercourse compared with a general health promotion control group.[3] Another study found that pregnant women given a 4-session HIV intervention had moderate increases in knowledge and safer sexual behaviors that were sustained 6 months after the intervention.[4]

Although few studies of HIV and STI interventions have targeted pregnant women, some have focused on women attending primary care clinics.[5–8] Interventions for STI clinic patients documented significant declines in STI incidence.[8,9] However, most HIV interventions are limited because they do not integrate HIV prevention with the provision of other services,[10,11] and are not theory based.[12–14]

Pregnancy offers a unique opportunity for intervention as it is a time when women engage in high-risk behaviors, make behavioral changes, and have frequent contact with health care professionals.[15–18] Finally, interventions integrated with existing care systems (e.g., prenatal care) can be sustained because care is reimbursable by insurance.[19]

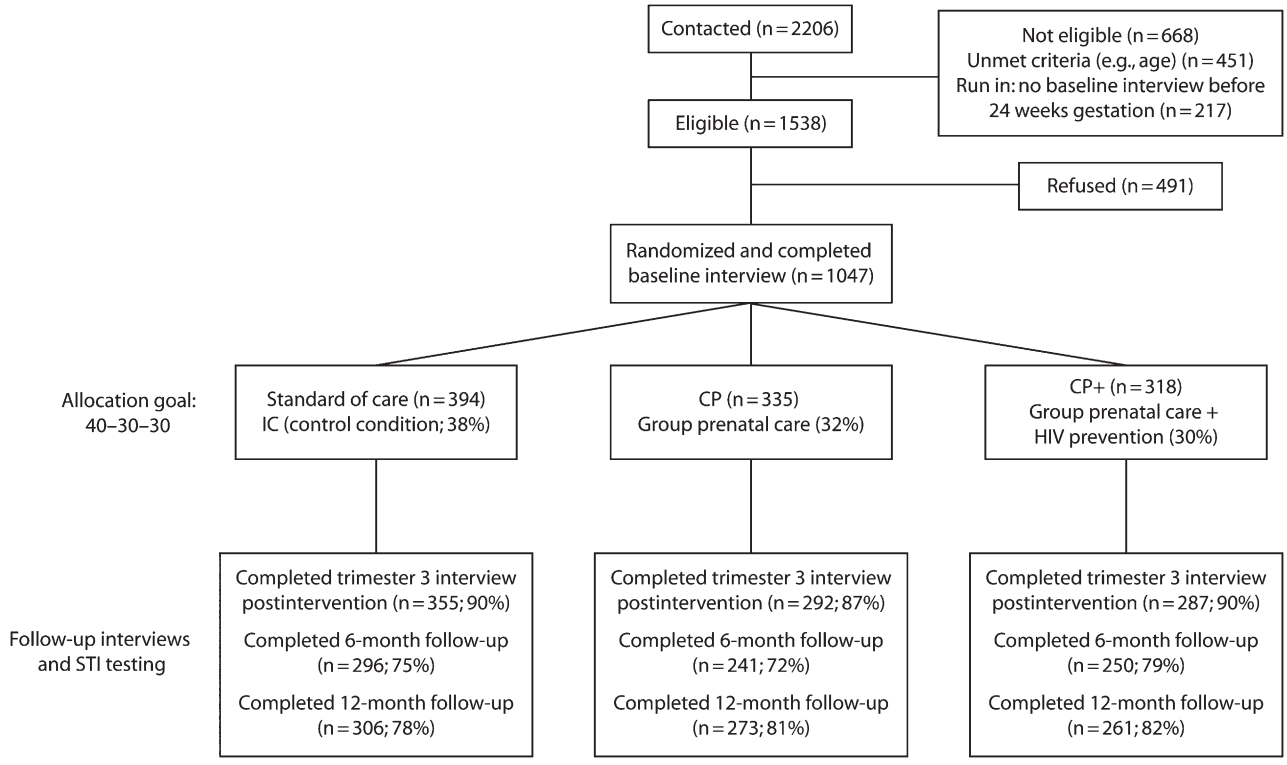
The bundling of HIV prevention with existing systems can increase the accessibility of HIV prevention by providing opportunities to reach individuals who may not have the motivation or time to attend stand-alone HIV prevention sessions.[19] HIV and STI prevention programs have been successfully integrated in care settings such as psychiatric, drug treatment, and palliative medicine.[20–22] We developed an HIV intervention that was integrated with a model of prenatal care.

