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Original article

The Developmental Association of Relationship Quality, Hormonal Contraceptive Choice and Condom Non-Use among Adolescent Women

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Abstract

Purpose: Consistent condom use is critical to efforts to prevent sexually transmitted infections among adolescents, but condom use may decline as relationships and contraceptive needs change. The purpose of this research is to assess changes in condom non-use longitudinally in the context of changes in relationship quality, coital frequency and hormonal contraceptive choice.

Methods: Participants were women (aged 14–17 years at enrollment) recruited from three urban adolescent medicine clinics. Data were collected at three-month intervals using a face-to-face structured interview. Participants were able to contribute up to 10 interviews, but on average contributed 4.2 interviews over the 27-month period. Independent variables assessed partner-specific relationship quality (five items; scale range 5–25; $\alpha = .92$, e.g., *this partner is a very important person to me*); and, number of coital events with a specific partner. Additional items assessed experience with oral contraceptive pills (OCP) use and injected depo medroxy-progesterone acetate (DMPA). The outcome variable was number of coital events without condom use during the past three months. Analyses were conducted as a three-level hierarchical linear growth curve model using HLM 6. The Level 1 predictor was time, to test the hypothesis that condom non-use increases over time. Level 2 predictors assessed relationship quality and coital frequency across all partners to assess hypotheses that participants' condom non-use increases over time as a function of relationship quality and coital frequency. Level 3 predictors assessed the participant-level influence of OCP or DMPA experience on time-related changes in condom non-use.

Results: A total of 176 women reported 279 sex partners and contributed 478 visits. Both average coital frequency and average condom non-use linearly increased during the 27-month follow-up. At any given follow-up, about 35% reported recent OCP use, and 65% reported DMPA use. HLM analyses showed that condom non-use increased as a function of time ($\beta = .12$; $p = .03$, Level 1 analysis). Increased condom non-use over time was primarily a function of increased coital frequency ($\beta = .01$; $p = .00$), although higher levels of relationship quality were associated with increased condom non-use at enrollment ($\beta = .44$; $p = .00$, Level 2 analysis). The temporal rise in condom non-use significantly increased among DMPA users ($\beta = .06$; $p = .00$) but not OCP users (Level 3 analysis) ($\beta = -.04$; $p = .06$).

Conclusions: Developmentally, relationship characteristics and coital frequency appear to have increasing weight in decisions about condom use. Hormonal contraceptive methods are not equivalently associated with the overall temporal decline in condom use. Future research associated with dual contraceptive/condom use should address differential factors associated condom use in combination with different hormonal methods.

Keywords: Hormonal contraception; Condom use; Relationship quality

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The prophylactic functions of condoms include prevention of sexually transmitted infections (STI) as well as conception [1]. This dual function makes condoms unique among the contraceptive methods available to adolescents. However, many adolescents, especially women, prefer more reliable, coitus-independent contraceptive methods that do not reduce STI risk [2]. In fact, hormonal contraceptive methods may increase risk of some STI, making condom use even more important [3]. Thus, so-called "dual use" of coitus-independent contraception plus condom use with each coitus has become a public health standard [4]. This ideal has been difficult to achieve, however, and fewer than 25% of adolescent women consider themselves to be "dual users" [5,6]. Many adolescent women view dual use as a "trade-off" between intimacy and decreased perceived STI risk. These women are especially unlikely to use condoms in addition to hormonal contraceptive methods [7].

Issues surrounding pregnancy and STI prevention become additionally complex because choices about contraception and condom use are not static characteristics of adolescents or their sexual relationships. Condom use is more common with a new sexual partner, and during the early weeks of a relationship [8,9]. Adolescents discontinue condom use quickly, perhaps less than one month, suggesting that consistent condom use is a relatively short-lived characteristic of many sexual relationships [10]. Among adolescent women, condom use is less likely in partnerships characterized as relatively higher in emotional affiliations [11,12]. Although coital frequency is typically higher in more stable relationships, greater coital frequency appears to be associated independently with increased levels of non-condom use, even when relationship characteristics are controlled [12,13].

