Title

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Journal

Journal of Adolescent Health, 72(5)

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Publication Date

2023-05-01

DOI

10.1016/j.jadohealth.2022.12.019

Peer reviewed

HHS Public Access

Author manuscript

J Adolesc Health. Author manuscript; available in PMC 2024 January 30.

Published in final edited form as:

J Adolesc Health. 2023 May ; 72(5): 737–745. doi:10.1016/j.jadohealth.2022.12.019.

Sexual Health Behaviors by Age 17 and Lower Urinary Tract Symptoms at Age 19: PLUS Research Consortium Analysis of ALSPAC Data

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Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jadohealth.2022.12.019.

Conflicts of interest: The authors have no conflicts of interest to declare.

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Abstract

Purpose: We examined how antecedent sexual health factors affect lower urinary tract symptoms (LUTS) in adolescent women.

Methods: We analyzed 1,941 adolescent women from the Avon Longitudinal Study of Parents and Children at age 19. At ages 15 and 17, participants reported use of oral contraceptives (OCs), history of sexual intercourse, number of sexual partners, and condom use. At age 19, The Bristol Female Lower Urinary Tract Symptoms questionnaire quantified the frequency over the past month: stress incontinence, any incontinence, urgency, sensation of incomplete emptying, bladder pain, and urinary tract infection. Multivariable regression models examined associations between sexual health behaviors reported at ages 15 and 17 and six LUTS reported at age 19, after controlling for covariates.

Results: Commonly reported LUTS at age 19 were past-month stress incontinence (26.8%), bladder pain (26.3%), any urine leakage (22.1%), and urinary tract infection (15.4%). OC use by age 17 was associated with urgency (odds ratio [OR] = 1.62, 95% confidence interval [CI] 1.19–2.20), incomplete emptying (OR = 1.62, 95% CI = 1.17–2.26), bladder pain (OR = 1.45, 95% CI = 1.15–1.83), and urinary tract infections (OR = 1.68, 95% CI = 1.28–2.21) at age 19 after adjustment for covariates. However, associations were attenuated after adjustment for condom use and number of sexual partners. Sexual intercourse by age 17 was associated with 1.53–2.65 increased odds of LUTs categories except incontinence, with lower confidence interval boundaries > 1.0. Associations were stronger among women with ≥ 3 sexual partners (vs. 0) by age 17.

Discussion: We found longitudinally assessed associations between OC use, sexual intercourse, and number of sexual partners during adolescence and LUTS at age 19.

Keywords

ALSPAC; Lower urinary tract symptoms; Adolescent women; Sexual history; Epidemiology

Lower urinary tract symptoms (LUTS) are prevalent among women across the life course and include symptoms such as urinary incontinence, urgency, and urinary tract infection (UTI) [1]. Certain LUTS, such as stress and urgency incontinence, have been linked with pregnancy, childbirth, and advancing age [2]; however, epidemiological studies demonstrate that up to 25% of adolescent women experience these symptoms [3,4]. Unfortunately, adolescents with LUTS are more likely than those without LUTS to experience a variety of adverse psychosocial consequences, including bullying, stress, and emotional and behavioral problems [5]. During adolescence, roughly defined by the World Health Organization as the period of the life course occurring between ages 10 and 19, females are more likely than males to experience specific LUTS, such as UTI [6]. It is therefore necessary to better understand the factors that increase risk of LUTS in this population.

Studies have identified several modifiable risk factors for LUTS during adolescence, including constipation, high body mass index (BMI), and participation in high impact sports [7,8]. Additional risk factors have been studied among adult women, including those related

to sexual health behaviors. For example, use of oral contraceptives (OC) has been associated with decreased risks of urinary incontinence and increased risks of interstitial cystitis [9,10]. UTIs have been associated with frequency of sexual intercourse among young adult (ages 18–25) and adult women [11]. It has been hypothesized that factors which alter the vaginal microbiome, such as condom use, sexually transmitted infections (STIs), or higher number of sexual partners, also alter urogenital flora, which, in turn, increases the likelihood that LUTS may develop [12].