CenteringPregnancy group prenatal care[23,24] has been shown to reduce preterm birth and increase prenatal care satisfaction.[23,25] We created a modified program, CenteringPregnancy Plus, by integrating HIV prevention with the group prenatal care model. The purpose of this study was to evaluate the effects of this integrated HIV prevention program on biological outcomes (STI, repeat pregnancy), sexual risk behaviors (condom use, unprotected sexual intercourse), and psychosocial variables (communication, perceived risk, self-efficacy).

METHODS

We conducted a randomized controlled trial of young pregnant women receiving prenatal care at 2 public clinics from September 2001 to December 2004. We randomly assigned women (N=1047) to 1 of 3 groups (CONSORT; Figure 1): (1) standard individual prenatal care (IC), (2) standard CenteringPregnancy group prenatal care (CP), or (3) CenteringPregnancy Plus group prenatal care that includes HIV-prevention components (CPP). We conducted baseline interviews in the second trimester (mean=18 weeks gestation; standard deviation [SD]=3.3) to correspond with the beginning of the group prenatal program (which begins on average at 20 weeks gestation). The participants completed follow-up interviews in the third trimester (mean=35 weeks gestation; SD=3.1), and at 6 months postpartum (mean = 27 weeks postpartum; SD=4.5), and 12 months postpartum (mean=53 weeks postpartum; SD=5.7).

To randomize participants, we used blocked randomized controlled design, stratified on site and expected month of delivery. We used a computer-generated randomization sequence to randomize participants with the allocation goal of 40% IC, 30% CP, and 30% CPP.



Note. CP = CenteringPregnancy group prenatal care control group; CPP = CenteringPregnancy group prenatal care plus HIV prevention components; IC = standard individual prenatal care control group; STI = sexually transmitted infection.

FIGURE 1—CONSORT study description.

Sample

Of the 1538 eligible women, 1047 (68%) enrolled. Recruitment was nearly equivalent between the 2 study sites: Atlanta, Georgia (n=546; 52%), and New Haven, Connecticut (n=503; 48%). Intervention effects were not statistically different on primary outcomes by study site (all $P > .05$); therefore, analyses were combined across sites. Even with randomization, baseline differences can emerge by chance. To evaluate this, we conducted χ^2 and t tests comparing study conditions on variables assessed at baseline. By chance, individuals randomized to CPP were more likely to be African American (86% in CPP; 80% in CP; 75% in IC; $\chi^2 = 19.96$; $P = .003$), and less likely to have positive health behaviors (mean=33.3 for CPP; 34.3 for IC; 33.3 for CP; F=3.65; $P = .026$). Therefore, all subsequent analyses controlled for these variables.

There were no differences between conditions on retention at each follow-up interview (all $P > .10$). Furthermore, 93% of participants had at least 1 follow-up interview.

Between September 2001 and December 2004, women attending prenatal care were referred by a health care provider or approached directly by research staff. Inclusion criteria included (1) pregnant at less than 24 weeks gestation, (2) aged 25 years or younger, (3) no severe medical problem (e.g., diabetes, hypertension, HIV), and (4) able to attend groups conducted in English or Spanish. All participants were paid $20 for each interview. Procedures were approved by human investigation committees at both sites.

