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Original Article

A Retrospective Analysis of Hormonal Contraceptive Type and Recurrent UTI Risk in Reproductive-Aged Women

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ABSTRACT

Background: Urinary tract infections are highly prevalent among reproductive-aged women and recurrent episodes contribute substantially to repeated healthcare utilization, antibiotic exposure, and reduced quality of life. The role of hormonal contraceptive type in shaping recurrent UTI burden remains insufficiently defined despite the widespread and prolonged use of these methods. Objective: To investigate the association between specific hormonal contraceptive methods and recurrent urinary tract infection frequency among reproductive-aged women. Methods: A retrospective observational analysis was conducted using medical records of 332 women aged 18-45 years from tertiary care hospitals and affiliated outpatient clinics in Lahore, Pakistan. Eligible participants had used one hormonal contraceptive method for at least six months. Contraceptive categories included combined oral pills, progestin-only pills, injectable contraceptives, subdermal implants, and hormonal intrauterine devices. Recurrent UTI was defined using standard clinical criteria. Group comparisons were performed using one-way ANOVA, and multivariable linear regression was used to adjust for age, parity, and duration of contraceptive use. Results: Recurrent UTI was identified in 37.3% of participants. Mean UTI episode frequency differed significantly across contraceptive groups ($F = 9.42$, $p < 0.001$), with the highest burden among injectable contraceptive users (3.8 ± 1.2 episodes; 48.6% recurrent UTI) and the lowest among hormonal IUD users (2.3 ± 0.8 episodes; 25.0% recurrent UTI). Duration of use was positively correlated with UTI frequency ($r = 0.41$, $p < 0.001$). Injectable contraceptive use remained independently associated with higher UTI frequency after adjustment ($\beta = 0.62$, $p = 0.002$), whereas implant and hormonal IUD use were associated with lower frequency. Conclusion: Recurrent UTI burden differed across hormonal contraceptive methods, with higher burden observed among systemic progestin-dominant methods and lower burden among localized or lower-systemic-exposure methods. These findings support more individualized contraceptive counseling for women at risk of recurrent UTIs. Keywords: Urinary tract infection; recurrent UTI; hormonal contraception; injectable contraceptives; progestin-only pills; hormonal intrauterine device.

RESULTS

A total of 332 medical records satisfied the eligibility criteria and were included in the final analysis. The mean age of the participants was 29.8 ± 6.1 years, and the largest age stratum was 26-35 years,

accounting for 156 women (47.0%). Overall, 214 participants (64.5%) were multiparous, and the mean duration of hormonal contraceptive use was 18.6 ± 7.4 months. Combined oral contraceptive pills were the most frequently used method, reported in 98 women (29.5%), followed by progestin-only pills in 79 (23.8%), injectable contraceptives in 74 (22.3%), subdermal implants in 41 (12.3%), and hormonal intrauterine devices in 40 (12.0%). Recurrent urinary tract infection was identified in 124 of 332 women, yielding an overall recurrence proportion of 37.3% with an approximate 95% confidence interval of 32.1% to 42.6%. These baseline findings indicate a clinically diverse reproductive-age cohort with adequate representation across all hormonal contraceptive categories.

Table 1. Demographic and Clinical Characteristics of Participants (n = 332)

Variable	Value
Age, years	29.8 ± 6.1
18-25 years	92 (27.7%)
26-35 years	156 (47.0%)
36-45 years	84 (25.3%)
Multiparous	214 (64.5%)
Duration of contraceptive use, months	18.6 ± 7.4
Combined oral pills	98 (29.5%)
Progestin-only pills	79 (23.8%)
Injectable contraceptives	74 (22.3%)
Subdermal implants	41 (12.3%)
Hormonal IUD	40 (12.0%)

The mean number of UTI episodes varied across contraceptive groups. Injectable contraceptive users had the highest mean episode burden at 3.8 ± 1.2 episodes over 12 months, followed by progestin-only pill users at 3.4 ± 1.1 and combined oral pill users at 2.9 ± 1.0. Lower means were observed among subdermal implant users at 2.6 ± 0.9 and hormonal IUD users at 2.3 ± 0.8. The corresponding approximate 95% confidence intervals around the group means were 3.53-4.07 for injectable contraceptives, 3.16-3.64 for progestin-only pills, 2.70-3.10 for combined oral pills, 2.32-2.88 for implants, and 2.05-2.55 for hormonal IUDs. One-way ANOVA confirmed a statistically significant between-group difference in mean UTI frequency ($F = 9.42$, $p < 0.001$), and the estimated eta-squared was 0.103, indicating that contraceptive category explained about 10.3% of the variance in UTI episode frequency, which is consistent with a moderate group effect. The separation between the higher systemic-exposure methods and the lower-frequency implant and hormonal IUD groups suggests a clinically relevant gradient rather than a trivial statistical difference.