A final factor that may affect condom use is the specific type of coitus-independent contraceptive method. The most widely used methods—oral contraceptive pills (OCP) and depot medroxy-progesterone acetate (DMPA)–are similar in terms of contraceptive effectiveness but differ markedly in terms of method characteristics and user perceptions. For example, up to one-half of OCP users miss enough doses to place them at risk for pregnancy, with the implied need for a back-up contraceptive method [14]. Thus, the demand of daily pill-taking (and awareness of failures in pill-taking) mandates more attention to contraception and STI prevention issues while the certainty of contraceptive protection and prolonged intervals between DMPA injections may diminish such attention [15]. Therefore, accumulation of experience with a method such as DMPA may be associated with increasing levels of condom non-use, whereas OCP experience would be less likely to change levels of condom non-use.

Existing research lacks an understanding of the effects of developmental change in condom use and contraceptive behaviors. The average age of first sexual intercourse for American women is about age 16, thus a substantial portion of middle and late adolescent development may be accompanied by sexual activity [16]. By age 20, an average of five lifetime sex partners is reported. These partnerships are usually sequential, allowing for an accumulation of experience with romantic and sexual relationships, changing personal and interpersonal motivations for sex, and changes in motivations for contraception [17]. Condom use behaviors appear to decline over time, not only within a given relationship, but in each succeeding relationship [9,10].

These developmental contexts of hormonal contraception and condom use warrant a more detailed understanding of their development over time. The purpose of this research, then, is to evaluate the short-term (within three-month intervals) and long term (over 27 months) changes in condom non-use in the context of partner-specific relationship quality, partner-specific coital frequency, and hormonal contraceptive choice. A latent growth curve (LGC) approach using hierarchical linear modeling (HLM) is used to allow the examination of patterns of change (e.g., linear or non-linear) as well as testing of hypotheses about potential predictors of these changes. LGC allows individual and group change to be modeled by using a varying number and spacing of data points across time, which is indicative of these data [18]. This method also allows the information from all the sex partners during any time period to be incorporated and analyzed in a predictive model.

Methods

Study design and procedures

Data were collected as part of a larger longitudinal study of risk and protective factors (initiated in 1999) associated with sexually transmitted infections among women in middle adolescence. Briefly, the larger study consisted of an enrollment visit and follow-up clinic visits each three months during a 27-month study period (up to 10 visits total). At each visit, a structured face-to-face interview with trained research assistants provided detailed information regarding sexual and contraceptive behaviors in the previous three-month period. Informed consent was obtained from each participant and permission obtained from a parent or legal guardian. This research was approved by the institutional review board of Indiana University/Purdue University at Indianapolis – Clarian.

Participants were adolescent women receiving health care in three primary health clinics in Indianapolis. These clinics serve mostly African-American neighborhoods of lower- and middle-income residents in areas with high rates of teen pregnancy and sexually transmitted infections. For example, the proportion of African-Americans in census tracts served by participating clinics was 78%, and the median household income was $28,000. The 2004 Chlamydia rates for zip codes in which the participating clinics are located ranged from 469/100,000 to 1656/100,000. A

majority (> 75%) of female clinic patients are African-American, and a large majority of clinic patients receive some form of public assistance for health care (> 85%). Study participants resembled the racial-ethnic composition of participating clinics in that 87% of the sample reported race as African-American.

Clinic patients were eligible for study participation if they were aged between 14 and 17 years at enrollment, spoke English, and were not pregnant at enrollment. However, participants who became pregnant were continued in the study. The age range of 14–17 years was chosen because of high rates of initiation of sexual activity. Thus, lifetime sexual experience was not an enrollment requirement because many initially sexually inexperienced could be expected to become sexually active during the follow-up period. For this analysis, women who became pregnant or who were not using a hormonal contraceptive method were excluded.

Measures

The primary outcome measure was condom non-use, defined as the total number of coital events (during the previous three months) unprotected by condoms. We chose this measure as a reflection of potential exposure to STI that does not confound levels of condom non-use with levels of coital frequency [19].

Independent variables consisted of partner-specific relationship quality and partner-specific coital frequency and partner-independent measures of hormonal contraceptive choice. At enrollment and each follow-up visit, participants were asked to identify sex partners by first name or initial, last name, nickname, any contact information, and street address if known. This information was used to create unique partner identifiers in order to link relationship-specific attitudes and behaviors to their specific relationships.