Intervention

CenteringPregnancy provides group prenatal care in groups of 8 to 12 women led by a trained practitioner (e.g., midwife, obstetrician). All prenatal care occurs within the group setting except for the initial assessment. The curriculum consists of 10 structured sessions (120 minutes each) during pregnancy. Participants engage in self-care activities of weight and blood pressure assessment and participate in group discussion to address issues in prenatal care, childbirth preparation, and postpartum care. CenteringPregnancy has been described in detail elsewhere.[25]

CenteringPregnancy Plus has the same structure, time commitment, and general content as CP with the exception that for 3 sessions (sessions 4, 5, and 7), 40 minutes is devoted to HIV prevention skills, resulting in 120 minutes of HIV-related content. The HIV prevention components of CPP are based on social cognitive theory and the ecological model[2,26] and are adapted from previous efficacious interventions.[27] We targeted key variables from social cognitive theory (e.g., self-efficacy, modeling) across all levels of the ecological model including individual (e.g., efficacy, perceived risk), dyad (e.g., interpersonal communication), and community levels (e.g., social norms). We based our intervention on social cognitive theory because of its demonstrated effectiveness for adolescents.[28]

In session 4, participants watched testimonials of adolescents with HIV to heighten risk perceptions and social norms, discussed

barriers and benefits of condom use, personalized their own HIV and STI risk, and set goals for safe sexual behavior. In session 5, participants developed sexual partner communication skills about safe sexual behavior through role-play and modeling. In session 7, group members reinforced communication skills through role play and modeling, evaluated their goals for safe sexual behavior from session 4, and set new goals for safe sexual behavior after pregnancy.

The CP control group had the same contact time, promotion of prenatal health behaviors, and opportunities for social support. Therefore, it served as a true attention-matched control, with the only difference being the specific HIV content and focus on skills-building.

The IC participants met on the same schedule and the same number of times with their health care providers as CPP and CP; however, the contact time was consistent with traditional prenatal care (i.e., 10 to 15 minutes per session).

We conducted structured interviews via audio computer-assisted self-interviewing. This technology helps participants with lower reading skills complete assessments with greater ease.

Measures

Biological outcomes. We assessed bacterial STI acquisition (chlamydia and gonorrhea) with biological ligase chain reaction testing. At each follow-up, we tested participants for chlamydia and gonorrhea with urine-based Strand Displacement Amplification testing (BD Diagnostic Systems, Sparks, MD). We assessed the presence of STIs at each follow-up independently of previous STI diagnoses (i.e., the results were not aggregated across time points).

We assessed repeat pregnancy at 6 and 12 months postpartum by asking participants whether they had become pregnant since their index pregnancy. At 12 months, repeat pregnancy was treated as an aggregate variable because many of the women who were pregnant at 6 months postpartum were also pregnant at 12 months.

Behavioral outcomes. Behavioral outcomes included percentage of condom use, which we calculated by the average self-estimated percentage of condom use among sexually active participants in the past 6 months across all partners. We assessed number of unprotected sex occasions by subtracting the number of times participants used a condom from the number of times they had sexual intercourse in the past 30 days. Individuals who did not have any sexual partners were coded as having zero unprotected sexual acts.

Psychosocial outcomes. We assessed safe sex communication with 4 items. Two items had participants respond whether they had asked or demanded to use a condom in the past 6 months.[6] For the other 2 items, participants assessed the number of times in the past month they had talked about condoms and HIV concerns with their sexual partner.[29] Responses were coded as talking about condoms or HIV concerns zero versus 1 or more times. The 4 items were summed (range=0–4), with higher scores indicating more communication about safe sexual activity. Results showed adequate internal consistency across all time points (α_M=0.74; range=0.65–0.79).

We assessed perceived HIV and STI risk by using 2 items in which participants rated their perceived susceptibility to getting an STI and HIV in the next year, from 0=no chance to 3=good chance.[30–32] Results showed good internal consistency across all time points (α_M=0.83; range=0.82–0.85).

We assessed condom use self-efficacy with 6 items that measured how confident women were in using condoms and communicating about condoms (e.g., "How sure are you that you could have a condom with you when you needed it?"; "Imagine that you and your boyfriend have been having sex but have not used condoms. You really want to start using condoms. How sure are you that you could tell your partner you want to start using condoms?"). Responses ranged from 1=not at all sure to 4=very sure.[33] Results showed adequate internal consistency (α_M=0.78; range=0.70–0.82).

We assessed HIV and STI risk knowledge with 11 items with responses ranging from 0=definitely false to 4=definitely true.[29] Results showed adequate internal consistency across all time points (α_M=0.70; range=0.64–0.74).

