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Long-Acting Reversible Contraception, Condom Use, and Sexually Transmitted Infections: A Systematic Review and Meta-analysis

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Abstract

Introduction: Given mixed findings regarding the relationship between long-acting reversible contraception and condom use, this systematic review and meta-analysis synthesizes studies comparing sexually transmitted infection–related outcomes between users of long-acting reversible contraception (intrauterine devices, implants) and users of moderately effective contraceptive methods (oral contraceptives, injectables, patches, rings).

Methods: MEDLINE, Embase, PsycINFO, Global Health, CINAHL, Cochrane Library, and Scopus were searched for articles published between January 1990 and July 2018. Eligible studies included those that (1) were published in the English language, (2) were published in a peer-reviewed journal, (3) reported empirical, quantitative analyses, and (4) compared at least 1 outcome of interest (condom use, sexual behaviors other than condom use, sexually transmitted infection–related service receipt, or sexually transmitted infections/HIV) between users of long-acting reversible contraception and users of moderately effective methods. In 2020, pooled ORs were calculated for condom use, chlamydia/gonorrhea infection, and trichomoniasis infection; findings for other outcomes were synthesized qualitatively. The protocol is registered on the International Prospective Register of Systematic Reviews (CRD42018109489).

Results: A total of 33 studies were included. Long-acting reversible contraception users had decreased odds of using condoms compared with oral contraceptive users (OR=0.43, 95%

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SUPPLEMENTAL MATERIAL

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CI=0.30, 0.63) and injectable, patch, or ring users (OR=0.58, 95% CI=0.48, 0.71); this association remained when limited to adolescents and young adults only. Findings related to multiple sex partners were mixed, and only 2 studies examined sexually transmitted infection testing, reporting mainly null findings. Pooled estimates for chlamydia and/or gonorrhea were null, but long-acting reversible contraception users had increased odds of trichomoniasis infection compared with oral contraceptive users (OR=2.01, 95% CI=1.11, 3.62).

Discussion: Promoting condom use specifically for sexually transmitted infection prevention may be particularly important among long-acting reversible contraception users at risk for sexually transmitted infections, including adolescents and young adults.

INTRODUCTION

Nearly half of pregnancies worldwide were unintended from 2010 to 2014 (on the basis of the most recent global estimates).[1] Long-acting reversible contraception (LARC), including intrauterine devices and implants, offers a highly effective pregnancy prevention option, with <1% of users becoming pregnant in the first year of typical use.[2] Evidence from the U.S. suggests that these methods contribute to population-level reductions in unintended pregnancies,[3–5] including among adolescents, for whom 75% of pregnancies are unintended.[6] Public health efforts have improved awareness of and access to LARC, and use has increased among reproductive-aged women generally and adolescent girls specifically.[7–10]

Although LARC methods are highly effective for preventing pregnancy, they do not prevent sexually transmitted infections (STIs), including HIV. The same is true for moderately effective contraceptive methods (i.e., oral contraception, injectables, patches, rings), for which 4%–7% of users will become pregnant in the first year of typical use.[2] Integration of STI prevention with family planning presents an opportunity to address the persistent burden of STIs globally,[11] including increasing STI rates in the U.S.[12] Using condoms with LARC or moderately effective methods for individuals at risk for STIs is recommended by the Centers for Disease Control and Prevention and the Office of Population Affairs,[13] and the American Academy of Pediatrics recently emphasized the importance of counseling adolescent patients on this practice.[14,15] However, condom use with more effective contraception among adolescents and young adults, who are disproportionately affected by STIs,[12] is suboptimal.[8,16] Furthermore, missed opportunities for provision of STI-related services in the context of contraceptive care have been documented.[17]

The conceptual model in Figure 1 shows well-established relationships between STIs and individual-level behaviors, including condom use, other sexual behaviors (e.g., having multiple partners), and receipt of services (e.g., STI testing, preventive counseling).[18,19] For each of these domains, there is a conceptual rationale for potential differences between LARC and moderately effective contraceptive method users. First, LARC users may be less likely to use condoms than moderately effective method users given that condom use for additional pregnancy prevention would not be salient.[20] In fact, some evidence suggests decreased condom use among LARC users relative to use among moderately effective method users generally and oral contraceptive users specifically,[7,21–23] although

other findings indicate no significant difference.[22,24,25] If condom use is lower among LARC users, then they may be more likely to acquire STIs. However, consideration of other sexual risk behaviors and STI-related services is needed. For example, if LARC users are less likely to have multiple partners, decreased condom use may not result in increased risk for STIs. In addition, any higher risk for STIs may not be detected if LARC users are less likely to receive STI testing than moderately effective method users. This association is plausible because many women receive STI-related services in the context of contraceptive health care,[26] but LARC methods remain effective for 3–10 years, reducing the need for engagement with providers for contraception.