Partner-specific variables included relationship quality and coital frequency. *Relationship quality* assesses positive emotional and affiliational aspects of a relationship. The additive index consists of five items coded as "strongly disagree," "disagree," "agree" or "strongly agree," (scale range 5–25; $\alpha = .92$) with higher scores indicative of greater relationship quality. Example items include *[this partner] is a very important person to me* and *I enjoy spending time with [this partner]*.

Coital frequency reflected the total number of coital events with a given partner. Coital frequency was assessed by asking "How many times in the past three months did you have sex?" Responses were recorded verbatim for each partner. Participants were asked for an approximate number, and "missing" was entered when a precise estimate was not provided. Information on all the sex partners in the past three months were used for this analysis in order to assess the total effects of relationship quality and coital frequency on the outcome measure.

The individual's experience with OCP or DMPA was assessed as the cumulative number of visits in which OCP or DMPA was reported as the method of contraception used in the previous three months. Values range from 0 to 10 with lower values representing less DMPA or OCP experience and higher values representing greater OCP or DMPA experience.

Statistical methods

Analyses were conducted as a three-level hierarchical linear growth curve (LGC) model using HLM 6 [20]. LGC analysis allows examination of patterns of change with repeated observations of nested variables and with a varying number of data points across time. In the current application, LGC is used to estimate individual growth trajectories of condom non-use by fitting a regression line to individual observations of condom non-use over time. The information from all the individual curves is used to create a summary measure of condom non-use. This summary measure is what is referred to as the "latent growth curve." The curve is latent because it captures group level growth based on the relationships between the observed measures across time [18].

The HLM approach to LGC conceptualizes time as nested within the individual. LGC with HLM allows examination of the influence of specific variables on these curves. Present analyses consisted of creating a taxonomy of nested models as suggested by other researchers employing the methodology [18]. These models are created by sequential addition of predictors, with examination of statistical significance of the predictors and changes in overall model fit. Improvements in fit were assessed by examination of the changes in pseudo-R^2, the deviance statistic, Akaike Information Criterion (AIC), and the Bayesian Information Criterion (BIC) [18]. The pseudo-R^2 represents changes in the percentage of unexplained variance as model components are added. The AIC and BIC assess model fit as a function of model complexity, with progressively smaller values for deviance, AIC and for BIC indicating better fit.

LGC produces two latent factors (the intercept and the slope), which together form the trajectory. The intercept is the start, or initial, value. The slope represents the rate of change, or growth, over time. A positive sign for the slope indicates an increase over time. A negative sign indicates a decrease over time. HLM assesses the influence of factors at different levels in the model on the intercept and slope. Here, condom non-use is assessed over time (measured by the sequence of three-month visits) and is specified as nested within partner-specific variables (i.e., relationship quality and coital frequency) because individual participants may have more than one partner during any given three-month period. Partner-specific variables are specified as nested within the duration of experience with a contraceptive method choice because a given method applies equally to all partners. Thus (in the language of LGC), the Level 1

Table 1
Descriptive statistics for Level 1, Level 2 and Level 3

Variable name	Mean	SD	Minimum	Maximum
Visit-specific variables (Level 1; n = 478 visits)				
Condom nonuse	6.95	14.38	0	60.00
Time	—	—	0 months (enrollment)	27 months
Partner-specific variables (Level 2; n = 275 partners)				
Relationship quality	18.53	4.22	6.00	25.00
Coital frequency	7.57	10.86	0	60.00
Participant-specific variables (Level 3; n = 175 participants)				
Hormonal contraceptive experience				
DMPA	2.33	2.59	0	10.00
OCP	1.24	1.67	0	10.00

Note: Sample represents 176 participants (Level 3 variables) with 278 sexual partners (Level 2 variables) and 478 visits (Level 1 variables).
* 4.10 per partner.

predictor was time, to test the hypothesis that condom non-use increases over time (i.e., during each three-month period over the 27 months). In the taxonomy of models, these analyses represent temporal change in condom non-use without assessment of influence by other predictors (see Time Only model, Table 2).