Data Analytic Plan

Analyses were a series of random effects regression analyses based on intention-to-treat models with randomized condition as the primary independent variable: CPP, CP, and IC.[34,35] Random effects allow the use of all available data rather than excluding missing data—this allows intent-to-treat analyses to be easily conducted.[34,35] For each random effects regression, we treated the 3 follow-up assessment points as a random effect of time controlling for baseline scores. We modeled a series of planned comparisons that looked at differences in follow-up controlling for baseline scores for CPP compared with the 2 control groups combined (e.g., CPP versus IC and CP). For all significant effects, we conducted post hoc analyses to assess if the nature of the differences were similar for each control group (i.e., IC and CP). For continuous outcomes, random effect regressions with general linear mixed models were employed by using SAS PROC MIXED (SAS Institute Inc, Cary, NC). For count data (e.g., number of unprotected sexual acts), we employed generalized linear mixed models that used SAS PROC GLIMMIX (SAS Institute Inc, Cary, NC). For the count data, we used a Poisson distribution, whereas for the binary data we used a binomial distribution. For the dichotomous variable (repeat pregnancy, STIs), we conducted logistic regression analyses.

In addition, we assessed the possibility that the intervention was more effective for key risk subgroups. Therefore, we tested for 2 possible moderators: race and age. These potential moderators were chosen because they have been shown to be important predictors of STI and HIV risk.[36] Interaction tests were assessed and followed up with stratified analyses.

RESULTS

Eighty percent of participants were African American, 13% were Latina, 6% were White, and 1% were mixed or other race/ethnicity. The average age was 20.4 years (SD=2.6); 49% were aged younger than 20 years and 51% were aged 20 years or older. Forty-eight percent were nulliparous. More than half of participants had a history of an STI diagnosis.

Biological Outcomes

As seen in Table 1, rates of bacterial STIs were highest 12 months postpartum. The rates of chlamydia and gonorrhea were 7.6% and 1.6% at third trimester, 6.3% and 2.1% at 6

TABLE 1—Means and Percentages of Biological, Behavioral, and Psychosocial Outcomes Among Young Pregnant Women, by Intervention Condition: Atlanta, GA, and New Haven, CT, September 2001–December 2004

	Baseline			Third Trimester					6 Mo Postpartum					12 Mo Postpartum				
	IC, % or Mean (SE)	CPP or Mean (SE)	CPP, % or Mean (SE)	IC, % or Mean (SE)	CP, % or Mean (SE)	CPP, % or Mean (SE)	OR (95% CI) or F Test	*P*	IC, % or Mean (SE)	CP, % or Mean (SE)	CPP, % or Mean (SE)	OR (95% CI) or F Test	*P*	IC, % or Mean (SE)	CP, % or Mean (SE)	CPP, % or Mean (SE)	OR (95% CI) or F Test	*P*
Biological																		
STI,[a]	NA	NA	NA	7.1	7.2	6.9	0.88 (0.53, 1.47)	.63	5.8	6.6	6.9	0.95 (0.55, 1.64)	.86	10.2	8.1	8.8	0.72 (0.38, 1.36)	.32
Repeat pregnancy	NA	NA	NA	NA	NA	NA	NA	NA	12.9	7.9	5.6	0.49 (0.27, 0.91)	.02*	26.0	22.5	23.1	0.95 (0.63, 1.78)	.79
Behavioral																		
% condom use	35.93 (38.1)	35.54 (37.0)	39.29 (37.7)	29.01 (39.3)	31.35 (37.9)	34.67 (39.2)	1.06	.30	40.67 (40.1)	42.74 (39.5)	51.03 (40.6)	7.45	.007*	44.11 (40.8)	41.88 (41.3)	49.76 (41.4)	3.93	.04*
No. of acts of unprotected sexual intercourse	5.66 (7.6)	6.45 (8.3)	5.26 (6.8)	4.14 (6.6)	5.05 (7.2)	4.47 (6.9)	0.49	.49	4.72 (7.0)	4.84 (7.2)	3.81 (6.5)	1.79	.18	5.26 (7.8)	5.69 (7.9)	3.89 (6.5)	3.78	.04*
Psychosocial																		
Communication about safe sexual activity	1.99 (1.4)	2.02 (1.4)	2.05 (1.3)	1.70 (1.6)	1.73 (1.5)	2.34 (1.5)	25.98	.001*	2.39 (1.5)	2.45 (1.4)	2.67 (1.4)	1.48	.22	2.40 (1.5)	2.32 (1.5)	2.69 (1.4)	4.54	.03*
Perceived risk for HIV or STI	2.63 (1.2)	2.82 (1.3)	2.70 (1.2)	2.61 (1.2)	2.48 (1.0)	2.64 (1.3)	0.54	.46	2.48 (1.0)	2.49 (1.0)	2.57 (1.0)	0.84	.36	2.47 (1.0)	2.50 (1.0)	2.63 (1.1)	2.75	.09
Condom use self-efficacy	22.09 (2.8)	22.06 (2.4)	22.20 (2.6)	22.43 (2.7)	22.34 (2.5)	22.38 (2.5)	0.20	.66	22.28 (2.9)	22.16 (3.1)	22.58 (2.6)	2.20	.14	22.38 (2.9)	22.1 (2.9)	22.47 (2.8)	0.39	.53