Given conflicting findings of studies comparing condom use between LARC users and moderately effective method users, this systematic review and meta-analysis synthesizes the literature and contextualizes findings in relation to the aforementioned conceptual model. Specifically, it includes observational and intervention research comparing LARC users with moderately effective method users in relation to the 4 domains presented in Figure 1: (1) condom use, (2) other sexual behaviors, (3) STI-related services, and (4) STIs. Studies among women generally are examined, but evidence specific to adolescent and young adults is also considered given the importance of STI prevention for this population.

METHODS

Search Strategy and Selection Criteria

The PRISMA and Meta-analyses of Observational Studies in Epidemiology guidelines were followed,[27,28] and the protocol was registered at the International Prospective Register of Systematic Reviews (CRD42018109489). Keyword searches in 7 public health and medical literature databases (MEDLINE, Embase, PsycINFO, Global Health, CINAHL, Cochrane Library, and Scopus) used combinations of terms related to LARC and STIs (Appendix 1, available online). These searches captured articles published from January 1990 through July 2018.

Eligibility criteria included studies (1) written in the English language, (2) published in a peer-reviewed journal, (3) that reported quantitative analyses, and (4) that compared at least 1 outcome of interest (i.e., condom use, other sexual behaviors, STI-related services, or STIs/HIV) between LARC (intrauterine devices or implants) and moderately effective method (oral contraception, injectables, patches, or rings) users. For STIs/HIV, studies that restricted analyses on the basis of condom use or adjusted for condom use were excluded because the conceptual model includes condom use as a mediator. Studies that only examined bacterial vaginosis or human papillomavirus were also excluded given the reduced effectiveness of condoms in preventing these infections.[29,30] For this specific report, STI findings addressed chlamydia (CT), gonorrhea (GC), and trichomoniasis given sufficient eligible studies and homogeneity in measurement. This report excludes data on HIV infection as it is not feasible here to discuss these data in relation to the robust literature examining associations between depot medroxyprogesterone acetate and HIV acquisition.[31] Study authors were not contacted because some studies were published nearly 30 years ago. The reference lists of included articles were reviewed to identify additional eligible studies.

In total, 3 authors (RJS, SP, KMK) screened the same subset (n=200) of titles and abstracts for eligibility to ensure consistency in screening. The remaining titles and abstracts were then divided between the 3 authors and screened independently. If any screener was uncertain about inclusion, the full text was reviewed and discussed as a group.

Data Analysis

Eligible articles were divided between 4 authors (RJS, SP, KMK, and NL) so that 2 individuals independently extracted data from each article. A standardized form captured data source, data collection year(s), geographic location, study setting (e.g., school, clinic, community), study design, sampling strategy, sample size, sample age, specific measure(s) used to assess LARC use, specific measure(s) used to assess moderately effective method use, outcome measure(s), and the most robust measure of association reported comparing STI-related outcome(s) between LARC and moderately effective method users. When reported, adjusted associations were used over unadjusted associations. Discrepancies in data extraction were resolved through discussion, either between the original 2 extractors or, if needed, among all 4 authors involved in data extraction.

Study quality was assessed using a modified version of the Newcastle–Ottawa Scale[32] that has been used in other reviews[33,34] (Appendix 2, available online) and evaluates (1) representativeness of the study sample, (2) size of the sample or sub-sample for LARC and moderately effective method users, (3) validity of contraception measures, (4) validity of STI outcome measures, (5) temporal precedence of contraceptive use in relation to STI outcome (e.g., prospective study design), and (6) comparability of LARC and moderately effective method users on the basis of study design (e.g., randomization) or analysis (e.g., statistical adjustment). Dichotomous indicators were assigned for each dimension to denote whether a study met the quality criterion (Appendix 3, available online). Each aspect of quality was examined independently rather than as a summed score to facilitate interpretation.