Level 1 generates individual change trajectories (intercept and slope) for each outcome of interest (here condom non-use). At Level 1 an *individual* growth model of condom non-use at time t with partner i for participant j is in the form:

$$Y_{1ij} \equiv \gamma_{0ij} + \gamma_{1ij}(\text{Time})_{tij} + e_{tij}$$

where Y_{tij} is the condom non-use at time t with partner i for adolescent j; γ_{0ij} represents the expected level of condom non-use for adolescent j at Time zero (i.e., the initial status or intercept); γ_{1i} is the rate of change in the condom non-use during the three-month interval with partner i for adolescent j; $(\text{Time})_{tij}$ is 0, 1, 2, 3, 4, ...12; γ_{2ij} is the rate of change with partner i for adolescent j; and, e_{tij} represents the within-person residual.

Level 2 predictors were coital frequency (with each partner) and relationship quality (with each partner) to assess hypotheses that participants' condom non-use increases over time as a function of partner-specific coital frequency and partner-specific relationship quality. Level 2 generates partner level change trajectories (mean intercept, intercept variance, mean slope, slope variance). The general unconditional Level 2 model with fixed effects and no covariates is:

$$\gamma_{0ij} = \gamma_{00j} + r_{0ij}$$

$$\gamma_{1ij} = \gamma_{10j} + r_{1ij}$$

where γ_{0ij} is the condom non-use for adolescent j with partner i at time zero; $\eth_{1ij}$ is the condom non-use rate of change over the length of the study; γ_{10j} is the mean rate of change across each partner for adolescent j; r_{1ij} and r_{2ij} are random errors (associated with the intercept and subsequent slope).

Three Level 2 models were evaluated: partner-specific coital frequency only; partner-specific relationship quality only; and simultaneous inclusion of both coital frequency and relationship quality.

Level 3 captures the variability between adolescents. In this case, Level 3 captures the variability between the groups (DMPA or OCP) to which the adolescents belong. The general conditional Level 3 model with fixed effects and no covariates:

$$\gamma_{00j} = \gamma_{000} + u_{00j}$$

$$\gamma_{10j} = \gamma_{100} + r_{10j}$$

where γ_{00j} represents the mean initial status within adolescent j; γ_{000} is the overall mean initial status; γ_{10j} is the mean rate of change within adolescent j; γ_{100} is the overall mean growing rate; and u_{00j} and u_{10j} are Level 3 random error terms (associated with the intercept and slope). As can be seen, the Level 2 slopes and intercepts become the outcomes of the Level 3 model. Level 3 predictors assessed the additional influence of OCP or DMPA experience on time-related changes in condom non-use.

Results

The original sample contained 237 women providing 732 enrollment and visits at three-month intervals over the 27-month follow-up. In order to focus appropriately on the effects of hormonal contraceptive choice, and partner-specific relationship quality and partner-specific coital frequency on change in condom non-use over time, analyses were limited to the 176 women using OCP or DMPA (Level 3 variables), during relationships with 279 sex partners (and thus 275 assessments of partner-specific relationship quality and partner-specific coital frequency; Level 2 variables) with 478 visits. On average, participants contributed 4.2 visits each, with a range from 2 to 10.

Overall, the average level of condom non-use was 4.10 unprotected coital events per partner during any given three-month period. The average number of coital events per partner was 7.57 during any given three-month period. Average relationship quality was 18.5 per partner during any given three-month period. At each visit, DMPA use was more common than that of OCP (Table 1).

Average condom non-use and average coital frequency increased linearly over the 27-month follow-up period (Figure 1). For example, the average number of unprotected coital events per partner was 6.13 at enrollment and 9.54 by the end of the 27-month follow-up period. Average rela-