Notes. Tests refer to differences among groups at each time point adjusting for baseline scores and race and health behavior. CI = confidence interval; CP = CenteringPregnancy group prenatal care control group; CPP = CenteringPregnancy group prenatal care plus HIV prevention component; IC = standard individual prenatal care control group; NA = not applicable; OR = odds ratio; STI = sexually transmitted infection. Sample size was N = 1047.

[a]STI testing for chlamydia and gonorrhea only.

*$P < .05$

months postpartum, and 10.3% and 2.9% at 12 months postpartum, respectively. Results showed no differences between CPP and control groups on bacterial STI incidence (chlamydia and gonorrhea) at follow-up. However, there was a significant difference on repeat pregnancy 6 months postpartum. When we used logistic regression, results showed a significant intervention effect (χ^2_1=5.69; *P*=.02). The odds of a repeat pregnancy at 6 months postpartum was significantly less likely for CPP participants compared with IC and CP control participants (odds ratio [OR]=0.49; 95% confidence interval [CI]=0.27, 0.91; *P*=.02). Post hoc analyses showed that this effect was largely driven by differences between CPP and IC participants (OR=0.39; 95% CI=0.20, 0.75; *P*=.005); there was no significant difference between CPP and CP participants on repeat pregnancy at 6 months postpartum (OR=0.69; 95% CI=0.33, 1.41; *P*=.31). Furthermore, the difference between CPP participants and IC and CP controls on repeat pregnancy was no longer significant at 12 months postpartum (OR=0.95; *P*=.79).

Behavioral Outcomes

There was partial support for the effectiveness of the intervention on behavioral outcomes. When we controlled for baseline scores, there were no differences in condom use in the third trimester of pregnancy. However, the CPP group had significantly more condom use than IC and CP control participants at 6 months postpartum (F=7.45; *P*=.007) and at 12 months postpartum (F=3.93; *P*=.04). Post hoc analyses showed that these differences were somewhat stronger for IC controls than for CP controls (d=0.23 for IC and d=0.16 for CP at 6 months postpartum; Figure 2a). Similar but somewhat weaker results were found for number of occasions of unprotected sexual intercourse (Figure 2b). The CPP participants did not differ from controls on unprotected sexual intercourse in the third trimester of pregnancy or at 6 months postpartum, but CPP participants did have less unprotected sexual intercourse compared with IC and CP control participants at 12 months postpartum (F=3.78; *P*=.05). Post hoc analyses showed that effect sizes were comparable for both IC and CP control groups (d=0.15 versus d=0.16, respectively).