For condom use, CT/GC, and trichomoniasis infection, a random-effects meta-analysis was conducted to allow for between-study heterogeneity in the true effect estimate. Condom use was primarily measured as use at last sex (yes/no) or frequency of use, which was then dichotomized as always versus sometimes or never.[35] For each outcome, comparisons included (1) LARC versus oral contraceptive users; (2) LARC versus injectable, patch, or ring users; and (3) LARC versus a combined measure of oral contraceptive, injectable, patch, or ring users. Pooled ORs and 95% CIs were generated using Comprehensive Meta-Analysis, version 2. In cases where there were findings at multiple timepoints, only the association at the last timepoint was included. Sensitivity analyses examined studies with samples limited to adolescents and young adults (aged 11–25 years on the basis of the included articles) and studies conducted in the U.S. Additional sensitivity analyses were conducted with studies published after 2002 when the distribution of Norplant, a levonorgestrel-releasing implant, was permanently discontinued in the U.S.[36] to distinguish studies examining modern LARC methods. Finally, sensitivity analyses accounted for individual dimensions of study quality (e.g., sample size, measurement validity) by only including those studies achieving a given quality indicator. Pooled effect estimates for

overall and sensitivity analyses are presented when at least 3 studies reported relevant data. Heterogeneity was assessed using I^2 values (with higher scores indicating more heterogeneity), and publication bias for overall effects was assessed using funnel plots and Egger's test (1-tailed *p*-values reported).

Meta-analyses were not conducted for findings about sexual behaviors other than condom use and STI-related service receipt owing to measurement heterogeneity and limited data, respectively. Instead, these findings were synthesized qualitatively. For each presented finding, point estimates and CIs or *p*-values were used to determine the magnitude, direction of association, and significance; if studies reported raw data without statistical comparison, RRs and 95% CIs were calculated. The number of unique associations that were null, risk (i.e., more likely to engage in other sexual behaviors or less likely to receive services), and protective (i.e., less likely to engage in other sexual behaviors or more likely to receive services) were counted. Data analysis was completed in 2020.

RESULTS

The literature search yielded 2,269 articles (Figure 2). A total of 41 distinct studies, described in 42 articles, met the inclusion criteria. However, 1 study noted substantial overlap with the sample of another study published by the same first author, and thus, these 2 studies are treated as 1, for a total of 40 included studies. A total of 7 studies met eligibility criteria but are not discussed further because they examined HIV only (n=6) or did not include CT, GC, or trichomoniasis as STI outcomes (and did not examine other STI-related outcomes reported in this paper; n=1). A total of 3 studies examined STI outcomes other than CT, GC, or trichomoniasis and were thus not included in the STI meta-analysis; however, because these studies examined other outcomes of interest (i.e., condom use, other sexual behaviors), they were retained for those specific analyses.

Study Characteristics

Characteristics of the 33 studies included in this analysis are summarized in Appendix 4[37–64] (available online). Two thirds (n=22) were published after 2002. Approximately half (n=16) were conducted in the U.S., and 19 other countries from Central America, South America, Asia, Africa, and Europe as well as New Zealand are also represented. The median sample size of LARC and moderately effective method users was 508 (range=13–6,744). A total of 9 studies were limited to adolescents and/or young adults aged <26 years. Most samples (n=23) were clinic based (data not shown). Approximately half (n=18) were cross-sectional, and about one fifth (n=7) were prospective cohorts.

Risk of Bias Assessment

A total of 7 studies utilized population-based sampling and met the quality criterion for representativeness of the study sample (Appendix 3, available online). A total of 23 studies met the quality criterion of $n \geq 200$. As for measurement quality, 19 studies reported assessing contraception through clinic records or by a structured interview with the timeframe for use defined as at last sex or use within the past year. A similar pattern was observed for measurement of condom use, other sexual behaviors, and STI-related services, with about

half of the studies meeting the quality criteria for each outcome. For STI infection, all of the 14 studies included in the meta-analysis met the quality criterion of laboratory-confirmed diagnosis. In total, contraceptive use preceded the STI-related outcome in 13 studies, and 10 studies had some degree of comparability between LARC and moderately effective method users through statistical adjustment or study design.

Condom Use

A total of 14 studies reported relevant data on condom use (Table 1 and Appendix 5, available online). Pooling 10 studies comparing condom use between LARC and oral contraceptive users, LARC users had nearly 60% lower odds of using condoms (OR=0.43, 95% CI=0.30, 0.63, I^2=49.2). LARC users also had lower odds of condom use than injectable, patch, or ring users (n=8, OR=0.58, 95% CI=0.48, 0.71, I^2=12.4) and the combined group of oral contraceptive, injectable, patch, or ring users (n=3, OR=0.54, 95% CI=0.34, 0.86, I^2=81.2). Examination of funnel plots (Appendix 6, available online) and Egger's test for these meta-analyses generally did not provide evidence of publication bias, except for the comparison of LARC with moderately effective methods combined (p=0.03).