Table 2
Taxonomy of models—condom nonuse over time

	Parameter[a]	Time only model	Relationship quality model	Coital frequency model	Coital frequency-relationship quality model	DMPA model	OCP model
Intercept	*y00*	3.64 (.82)	3.52 (.82)	4.14 (.94)	3.78 (.81)	3.83 (.81)	3.63 (.78)
Time	*y10*	.2 (.09)	.18 (.08)	.13* (.07)	.16 (.06)	.12 (.05)	.2 (.06)
Relationship quality	*y01*	—	.65 (.17)	—	.44 (.15)	.44 (.15)	.44 (.15)
Coital frequency	*y11*	—	—	.02 (.00)	.01 (.00)	.01 (.00)	.01 (.00)
DMPA experience	*y101*	—	—	—	—	.06 (.02)	—
OCP experience	*y101*	—	—	—	—		−.04* (.02)
Pseudo R-square		.07					
	—	.09					
	—	—	.11				
	—	—	—	.13			
	—	—	—	—	.15	.15	
Deviance		3761.5	3747.8	3716.8.9	3708.4	3705.5	3711.2
AIC		3715.9	3693.1	3704.9	3701.9	3653.7	3659.6
BIC		3728.3	3699.0	3706.3	3658.8	3656.3	3658.2

Note. Numbers are beta and (standard errors). All beta coefficients are statistically significant at $p < .05$ unless otherwise noted.
[a] See Appendix for guide to symbols.
[b] Final model includes time (Level 1), coital frequency and relationship quality (Level 2) plus contraceptive method experience (Level 3).
* $p = .06$.

tionship quality remained relatively stable during the follow-up period (Figure 2).

Analyses showed that condom non-use increased as a function of time ($\beta = .12$; $p = .03$, Level 1 analysis). A convention of LGC analysis is to report parameter estimates as unstandardized betas [16]. Estimates should be understood in reference to their original metrics: for example, a one-unit increase in time is associated with a .12-unit increase in condom non-use.

Both coital frequency and relationship quality separately resulted in improved model fit compared to the Time Only model. Addition of both coital frequency and relationship quality yielded improved fit over models with only coital frequency or relationship quality (Table 2). The source of

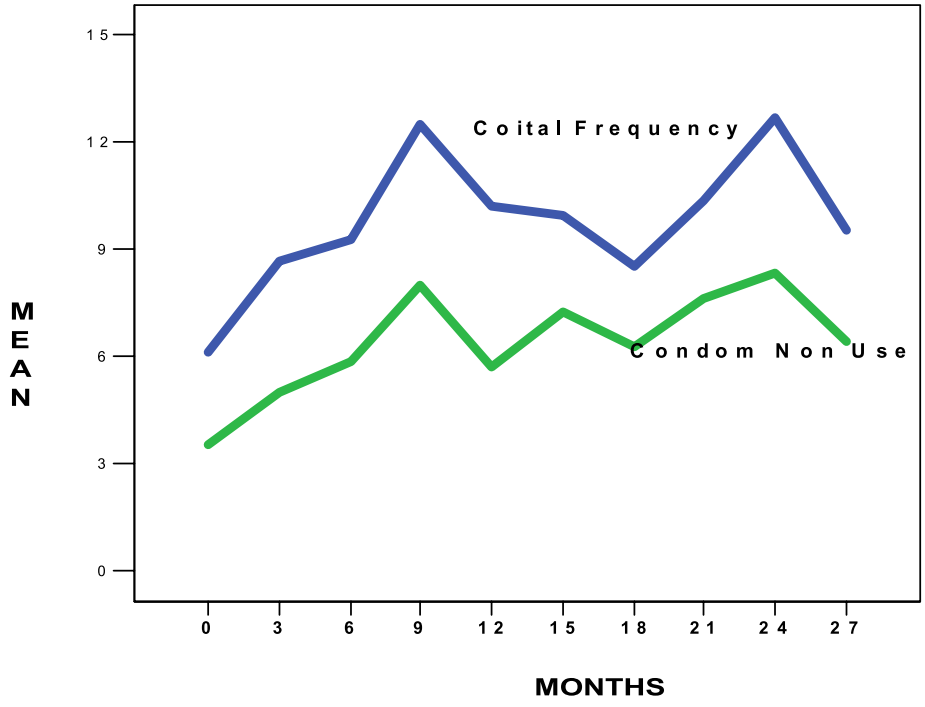

Figure 1. Partner-specific coital frequency and condom non-use over the 27 months.