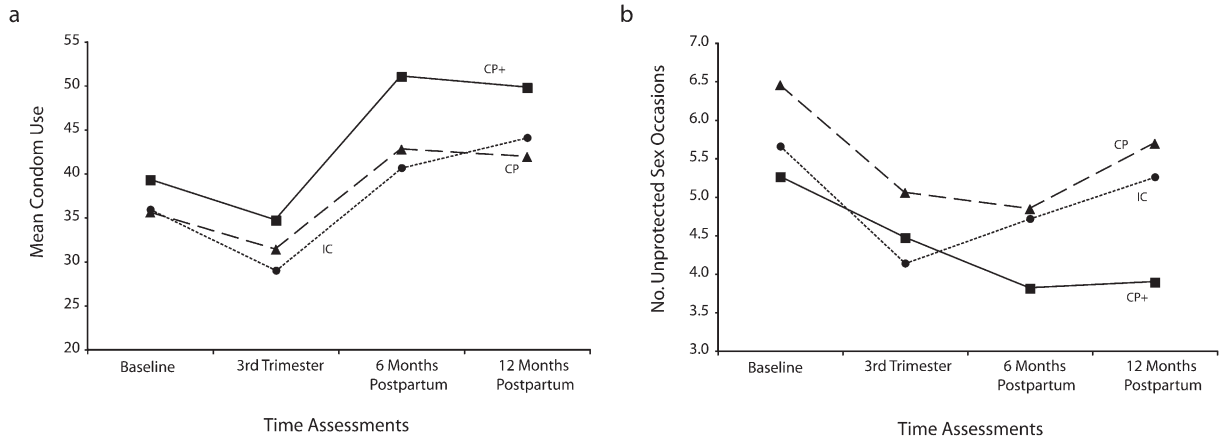
To explore condom use motivations we conducted post hoc analyses among condom users. Of those using condoms at 6 months postpartum, there were no differences in the reason for condom use between the CPP participants and the IC and CP controls (*P*>.05). Eighty-six percent of participants reported they used condoms for pregnancy prevention and 52% reported using them for STI protection. However, at 12 months postpartum, participants in CPP were more likely to report using condoms for STI protection compared with the IC and CP controls (64% versus 55%; *P*=.028). There were no differences between groups on use of condoms for pregnancy prevention at 12 months (with an overall rate of 83%).

Psychosocial Outcomes

The CPP participants had significantly more communication with their sexual partners about safe sexual activity than IC and CP control participants during the third trimester of pregnancy (F=25.98; *P*=.001) and at 12 months postpartum (F=4.54; *P*=.03). However, there were no differences between the CPP group and the IC and CP control groups at 6 months postpartum. Post hoc analyses showed comparable differences for IC and CP groups (d=0.38 versus d=0.37) for the third trimester of pregnancy. However, the differences at 12 months postpartum were somewhat stronger for CP than for IC (d=0.20 versus d=0.16). There were no differences between CPP and control participants on perceived risk and condom use self-efficacy.

Subgroup Analyses

Although we did not find differences on STI incidence among the groups, it is possible that the intervention was stronger in some subgroups than in others. We tested 2 potential moderators (race and age). Because the majority of participants were African American, we compared the effectiveness of the intervention for African American versus non–African American participants. There were no



Note. CP = CenteringPregnancy group prenatal care control group; CPP = CenteringPregnancy group prenatal care plus HIV prevention components; IC = standard individual prenatal care control group. Sample size was N = 1047.

FIGURE 2—Among young pregnant women at 2 public clinics, (a) condom use percentage by intervention condition and (b) occasions of unprotected sexual intercourse by intervention condition: Atlanta, GA, and New Haven, CT, September 2001–December 2004.

significant interactions between race and intervention groups on STIs at any follow-up assessment (all $P > .05$).