Odds of condom use were significantly lower for LARC users than for oral contraceptive users when restricting to studies with adolescent and young adults only (n=4, OR=0.46, 95% CI=0.38, 0.55, data not shown), when restricting to studies set in the U.S. (n=8, OR=0.42, 95% CI= 0.27, 0.65, data not shown), and in 5 additional sensitivity analyses (published after 2002, population-based, comparability on the basis of statistical adjustment, quality contraceptive use measures, quality condom use measures). The association comparing LARC users with injectable, patch, or ring users held when restricting to studies from the U.S. (n=6, OR=0.58, 95% CI=0.45, 0.74, data not shown) and in 5 other sensitivity analyses (published after 2002, population-based, comparability on the basis of statistical adjustment, quality contraceptive use measures, quality condom use measures).

Sexually Transmitted Infections

Pooled effects for CT/GC comparing LARC users with oral contraceptive (n=7, OR=1.38, 95% CI=0.98, 1.94, I^2=34.2), injectable (n=4, OR=0.69, 95% CI=0.29, 1.65, I^2=82.4), and indicators combining moderately effective method (n=4, OR=1.17, 95% CI=0.85, 1.62, I^2=33.8) users were null (Table 1 and Appendix 5, available online). Comparisons between LARC and oral contraceptive users remained null in 2 sensitivity analyses (published after 2002, ascertainment of contraceptive use preceded CT/GC diagnosis). However, one sensitivity analysis pooling findings from 3 studies that used quality measures for contraception yielded significantly increased odds of CT/GC infection for LARC users compared with those for oral contraceptive users (OR=1.26, 95% CI=1.02, 1.56, data not shown). For comparisons of CT/GC between LARC and injectable users, the only possible sensitivity analysis examined studies with temporal precedence for contraceptive use on the basis of study design, and the association remained null. Two sensitivity analyses (published after 2002, quality contraceptive use measures) for LARC versus moderately effective contraceptive methods combined were also null.

For trichomoniasis, there were only sufficient studies to synthesize comparisons between LARC and oral contraceptive users. Pooling 5 studies, LARC users had increased odds of trichomoniasis (OR=2.01, 95% CI=1.11, 3.62, I^2=0.0). However, this association was no longer significant in the 1 possible sensitivity analysis limited to 3 prospective cohort studies in which contraceptive use preceded trichomoniasis diagnosis (OR=2.01, 95% CI=0.91, 4.41, data not shown). Funnel plots (Appendix 6, available online) and Egger's test did not suggest publication bias for the STI findings.

Other Sexual Behaviors

On the basis of the qualitative synthesis, 9 studies provided data on 20 associations between other sexual behaviors and contraceptive type (Table 2[22,23,37,38,42,49,51,63,64]). Outcomes included multiple sex partners, frequency of sex, and substance use before sex. Of 8 associations from 6 studies comparing multiple partners between LARC and oral contraceptive users, 2 showed an increased likelihood for LARC users, 2 showed a reduced likelihood, and 4 were null. Findings for this same outcome based on 5 associations from 4 studies comparing LARC users with injectable, patch, or ring users were a mixture of null and increased likelihood for LARC users. There was not a clear pattern to the findings for multiple sex partners on the basis of study quality. All findings for frequency of sex and substance use at last sex were null.

Sexually Transmitted Infection–Related Services

Only 2 studies compared STI-related services between LARC and moderately effective method users, so findings are synthesized qualitatively. Overall, 13 relevant associations were reported given different comparisons, outcome measures, and timing of service receipt. A total of 10 of these findings addressed CT testing—most were null, yet 3 associations indicated that LARC users were less likely to be tested, and 1 association indicated that LARC users were more likely to be tested (data not shown).