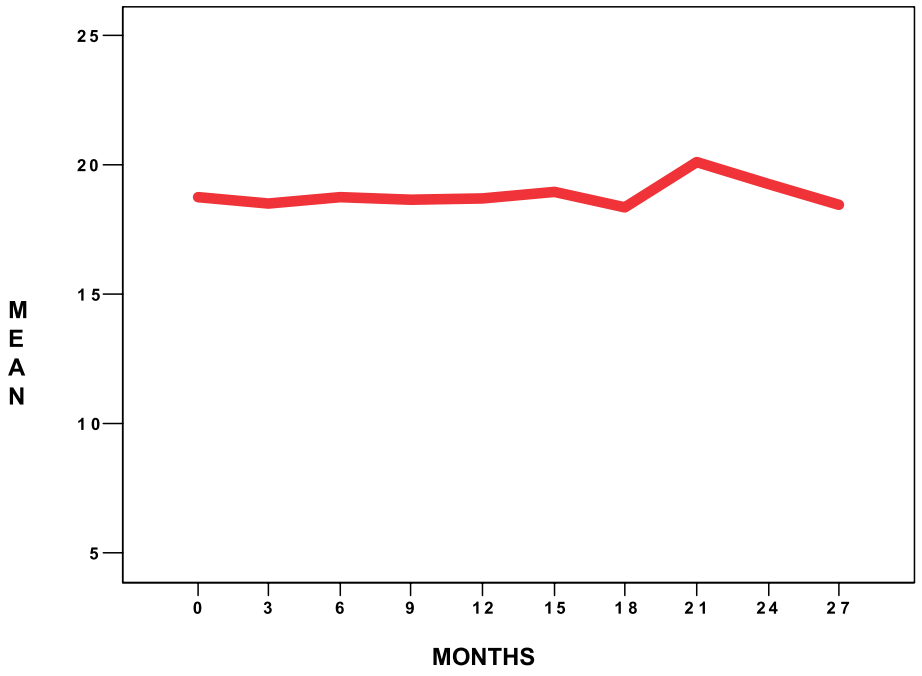

Figure 2. Mean partner-specific relationship quality over 27 months.

influence differed, however. Increased condom non-use over time was a function of increased coital frequency (β = .01; p = .00), while higher levels of relationship quality were associated with increased condom non-use at enrollment (β = .44; p = .00, Level 2 analysis).

Addition of measures of OCP and DMPA experience produced significant increases in model fit. The pseudo-R^2 estimates showed substantial reductions in model variance with the addition of model components (Table 2). The AIC and BIC of the final model decreased (compared to the models containing only coital frequency and relationship quality [Table 2]), indicating improved model fit.

Increased OCP experience (compared to DMPA) was associated with decreased rate of change in condom non-use (β = −.04; p = .06) (Table 2). Increased DMPA experience was associated with increased rate of change in condom non-use (β = .06; p < .00). The contrast in latent growth curves for OCP users versus DMPA users is illustrated in Figure 3. This figure shows a much steeper rate of increase in condom non-use for participants who reported more cumulative experience with DMPA, compared to those with greater OCP cumulative experience.

Discussion

The results of this study clearly demonstrate a temporal increase in condom non-use during a 27-month follow-up. Both relationship characteristics and coital frequency influence the rate of increase in condom non-use, with adolescent women perceiving higher relationship quality and reporting greater coital frequency at greater risk for STI exposure. Hormonal contraceptive methods are not equivalently associated with the overall temporal decline in condom use: more experienced DMPA users become substantially less likely to use condoms over time, while experienced OCP users maintain relatively stable rates of condom use.

The finding that condom non-use becomes more frequent over time is consistent with other research. For example, condom use declines not only within relationships, but becomes lower with succeeding relationships [9]. In other research, the time required for levels of condom use in new relationships to approximate that of established relationships is about three weeks [10].