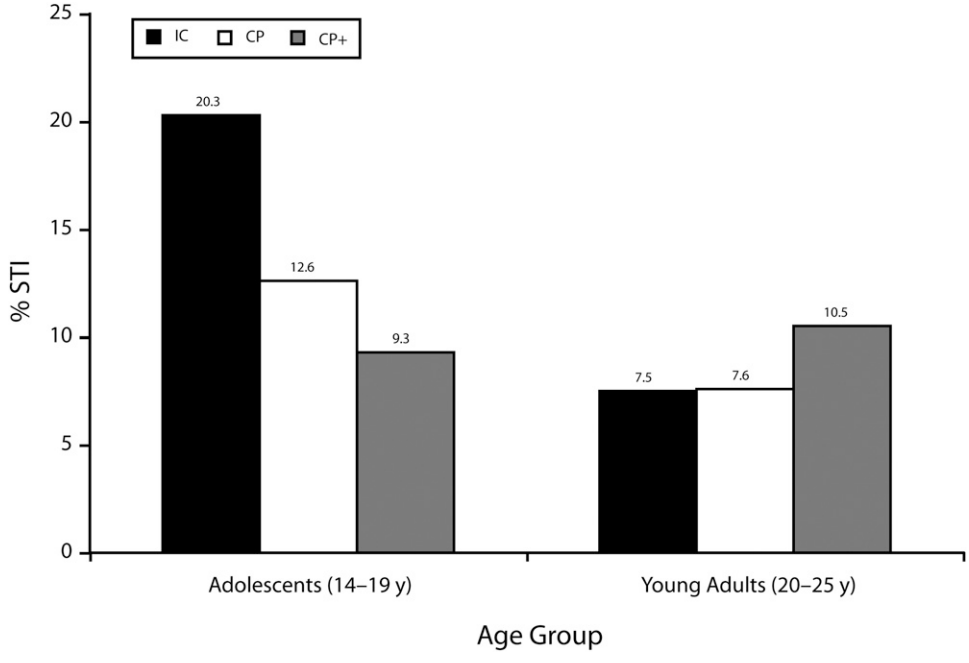
For age, we compared adolescents (aged 14 to 19 years) with young adults (aged 20 to 25 years). Results showed a significant interaction between age and intervention group on STI at 12 months postpartum ($\chi^2_1 = 6.61$; $P = .01$; Figure 3). Post hoc stratified analyses showed that among adolescents, CPP participants had significantly fewer STIs at the 12-month follow-up compared with control participants (9.3% versus 16.5%; OR = 0.48; 95% CI = 0.24, 0.96). Post hoc analyses showed that this effect was stronger compared with IC control participants (OR = 0.37; 95% CI = 0.17, 0.77) than with CP participants (OR = 0.67; 95% CI = 0.30, 1.45). Among young adults, there were no differences in STI rates between the CPP group and IC and CP control participants ($P = .19$).

DISCUSSION

CenteringPregnancy Plus is different from other HIV interventions because it seamlessly integrates HIV prevention into an existing health care structure (prenatal care). By bundling HIV prevention services into existing prenatal health care services, we maximize the reach and minimize the barriers to implementing the intervention broadly to at-risk populations. Furthermore, the additional time needed for HIV prevention does not come at the expense of prenatal care. We have previously shown that CPP and CP do not differ on birth outcomes (preterm labor, low birthweight), prenatal care satisfaction, prenatal distress, or initiation of breastfeeding.[25]

Participation in the CPP group reduced repeat pregnancy at 6 months postpartum by 51% compared with participants in the control groups. Repeat pregnancy for adolescents that occurs shortly after index birth can increase parenting stress and negative parenting behaviors.[37] Therefore, this reduction in repeat pregnancy may significantly impact quality of life of young mothers. However, it should be noted that this effect was not sustained by 12 months postpartum, indicating that booster sessions may be needed to sustain these effects. A possible mechanism of this effect at 6 months postpartum may have been increased breastfeeding. We have shown in a previous study that the CPP group had increased breastfeeding compared with the IC group.[25] We conducted a post hoc test including breastfeeding postpartum as a potential mediator of the repeat pregnancy effect (results not shown). The CPP group still significantly differed from controls with regard to repeat pregnancy at 6 months postpartum after we controlled for breastfeeding. Furthermore, breastfeeding did not significantly relate to repeat pregnancy. This suggests that breastfeeding was not a mechanism of the influence of CPP on repeat pregnancy at 6 months.