DISCUSSION

Considering the recent increase in studies regarding the relationship between LARC and condom use and mixed findings across multiple studies, this review synthesizes the existing evidence to provide some clarity for clinicians and public health practitioners. In addition, the synthesis of research on other sexual behaviors, receipt of STI-related services, and STIs serves to contextualize the findings about condom use in relation to STI risk and prevention. Pooled effect estimates suggest that LARC users are approximately 40%–60% less likely than moderately effective method users to use condoms. This relationship remained in all possible sensitivity analyses accounting for study quality, contributing to confidence in the overall pooled effects. Lower likelihood of condom use for LARC users than for oral contraceptive users was also observed when restricting to studies with only adolescents and young adults, which is concerning given their disproportionate burden of STIs.[12]

However, the implications of this association for STI prevention remain unclear given the synthesis of other outcomes. Meta-analysis of STIs yielded inconsistent findings. Pooled estimates comparing CT/GC infection between LARC users and oral contraception,

injectable, patch, or ring users were not statistically significant, although the overall effect estimate for the comparison between LARC users and oral contraceptive users suggested increased CT/GC risk. In addition, this risk association was significant in 1 sensitivity analysis. LARC users were also significantly more likely to have trichomoniasis than oral contraceptive users, although the association did not remain significant in the sensitivity analysis limited to prospective studies. The reasons for these mixed findings are unclear. One possibility is that the null findings reflect limited statistical power given the relatively low prevalence of STIs. Another possibility is that observed differences reflect biological rather than behavioral mechanisms unique to specific STIs and contraceptives.[65–68] For example, a recent review found a protective effect between oral contraception and trichomoniasis[65]—this could be underlying what may appear to be increased risk among LARC users relative to oral contraceptive users.

The qualitative synthesis of other sexual behaviors, beyond condom use, did not suggest that LARC users are at differential risk for STIs. All findings from the qualitative synthesis of frequency of sex and substance use before sex were null, and findings related to number of sex partners were mixed. However, heterogeneity in outcome measures precluded meta-analysis, so additional research is needed to draw more definitive conclusions. In addition, there are insufficient data (only 2 studies[58,62]) on STI-related services by contraceptive type, although it is promising that most findings did not indicate that the reduced need for contraceptive visits with LARC methods impacted receipt of STI services.

Further research to clarify the mixed findings for other sexual behaviors and STI diagnoses is needed, especially among adolescents and young adults. Heterogeneity in indicators of sexual risk underscores a need to identify and consistently use the most appropriate measures to evaluate STI risk. Behaviors and characteristics related to partnerships (e.g., number of sex partners, partner concurrency) may be most salient, and network analyses that consider differences in sexual networks by contraceptive type may be warranted. As for STI diagnoses, studies can examine medical claims databases with large, national samples to increase statistical power and generalizability. For example, a study published since our literature search used Medicaid claims data to compare a variety of STI diagnoses between LARC users and oral contraceptive users (most associations were null).[69] To ensure that any differences in STI diagnoses are not attributable to differential receipt of STI testing, such analyses should also adjust for STI testing, as another recent study did.[70] Particular attention to differences in CT/GC testing by contraceptive type among sexually active female adults aged <25 years is warranted because these services are recommended annually for this population.[71] It will be important to distinguish between new and continuing LARC users because any decrease in STI testing in relation to recommendations for annual testing may be observed in the years after LARC method initiation.[62]

As research on LARC and condom use continues,[72,73] there is a need for studies that explicitly examine the conceptual framework presented in this review, considering dimensions of STI risk, prevention, and care in concert. For example, studies comparing condom use by contraceptive type should account for number of partners or relationship type as a potential confounder, as a recently published study that found no association between LARC and condom use has done.[72] There were insufficient data from the review

(only 5 studies[38,40,45–47]) to conduct sensitivity analyses by partnership characteristics. That said, the pooled estimate for LARC versus that for the combined indicator for moderately effective methods is based on 3 studies that all controlled for this potential confounder;[38,40,47] the other 2 studies that included a relevant covariate also found a risk association between LARC and condom use.[45,46] Utilizing prospective study designs would help to ensure appropriate temporal ordering for causal inference. Some cohort studies have addressed whether condom use decreases after LARC initiation, and findings have been mixed.[38,45,74] However, potential variation in condom use over time by contraceptive type has not been extensively explored. Longitudinal studies that consider the association between contraceptive type and STI diagnosis can examine condom use as a potential mediator. Future quantitative research that considers condom use motivations as a potential mediator of associations between contraceptive type and condom use would also be useful, especially given mixed findings from several recent qualitative studies exploring whether motivations to use condoms for additional pregnancy prevention explain observed differences in condom use between LARC users and moderately effective method users.[75–76] Finally, there is a need to consider how associations may vary by demographic characteristics and how factors beyond the individual level, such as population-level differences in condom and contraceptive use (e.g., by race/ethnicity, urbanicity) and community-level prevalence of STIs, may affect observed relationships.