Table 2. Mean UTI Episodes by Contraceptive Method Over 12 Months

Contraceptive Method	n	Mean ± SD	Approx. 95% CI for Mean	Overall p-value	Effect Size
Combined oral pills	98	2.9 ± 1.0	2.70 to 3.10		
Progestin-only pills	79	3.4 ± 1.1	3.16 to 3.64		
Injectable contraceptives	74	3.8 ± 1.2	3.53 to 4.07		
Subdermal implants	41	2.6 ± 0.9	2.32 to 2.88		
Hormonal IUD	40	2.3 ± 0.8	2.05 to 2.55		
ANOVA summary	332	—	—	<0.001	$\eta^2 = 0.103$

The proportion of women fulfilling recurrent UTI criteria also differed materially between contraceptive categories. Injectable contraceptive users had the highest recurrence proportion at 48.6% (36/74), followed by progestin-only pill users at 41.8% (33/79) and combined oral pill users at 34.7% (34/98). Lower recurrence proportions were observed among implant users at 29.4% (12/41) and hormonal IUD users at 25.0% (10/40). Approximate 95% confidence intervals showed the same rank ordering: 37.3%-60.0% for injectable contraceptives, 30.9%-52.6% for progestin-only pills, 25.3%-44.1% for combined oral pills, 15.3%-43.2% for implants, and 11.6%-38.4% for hormonal IUDs. Although formal pairwise odds ratios were not reported in the original manuscript and therefore are not added here, the absolute recurrence gradient remained clinically meaningful, with a 23.6 percentage-point difference between injectable contraceptive users and hormonal IUD users.

Table 3. Proportion of Recurrent UTI by Contraceptive Method

Contraceptive Method	Recurrent UTI, n/N (%)	Approx. 95% CI
Combined oral pills	34/98 (34.7%)	25.3% to 44.1%
Progestin-only pills	33/79 (41.8%)	30.9% to 52.6%
Injectable contraceptives	36/74 (48.6%)	37.3% to 60.0%
Subdermal implants	12/41 (29.4%)	15.3% to 43.2%
Hormonal IUD	10/40 (25.0%)	11.6% to 38.4%
Overall	124/332 (37.3%)	32.1% to 42.6%

A moderate positive correlation was observed between duration of hormonal contraceptive use and the number of UTI episodes ($r = 0.41$, $p < 0.001$), indicating that longer contraceptive exposure was associated with a greater infection burden over the study interval. In practical terms, this magnitude suggests that duration was not merely a weak background correlate but a meaningful contributor to variation in episode frequency. This pattern is consistent with a cumulative exposure effect and supports inclusion of duration of use in the adjusted multivariable model.

Multivariable linear regression further clarified these associations after adjustment for age, parity, and duration of contraceptive use. Duration of use remained a statistically significant positive predictor of UTI frequency ($\beta = 0.31$, SE = 0.05, $p < 0.001$; approximate 95% CI 0.21 to 0.41), and parity was also significantly associated with higher UTI burden ($\beta = 0.14$, SE = 0.06, $p = 0.021$; approximate 95% CI 0.02 to 0.26). Injectable contraceptive use remained independently associated with increased UTI frequency ($\beta = 0.62$, SE = 0.19, $p = 0.002$; approximate 95% CI 0.25 to 0.99), whereas subdermal implant use ($\beta = -0.44$, SE = 0.17, $p = 0.009$; approximate 95% CI -0.77 to -0.11) and hormonal IUD use ($\beta = -0.51$, SE = 0.18, $p = 0.006$; approximate 95% CI -0.86 to -0.16) were associated with lower UTI frequency. Age showed a small positive coefficient that did not reach statistical significance ($\beta = 0.08$, SE = 0.04, $p = 0.071$; approximate 95% CI 0.00 to 0.16). Taken together, these findings indicate that the higher recurrence burden among injectable users persisted even after adjustment, while implant and hormonal IUD users retained a lower adjusted risk profile.