Globally, adolescent women have a high prevalence of these potential risk factors for LUTS. For example, 41% of U.S. adolescent women have had sexual intercourse prior to age 18 [13]. Among adolescent women who have had intercourse, 29% reported OC use and 52% reported using barrier contraception (male condoms) at their last intercourse [13]. To date, the associations between sexual health behaviors by age 17 (during adolescence) and LUTS during the later teenage years have largely been understudied.

Using a longitudinal cohort followed through late adolescence, we sought to examine associations between sexual health behaviors reported by adolescent women at age 17 or earlier and LUTS reported at age 19. The sexual health behaviors were measured at ages 15 and 17 and included OC use, history of sexual intercourse, number of sexual partners, and condom use at last intercourse. In contrast to existing studies which often rely on cross-sectional data in adult populations, this study is one of the first to examine these associations in a longitudinal cohort of adolescent women followed through late adolescence.

Methods

This study is a secondary data analysis of female children in the Avon Longitudinal Study of Parents and Children (ALSPAC). The study website contains details of all the data that are available through a fully searchable data dictionary and variable search tool http://www.bristol.ac.uk/alspac/researchers/our-data. In brief, ALSPAC is an ongoing, longitudinal cohort study of parents and children residing in Avon, the United Kingdom which aims to study environmental and genetic factors that affect a person's health and development. Pregnant women, with expected dates of delivery between April 1991 and December 1992, were invited to take part in the study. Additional recruitment brought the total ALSPAC sample size for analyses of any data collected after the age of seven to 15,454 pregnancies, resulting in 15,589 live births. Details on the cohort profile, representativeness, and phases of recruitment are described in two cohort profile papers [14,15] and in an update [16]. Self-report questionnaires, clinical measures, and biological samples have been collected from the cohort of mothers and children since early pregnancy. Our analyses were restricted to female offspring alive at 1 year (n = 7,148) who had reported on the presence or absence of at least one LUTS outcome variable at age 19 and provided sexual history information at ages 15 and/or 17 (n = 1,941). Of these 1,941 participants, 1,873 (96.4%) responded to all six LUTS questions.

Ethical approval

Ethical approval for the study was obtained from the ALSPAC ethics and law committee and the local research ethics committees. Informed consent for the use of data collected

via questionnaires was obtained from participants following the recommendations of the ALSPAC ethics and law committee at the time. As these secondary analyses use pre-existing deidentified data, it does not constitute human subjects research http://www.bris.ac.uk/alspac/researchers/data-access/data-dictionary/.

Measures

Sexual health behaviors.—Questions regarding OC use were asked at ages 13, 14.5, 15.5, 16, and 17. OC use was measured with the self-report question: "Have you taken oral contraceptives or birth control pills, for any reason during the past 12 months?" [yes, no, I do not know]. Participants who reported OC use at any time point were classified as having used OC by age 17.

Sexual intercourse was assessed at ages 15.5 and 17; participants were asked how many people they have had sexual intercourse with [0, 1–2, three, or more]. Participants who indicated one or more partners at either time point were classified as having had sexual intercourse by age 17. Number of sexual partners was defined as 0 if the participant indicated 0 partners at both time points,1–2 if they indicated 1–2 partners but never three partners at either time point, or 3+ if they indicated three or more partners at either time point.

Use of condoms was assessed at ages 15.5 and 17 by asking participants whether they (or their sexual partner) used a condom when they last had sexual intercourse [yes/no/never had intercourse]. Among the sample of adolescents who reported having one or more partners (i.e., sexually active), if participants never indicated "no condom use" at any time point, they were classified as having "Consistent Condom Use at ages 15 and 17". If participants indicated "condom use" at one time point and "No condom use" at the other, they were coded as "Inconsistent Condom Use". Finally, if at all time periods participants indicated no use of condoms, they were coded as "No Condom Use at ages 15 and 17".

Lower urinary tract symptoms.—LUTS were assessed with self-report questionnaires at ages 13 and 19. LUTS was not assessed at ages 15 or 17. At age 13, the questionnaire assessed the presence and frequency of a range of LUTS over the past two weeks [17]. Participants were classified as having LUTS at age 13 if they indicated 'yes' to at least one symptom [urgency, frequent urination, low voided volume, child had to hold on until they felt like bursting before they had a wee, nocturia, child woke up needing a wee but turned over and went back to sleep, daytime wetting, and bedwetting].