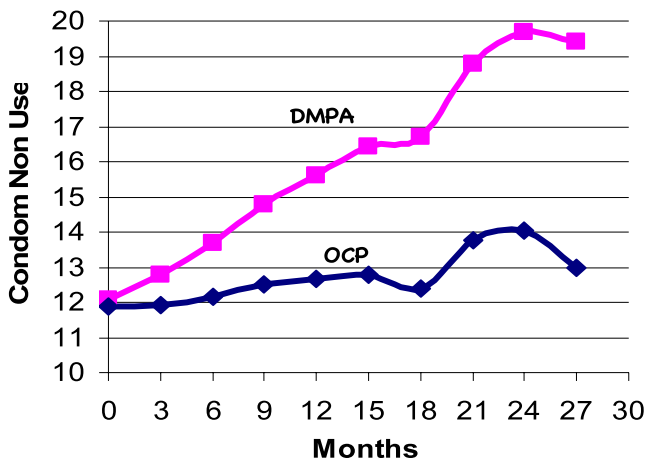

Figure 3. Growth curves of condom non-use for OCP coverage, and DMPA coverage 27 months.

Developmentally, adolescent romantic relationships appear to shift from a primarily self-focus during early adolescence to a substantially couples-perspective during middle and late adolescence [21]. Parental control and supervision is likely stricter for younger than for older adolescents. The less relationship-oriented sexual activity and tighter parental control of early and middle adolescence makes condoms an expedient but reasonably effective form of contraception. From a relationship perspective, an increasing sense of oneself as a member of a couple rather than an individual in a pair means that factors such as trust, intimacy, and relationship maintenance become important functions of sex within relationships [22]. Even if adolescents accurately estimated STI and pregnancy risk in sexual relationships, condom use works against the romantic ideals that are part of many adolescent sexual relationships [23]. From a pragmatic perspective, condom non-use may increase over time simply as a function of interest in and access to effective methods that separate sex from pregnancy and STI prevention [24].

These findings are also consistent with others in that both relationship characteristics and coital frequency are important influences on levels of condom use within a relationship [11,12,19]. One important contribution of the current research is evidence that coital frequency and relationship quality have different effects on levels of condom non-use. Relationship quality appears to affect condom non-use by its influence on initial levels of non-use, so that higher levels of relationship quality were associated with more frequent condom non-use at study entry. Coital frequency, on the other hand, influenced the rate of change of condom non-use over time. This suggests that relationship characteristics present early in a relationship, rather than relationship duration, are important early influences on a couple's condom use behaviors. As shown elsewhere, relationship quality is an important correlate of coital frequency, but coital frequency has the most direct proximal effect on condom non-use [25].

The data also demonstrate important differences in the association of contraceptive method choice and condom non-use, with increased non-use primarily a characteristic of participants with more experience with DMPA. An earlier study found low levels of condom use among users of contraceptive implants [26]. However, that study did not assess condom use among users of other contraceptive methods. Reasons for the differential effect of contraceptive method on condom non-use are not known, although the marked difference in demand characteristics of the methods is a plausible explanation [15]. Differential effects suggest that "dual contraceptive method use" is not simply an issue of a combination of any coitus-independent method with condom use. Rather, clinical and public health efforts to encourage dual method use may need to include evaluation of method choice as well as relationship and sexual behavior factors. Contraceptive patches or vaginal contraceptive rings are coitus-independent but require weekly attention (and do not typically affect menses), future research should address condom non-use among users of these methods.

Limitations

The sample is relatively homogenous in terms of geography (drawn from residents of a single urban area), race (mostly African-American) and socioeconomic status (mostly lower and middle socioeconomic status). Although the sample reasonably resembles the clinical population from which it was assembled, generalization of results should be made with caution. Secondly, a limited number of predictors of condom non-use were examined. Condom use has been linked to a host of socioeconomic, cultural, familial, psychological, and behavioral factors [27]. However, few of these factors have been investigated in the context of complex longitudinal models. We chose to focus on factors likely to have proximal influence on condom use behaviors. Thirdly, a limited number of contraceptive methods were assessed. If other coitus-independent methods become increasingly used with condoms these methods would be of interest. Finally, the resulting growth curves refer to *group-level* change over time in condom non-use. These results cannot be interpreted to represent developmental trajectories of individual participants.

Conclusion

The sometimes competing needs for effective contraception and effective STI prevention represent complex behavioral targets to achieve even for a short period of time. These data demonstrate, however, that condom use, especially, represents a developmental "moving target" subject to change over time and in response to changes in relationships, sexual behaviors and contraceptive choices. Perhaps the most important message to derive from our data is the suggestion that efforts to encourage condom use must be persistent, and must be adjusted to the relational and contraceptive needs of a given time.

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