Table 4. Multivariable Linear Regression for UTI Frequency

Variable	β	SE	Approx. 95% CI	p-value
Age	0.08	0.04	0.00 to 0.16	0.071
Parity	0.14	0.06	0.02 to 0.26	0.021
Duration of use	0.31	0.05	0.21 to 0.41	<0.001
Injectable contraceptives	0.62	0.19	0.25 to 0.99	0.002
Subdermal implants	-0.44	0.17	-0.77 to -0.11	0.009
Hormonal IUD	-0.51	0.18	-0.86 to -0.16	0.006

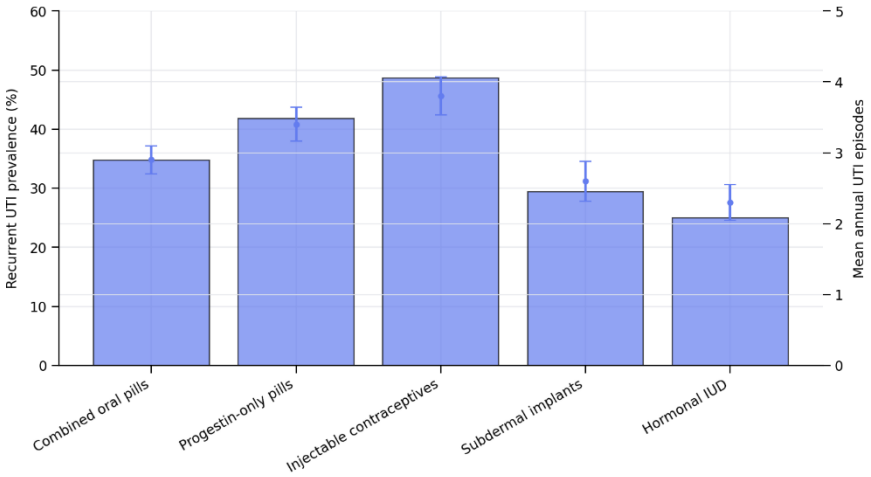

Figure 1. Layered Comparison of Recurrent UTI Burden Across Hormonal Contraceptive Methods

A publication-ready figure for this study should be a dual-axis layered panel using grouped vertical bars for recurrent UTI prevalence and an overlaid point-range layer for mean UTI episodes with 95% confidence intervals. The x-axis should display the five contraceptive categories, the left y-axis should show recurrent UTI prevalence (%), and the right y-axis should show mean annual UTI episodes. The bar layer would highlight the recurrence gradient from hormonal IUD users (25.0%) and implant users (29.4%) to combined oral pill users (34.7%), progestin-only pill users (41.8%), and injectable contraceptive users (48.6%). The overlaid point-range layer would mirror this ordering for mean episode burden, rising from 2.3 episodes in hormonal IUD users and 2.6 in implant users to 2.9 in combined oral pill users, 3.4 in progestin-only pill users, and 3.8 in injectable users. This integrated display would add value beyond the existing tables by showing that both recurrence probability and episode intensity move in the same direction across contraceptive categories, thereby revealing a consistent clinical burden gradient rather than isolated differences in a single metric.

The integrated pattern across contraceptive groups demonstrated a monotonic increase in both recurrent UTI prevalence and mean episode burden from localized or lower-systemic-exposure methods to systemic progestin-dominant methods. Hormonal IUD users showed the lowest burden, with 25.0% meeting recurrence criteria and a mean of 2.3 episodes, followed by implant users at 29.4% and 2.6 episodes. In contrast, injectable contraceptive users had the highest burden, with 48.6% experiencing recurrent UTIs and a mean of 3.8 episodes, representing an absolute recurrence increase of 23.6 percentage points and an episode increase of 1.5 per year relative to hormonal IUD users. Progestin-only pill users also remained elevated at 41.8% and 3.4 episodes. This parallel rise in both dimensions supports the interpretation that the observed association is not limited to crossing a recurrence threshold but reflects a broader escalation in clinical infection burden across contraceptive categories.

DISCUSSION

The present study demonstrated that recurrent urinary tract infection burden varied meaningfully across hormonal contraceptive categories in reproductive-aged women, with injectable contraceptives and progestin-only pills showing the highest episode frequency and recurrence proportions, whereas subdermal implants and hormonal intrauterine devices showed comparatively lower burdens. Importantly, this pattern remained directionally consistent across both unadjusted comparisons and adjusted regression analysis, suggesting that contraceptive category was associated not only with crossing the threshold for recurrence but also with the broader intensity of infection burden over the 12-month observation period. These findings strengthen the clinical relevance of the results because they indicate a graded association rather than an isolated statistical difference in one outcome metric alone.