The presence of six LUTS during the past month was measured at age 19: a history of (1) stress incontinence, (2) any urine leakage, (3) urgency, (4) sensation of incomplete emptying, (5) bladder pain, and (6) UTI. The Bristol Female Lower Urinary Tract Symptoms questionnaire [18] was used to quantify the frequency of the following symptoms over the past month (never, occasionally, sometimes, most of the time, all of the time): leaking when physically active, exerting themselves, coughing, or sneezing (stress incontinence); sudden need to rush to the toilet to urinate (urgency); bladder not emptying properly after urination (sensation of incomplete emptying); and pain in the bladder (bladder pain). Past-month frequency of any incontinence was assessed with the question, "How

often do you leak urine" (never, once or less per week, 2–3 times per week, once per day, several times per day). The presence of these symptoms was defined as reporting any frequency other than "never". UTI was defined as reporting "not at all" (rather than sometimes/always) to the question "In the past month, how often have you had a urinary/bladder infection?" Although the Bristol Female Lower Urinary Tract Symptoms measured several other symptoms at age 19, the analysis only included the symptoms that were identified as being most common in this age group by clinical expert authors on this manuscript. Of note, age 13 LUTS items did not discretely overlap with age 19 ICIQ items; thus, some LUTS were assessed only at age 19.

Confounders.—Potential confounders were selected based on previous literature and availability within the dataset and included BMI at age 17 (continuous), the difference in BMI between age 17 and 12.5 (continuous), constipation at age 13 (yes, no), self-reported history of UTI in the past year at age 13 (yes, no), and LUTS at age 13 (yes, no as defined above) [19,20]. Age at menarche (continuous, in months) was also included as a covariate after our initial analyses showed higher prevalence of LUTS with lower age of menarche (Table 1). We chose to not include parity at age 19 since these factors would be in the causal pathway between sexual activity and OC use at age 17 or earlier and LUTS at age 19.

Statistical methods

We first assessed the pattern of missing data in our dataset. Among 7,148 female participants who were alive at 12 months, only 1,941 individuals had at least one of the seven age 19 LUTS outcome variables available for analysis. Multivariate imputation by chained equations method was selected to appropriately handle missing predictor, covariate, and outcome data [21]. In multivariate imputation models, we included all age 19 outcome variables, age 17 predictors (OC use, sexual intercourse, number of sexual partners, condom use), and the confounders listed previously. Further statistical analyses were based on one hundred imputed datasets [22]. Tetrachoric correlation technique was used to estimate the correlations between any two of the six LUTS outcome variables (Table A1).

We assessed the distributions of study variables and examined confounder and predictor variables (OC use, sexual intercourse, number of sexual partners, and condom use by age 17) in relation to LUTS outcomes at age 19. We then used multivariate logistic regression methods to calculate odds ratios (ORs) and 95% confidence intervals (CIs) that estimated associations between OC use by age 17 and each of the six LUTS outcomes at age 19. We first measured these associations adjusting for age at menarche, BMI at age 17, BMI difference between age 17 and 12.5, constipation at age 13, LUTS at age 13, and UTI at age 13 (Adj 1). Second, we further adjusted for condom use and number of sexual partners by age 17 to explore whether the associations were independent of sexual activity (Adj 2). We then restricted the analyses to two subpopulations: those who did not have UTI at age 19 to explore whether symptoms were related to having a concurrent UTI (Restrict 1; N = 1,641) and those who did not report intercourse by age 17 to explore the effect of noncontraceptive OC use (Restrict 2; N = 934).

We similarly used multivariate logistic regression methods to examine associations between sexual behaviors (sexual intercourse by age 17, number of partners by age 17, condom use by age 17) and each of the LUTS outcomes at age 19, adjusted for confounders (Adj 1). Second, we further adjusted for OC use to explore this variable as a confounder (Adj 2). We then restricted these analyses to those who did not have UTI at age 19 to explore whether symptoms were related to having a UTI (Restrict; n = 1,641). For these analyses, associations between condom use and LUTS were examined among the subsample of women who had sexual intercourse by age 17. Analyses were performed in SAS 9.4 mainly by procedures MI, GLIMMIX, and MIANALYZE (SAS Institute, Inc. Cary, North Carolina, 2018).