Any concerns about the implications of LARC use for STIs should not deter access to these highly effective contraceptive methods, including among adolescents and young adults. Rather, concerns underscore the value of integrating pregnancy and STI prevention in health education and clinical practice. Because condom use with more effective contraception may be primarily for backup pregnancy prevention, clearly explaining STI risk and emphasizing condom use as effective STI prevention in sexual health education materials and counseling is important. Explicitly addressing STI prevention in conjunction with pregnancy prevention methods provides an opportunity to assess STI-related risk and present a comprehensive array of prevention strategies in addition to condoms, including testing and mutual monogamy.[20] Attention to STI testing would likely have the added benefit of minimizing any potential unintended consequences of LARC use in relation to healthcare utilization and receipt of recommended services. Finally, findings reinforce the potential value of multipurpose prevention technologies that prevent both pregnancy and certain STIs.[78]

Limitations

Study limitations should be considered. Condom use measures were self-reported and do not account for correctness of use. Most studies examining condom use were cross-sectional. Furthermore, not all prospective studies accounted for contraceptive method switching. In addition, ORs for condom use may overestimate effects given that the prevalence of condom use was not a rare outcome. Although RRs would be more appropriate, reported ORs were used to include adjusted findings when available. For other sexual behaviors and STI-related services, the inability to conduct meta-analyses owing to lack of literature is the most notable limitation. In addition, because eligible studies examined sexual risk behaviors as outcomes, any studies only assessing sexual risk behaviors before LARC initiation were not included. However, such data would also be informative in understanding whether

LARC users were at differential risk of STIs. For STIs, most studies were not explicitly addressing the research question of interest; relevant data on sample sizes and proportions were the most robust findings that could be extracted. In addition, a few studies did not explicitly state that the examined STIs were genital infections, although it is unlikely that oropharyngeal infections were included on the basis of study descriptions. Finally, there was some evidence of publication bias when examining condom use for comparisons between LARC users and indicators combining moderately effective method users, and this review does not include gray literature (e.g., dissertations, conference abstracts, reports) that may be more likely to include null findings.

CONCLUSIONS

This review suggests that LARC users are less likely to use condoms than moderately effective method users. However, outstanding questions remain regarding the implications relating to STI prevention, especially given inconclusive results for other sexual behaviors, STI-related services, and actual STIs. These findings underscore the importance of integrating pregnancy and STI prevention in both research and public health and clinical practice. Future studies that account for the complex interplay among contraceptive use, sexual behavior, service utilization, and STIs, particularly among adolescents and young adults, would be useful. Understanding these relationships can help inform efforts to strengthen sexual and reproductive health.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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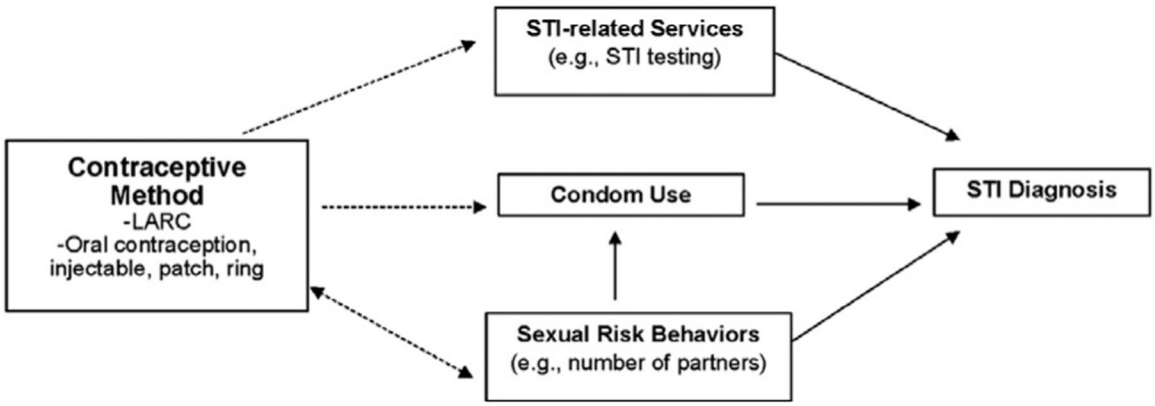

Figure 1.

Conceptual model of behavioral relationships between highly and moderately effective contraception and STI-related outcomes.

Solid lines indicate empirically established.

Dashed lines indicate not empirically established.

STI, sexually transmitted infection; LARC, long-acting reversible contraception.