Participation in the CPP group had sustainable effects on condom use. The CPP participants had more condom use and less unprotected sexual activity than did participants in both the IC and the CP groups. It should be noted that these effects were primarily seen at the postpartum follow-ups. Even though pregnancy is a time women may make many changes, it may be harder for them to change condom use behavior during pregnancy because they are not trying to prevent pregnancy. However, once the baby is born and



Note. STI testing for chlamydia and gonorrhea only. CP = CenteringPregnancy group prenatal care control group; CPP = CenteringPregnancy group prenatal care plus HIV prevention components; IC = standard individual prenatal care control group; STI = sexually transmitted infection. Sample size was N = 1047.

FIGURE 3—Sexually transmitted infection (STI) incidence at 12 months postpartum among young pregnant women at 2 public clinics, by intervention condition and age group: Atlanta, GA, and New Haven, CT, September 2001–December 2004.

contraceptive practices are reintroduced, women in the CPP groups were more likely to initiate condom use than were control participants. It should be noted that condom use was significantly different at both 6 and 12 months postpartum, whereas number of acts of unprotected sexual intercourse was only significant at 12 months. This may be because of reduced incidence at 6 months compared with 12 months. Less frequency of sexual intercourse overall provides less opportunity for groups to differ. Percentage of condom use is not as affected by intercourse frequency and therefore was different at both time points.

One potential mechanism of these results is attributable to increased communication with sexual partners about sexual activity and HIV. HIV and STI risk is influenced by interpersonal factors. Studies have shown that sexual communication is related to condom use and STI risk. Through the use of modeling and role-play, we were able to increase participants' communication about sexual risk behavior and condoms with their partners. This may have helped them negotiate safe sexual behavior.

Despite the behavioral effects of increased condom use and communication, we did not show overall differences in STI incidence. However, we did show that participation in the CPP group was effective in reducing STIs for adolescents. Our results showed that at 12 months postpartum, adolescent CPP participants showed a 52% reduction in STI incidence compared with adolescent control participants. Young pregnant women are particularly vulnerable to STI and HIV risk.[1] Therefore, finding an intervention that is effective for this subpopulation is crucial in reducing women's risk of HIV and STIs.

This study had several limitations that should be noted. The sample represents a restricted group of young, ethnic minority women of low socioeconomic status who attend urban hospital clinics for prenatal care. Replication with diverse patient populations is essential. Also, despite differences between the conditions, most effect sizes were small (d=0.15–0.38), with an overall average effect size across all significant effects of 0.19. Therefore, although the intervention was effective, the difference was modest in size.

However, the results are still compelling. Meta-analyses of HIV prevention interventions among adolescents have shown an average effect size of 0.05 for condom use.[14] Our results showed effect sizes that are well above the average of other HIV interventions. Furthermore, because CPP is bundled in an existing prenatal care intervention, the positive effects on HIV prevention behavior were in addition to reductions in preterm birth and prenatal distress and improvements in prenatal care satisfaction and breastfeeding.[25] Finally, although the age and race subgroup analyses were made a priori, the study was not designed or powered on these moderation analyses. Therefore, lack of differences for the race subgroup analysis may be partially from differential sample size between racial groups and inadequate power.

Despite these limitations, the intervention is one of the first to affect sexual risk behavior among pregnant women. Pregnancy may be an important window of opportunity to foster behavioral change and improve the health of women across multiple domains. Furthermore, this study may have a significant impact on the design and delivery of future prenatal care services. Making HIV/STI prevention a part of prenatal care may prove to be a useful tool in the reduction of HIV, STIs, and repeat pregnancy. ■

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Contributors

T.S. Kershaw was the project director, prepared the article, and conducted all data analyses. T.S. Kershaw and J. Ickovics were responsible for interpretation of the data and study design. U. Magriples contributed substantively to the writing and editing of this article. C. Westdahl was responsible for study implementation in Atlanta, GA. T.S. Kershaw, U. Magriples, and J. Ickovics were responsible for study implementation in New Haven, CT. S.S. Rising developed the CenteringPregnancy group prenatal care model and conducted all provider training. J. Ickovics was the principal investigator. All authors contributed to article review and editorial suggestion.

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The trial is registered on ClinicalTrials.gov: NCT00271960.

Human Participant Protection

Procedures were approved by human investigation committees at both sites (Yale #11972 and Emory #197-2001).

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