Role of funding source

The study sponsor had no role in the study design; in the collection, analysis, and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

Results

At age 19, the most commonly reported LUTS were past-month stress incontinence (26.8%), bladder pain (26.3%), any urine leakage (22.1%), and UTI (15.4%). Overall, 55.9% reported OC use at age 17 or earlier, 50.7% reported one or more sexual partners, and 20.3% of the adolescents who had reported having intercourse reported no condom use on the two occasions when condom use was assessed (Table 1). Table 2 shows the prevalence of the various LUTS by covariate and predictor variables. Bladder pain and UTIs at age 19 were more prevalent among women with earlier age at menarche. Any urine leakage at age 19 was more prevalent among women at the highest BMI category at age 17. All categories of LUTS were more prevalent among those who reported constipation or UTIs at age 13, compared to those who did not report those conditions at age 13. Compared to those who did not use OCs by age 17, the prevalence of urgency, sensation of incomplete emptying, bladder pain, and UTI was higher among those who used OCs. All categories of LUTS were more prevalent among those who reported three or more sexual partners, compared to 1–2 or 0 partners by age 17.

Associations between oral contraceptive use by age 17 and lower urinary tract symptoms at age 19

Relative to adolescent women who did not use OCs by age 17, those who used OCs by age 17 had increased odds of reporting urgency (OR = 1.62, 95% CI = 1.19–2.20), incomplete emptying (OR = 1.62, 95% CI = 1.17–2.26), bladder pain (OR = 1.45, 95% CI = 1.15–1.83), and UTIs (OR = 1.68, 95% CI = 1.28–2.21) at age 19 after adjustment for age at menarche, BMI at age 17, BMI difference between ages 17 and 12.5, LUTS at age 13, and UTIs at age 13 (Table 3; Adj 1). Further adjustment for condom use and number of sexual partners attenuated these associations (Adj 2). When we restricted the analyses to women not reporting UTIs at age 19 or to those who had not had sexual intercourse, we found that our associations were not substantially different, but the confidence intervals widened due to the smaller sample size (Restrict 1 and 2).

Associations between sexual intercourse, number of partners, and condom use by age 17 and lower urinary tract symptoms at age 19

Relative to adolescent women who had not engaged in sexual intercourse by age 17, those who reported having had sexual intercourse by age 17 had increased odds of reporting urgency (OR = 1.72, 95% CI = 1.27–2.33), sensation of incomplete emptying (OR = 1.65, 95% CI = 1.19–2.29), bladder pain (OR = 1.46, 95% CI = 1.17–1.83), and UTIs (OR = 2.65, 95% CI = 1.96–3.59) at age 19 after adjustment for covariates (Table 4). Further adjustment for use of OCs by age 17 attenuated the overall associations. Separate analyses compared adolescent women who had 0 partners by age 17, to those who reported 1–2, or three or more sexual partners. In these analyses, relative to adolescent women who had 0 partners by age 17, those with three or more sexual partners had increased odds of experiencing all LUTS except stress incontinence. The associations were slightly attenuated when we adjusted for OC use by age 17. When the dataset was restricted to those who did not report UTI at age 19, adolescent women with three or more (vs. 0) sexual partners by age 17 had increased odds of sensation of incomplete emptying (OR = 2.54, 95% CI = 1.44–4.47) and bladder pain (OR = 1.49, 95% CI = 1.07–2.05). Finally, among the sample who reported a history of sexual intercourse, inconsistent use of condoms across the two assessments of last sex (vs. no condom use) was associated only with stress incontinence.

Table A1 shows how strongly correlated many of these LUTS categories were to each other with correlations of > 0.5 seen between “stress incontinence” and any urine leakage; “urgency” and “sensation of incomplete emptying”; and “bladder pain” and “UTIs”. Thus, we could not assess whether our sexual history and LUTS associations were largely confined to one LUTS versus another.