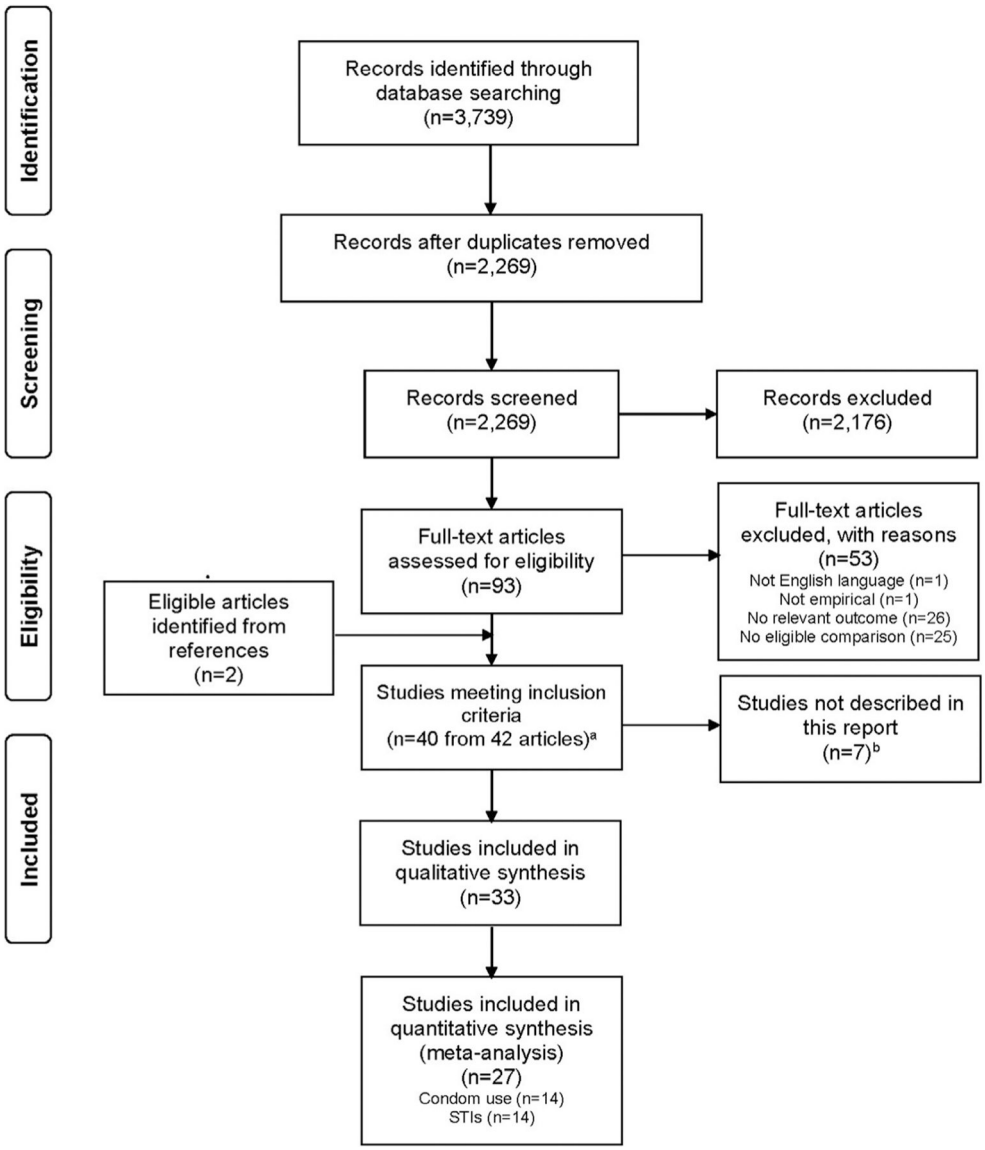

Figure 2.

Flow chart of literature search and article selection process.

[a]Forty-one distinct studies were identified, but 1 study noted substantial overlap with the sample of another study published by the same first author, and thus these 2 studies are treated as 1.

[b]Six studies that reported only on HIV infection are not included. In addition, 1 study reported on STIs other than chlamydia, gonorrhea, or trichomoniasis (and did not compare other STI-related outcomes between LARC users and moderately effective method users).

STI, sexually transmitted infection; LARC, long-acting reversible contraception.

Table 1.