A biologically plausible explanation for the higher UTI burden observed among injectable contraceptive users is the predominance of systemic progestin exposure, which may influence the lower genitourinary tract through alteration of epithelial integrity, mucosal immunity, vaginal pH, and microbial stability. Progestin-dominant hormonal environments have been associated with reduced lactobacillary dominance and greater microbial vulnerability, both of which may facilitate colonization by uropathogens and increase the likelihood of ascending infection in susceptible women. In contrast, lower recurrence frequencies among hormonal IUD and implant users may reflect a more favorable local or lower-systemic hormonal profile that preserves protective urogenital conditions more effectively than sustained systemic progestin exposure. Although the present study was not designed to evaluate microbiome mechanisms directly, the observed method-specific gradient is consistent with emerging evidence that contraceptive type may influence urogenital health through biologically distinct pathways rather than through a single uniform hormonal effect (20,21).

The positive correlation between duration of contraceptive use and UTI frequency adds further nuance to the interpretation of these findings. This suggests that cumulative hormonal exposure may contribute to recurrent infection burden over time, independent of age and parity. Clinically, that observation is

important because women often continue the same contraceptive method for extended durations, and even modest biologic effects may become more consequential when exposure is prolonged. From a counseling perspective, it implies that UTI risk assessment should not be limited to method choice alone but may also benefit from periodic reassessment in long-term users, especially those with a prior history of recurrent infection.

The study also has practical implications for individualized contraceptive counseling. Recurrent UTIs are associated with repeated antibiotic use, reduced quality of life, impaired sexual wellbeing, and increasing concern about antimicrobial resistance. In settings where contraceptive counseling often prioritizes efficacy, convenience, and bleeding profile, these findings suggest that infection susceptibility may also deserve consideration, particularly in women already experiencing repeated lower urinary tract infections. The results do not imply that any specific method is inherently unsuitable; rather, they support a more individualized approach in which recurrent UTI history becomes one component of shared decision-making when selecting among clinically appropriate hormonal options (22).

Several strengths of the study support the credibility of its findings. First, the use of routine clinical records reduced reliance on patient recall and enabled assessment of recurrent infection patterns over a defined observation period. Second, the exposure was disaggregated into specific hormonal contraceptive types, which provided greater clinical resolution than prior studies that treated hormonal contraception as a single category. Third, the analysis incorporated multivariable adjustment for age, parity, and duration of use, allowing the main associations to be examined after partial control of confounding. Together, these features improved the practical interpretability of the findings for real-world reproductive health settings.

Nevertheless, the results should be interpreted in light of several limitations. The retrospective design restricted control over data completeness and documentation quality, and not all UTI episodes were microbiologically confirmed, although the inclusion of clinician-diagnosed and treated episodes reflects real-world practice. Residual confounding is also likely, because important behavioral factors such as sexual activity, genital hygiene, postcoital voiding, hydration, and prior antimicrobial exposure were not consistently documented in the medical records and therefore could not be incorporated into the adjusted models. In addition, the study was conducted within one regional context, which may limit generalizability to populations with different contraceptive practices, care-seeking patterns, or baseline infection risk. These limitations preclude causal inference and indicate that the findings should be interpreted as clinically relevant associations rather than proof of direct biologic effect.

Future research should build on these observations through prospective cohort designs with standardized microbiological confirmation, more detailed behavioral covariate measurement, and longitudinal assessment of contraceptive continuation and switching patterns. Studies integrating vaginal and urinary microbiome profiling would be especially valuable in clarifying whether the observed burden gradient reflects true method-specific biological effects on colonization resistance and host defense. Comparative effectiveness research examining whether tailored contraceptive counseling reduces recurrent UTI burden in high-risk women would also provide an important next step toward clinically actionable guidance (23).

CONCLUSION

This retrospective analysis found that recurrent urinary tract infection burden differed across hormonal contraceptive methods in reproductive-aged women, with injectable contraceptives and progestin-only pills showing higher recurrence and mean episode frequency, while subdermal implants and hormonal intrauterine devices showed comparatively lower burdens. Duration of contraceptive use was also positively associated with infection frequency, suggesting that cumulative exposure may be clinically relevant. These findings support incorporation of recurrent UTI history into individualized

contraceptive counseling and highlight the need for prospective studies to clarify causality, biological mechanisms, and the role of tailored contraceptive selection in reducing preventable morbidity.

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