Pooled Estimates fFrom Random-Effects Meta-Analysis

	LARC versus oral contraception			LARC versus injectable, patch, ring			LARC versus oral contraception, injectable, patch, ring		
Outcomes	**Studies, *n***	**OR (95% CI)**	**I^2**	**Studies, *n***	**OR (95% CI)**	**I^2**	**Studies, *n***	**OR (95% CI)**	**I^2**
Condom use	10	0.43 (0.30, 0.63)	49.2	8	0.58 (0.48, 0.71)	12.4	3	0.54 (0.34, 0.86)	81.2
Chlamydia/gonorrhea	7	1.38 (0.98, 1.94)	34.2	4	0.69 (0.29, 1.65)	82.4	4[a]	1.17 (0.85, 1.62)	33.8
Trichomoniasis	5	2.01 (1.11, 3.62)	0.0		N/A			N/A	

[a]All of the 4 studies examined chlamydia only.

LARC, long-acting reversible contraception; N/A, not applicable.

Table 2.

Qualitative Synthesis of Other Sexual Behaviors

Measures	Comparison	Finding
LARC versus OC		
Multiple sex partners		
Change in number of partners, past 3 months[37]	IUD versus OC	Null (In-text statement: “These differences are not significant by the test of Yates and Cochran”)
Number of partners, lifetime[42] (dichotomized as 6–20 versus <6)[a]	IUD versus OC	Null (RR=1.10, 95% CI=0.16, 7.75)
≥1 new partner, Year 1[23]	Implant versus OC	Protective (26% vs 50%, $p<0.05$)
≥1 new partner, Year 2[23]	Implant versus OC	Null (37% vs 48%, $p>0.05$)
Number of partners, lifetime[49,b]	IUD versus OC	Protective (2.5, 95% CI=2.23, 2.77 vs 3.0, 95% CI=2.82, 3.18)
>1 partner, past 5 years[53]	IUD versus OC	Null (RR=0.79; 95% CI=0.61, 1.02)
≥4 partners, lifetime[22]	LARC versus OC	Risk (APR=1.87, 95% CI=1.36, 2.58)
≥2 partners, past 3 months[22]	LARC versus OC	Risk (APR=2.61, 95% CI=1.75, 3.90)
Frequency of sex		
Frequency of sex, past year[42] (dichotomized as >1 time/week-1 time/day versus ≤1 time/week)[a]	IUD versus OC	Null (RR=1.00, 95% CI=0.82, 1.23)
Frequency of sex[63]	IUD versus OC	Null (In-text statement: “No significant changes were observed…”)
Substance use		
Drank alcohol or used drugs before last sex[22]	LARC versus OC	Null (APR=1.28, 95% CI=0.75, 2.18)
LARC versus injectable, patch, or ring		
Multiple sex partners		
Number of partners, lifetime[42] (dichotomized as 6−20 versus <6)[a]	IUD versus injectable	Null (RR=0.47, 95% CI=0.07, 3.29)
>1 partner, past 5 years[53]	IUD versus injectable	Null (RR=0.90, 95% CI=0.62, 1.30)
≥4 partners, lifetime[22]	LARC versus injectable, patch, ring	Risk (APR=1.37, 95% CI=1.01, 1.85)
≥2 partners, past 3 months[22]	LARC versus injectable, patch, ring	Risk (APR=2.58, 95% CI=1.17, 5.67)
Number of partners, past 12 months[64] (dichotomized as ≥4 versus <4)[a,c]	IUD versus injectable	Null (RR=0.21, 95% CI=0.02, 1.87)
Frequency of sex		

Measures	Comparison	Finding
Frequency of sex, past year[42] (dichotomized as >1 time/week-1 time/day versus ≤1 time/week)[a]	IUD versus injectable	Null (RR=1.06, 95% CI=0.81, 1.39)
Substance use		
Drank alcohol or used drugs before last sex[22]	LARC versus injectable, patch, ring	Null (APR=1.21, 95% CI=0.59, 2.51)
Other comparisons		
Multiple sex partners		
New partner, past 6 months[38]	LARC versus OC, injectable, patch, ring	Null (OR=1.18, 95% CI=0.75, 1.87)
Number of partners, 12 months[64] (dichotomized as ≥4 versus <4)[a,c]	IUD versus OC, patch	Null (RR=0.24, 95% CI=0.03, 1.77)

[a]Raw numbers were extracted or calculated on the basis of the dichotomy noted, and Comprehensive Meta-Analysis was used to generate a relative risk.

[b]95% CI was calculated using mean, SD, and sample size.

[c]Raw numbers were calculated on the basis of weighted percentages and unweighted ns.

APR, adjusted prevalence ratio; IUD, intrauterine device; LARC, long-acting reversible contraception; OC, oral contraception.