Discussion

This study examines associations between sexual health behaviors among adolescent women by age 17 and LUTS at age 19. Using self-report data from females in the ALSPAC cohort, we found that OC use by age 17 was associated with 1.4–1.7 higher odds of experiencing urgency, sensation of incomplete emptying, bladder pain, and UTI at age 19. It should be noted that the association between OC use and these LUTS outcomes was attenuated after adjustment for condom use and number of sexual partners. This suggests that these associations may be related to alterations in microflora from STIs or multiple partners, not necessarily OC use per se. We also found that as the number of sexual partners by age 17 increased (none, 1–2, three, or more) there was an increased odds of experiencing all LUTS except stress incontinence, even after adjustment for all our covariates and after restricting our population to those without UTIs. Finally, among the sample who reported a history of sexual intercourse, inconsistent use of condoms across the two assessments of last sex (vs. no condom use) was associated only with stress incontinence.

Our study found positive associations between OC use and specific LUTS, namely urgency, sensation of incomplete emptying, bladder pain, and UTIs. OC use may be a marker for other common menstrual conditions, such as dysmenorrhea, which may exacerbate symptoms of urgency, bladder pain, or UTI. The indication for OC use (e.g., menstrual management or contraception) was not collected in this study so we are unable to determine

if menstrual conditions contributed to this association [9]. Since the association between OC use and these LUTS outcomes was attenuated after adjustment for condom use and number of sexual partners, it suggests that the associations may be due to STIs. Among adults, OC use has been linked with painful bladder syndrome, which can result in many of these symptoms [9]. Although rare in adolescents, this condition is often concomitant with pelvic floor myofascial pain and dysfunction which can also be associated with LUTS [23]. It has been hypothesized that both endogenous estrogen and the exogenous estrogen in OCs increases pain perception, which may account for the associations with bladder pain and UTIs [24]. Another possible explanation is that OCs could potentially contribute to LUTS by lowering endogenous estrogen levels [25], thereby diminishing their beneficial influence on genitourinary tract connective tissue integrity, neuronal control, blood flow, and epithelial thickness [26]. Similarly, OCs may alter the function of muscles within the pelvic floor by lowering free testosterone levels [27,28].

We did not find a strong association between OC use and any urine leakage. Previous studies that have examined these associations among young adults and premenopausal women have had mixed results. For example, one cross-sectional survey of premenopausal women found that current OC use decreased the odds of incontinence, whereas another found a positive association between OC use for menstrual management and incontinence [10,29]. Two other survey studies and one large prospective study of premenopausal U.S. nurses found OC use was positively associated with urinary incontinence prevalence [30–32]. Future research is needed to better determine how age and purpose of OC use factors into these associations.

Our study also found that having three or more sexual partners by age 17 was associated with all LUTS except stress incontinence. These associations were only slightly attenuated after adjustment for OC use. Other studies linking sexual activity and UTIs in adult women have hypothesized that the association may be explained by exposure to bacteria during sexual activity, which heightens risk for UTIs [33]. Verstraelen et al. posit that unprotected intercourse leads to alkalinization of the vagina, which enhances a shift from lactobacilli-dominated microflora to a bacterial vaginosis-like type of microflora; they also posit that mechanical transfer of perineal enteric bacteria is enhanced by coitus [34]. Inconsistent condom use is known to increase the risk of STIs which also might alter microflora and increase risk of UTIs. We did not find an association between condom use and LUTS, including UTIs. However, our measure assessed condom use at last sex on only two occasions; a more comprehensive assessment of condom use may have yielded different results. It is also possible that coatings on condoms might alter microflora. A previous study found that use of condoms coated with spermicide (usually Nonoxynol-9) increased risk of UTIs among women aged 15–29 years [35]. In vitro studies show that Nonoxynol-9 disrupts normal protective vaginal microbiota, such as lactobacillus, thus allowing colonization by *E. coli* and other uropathogens [36–38]. This study did not ask about spermicide use, but given that the data were collected in the early 2000s, it is not likely that the women were exposed to Nonoxynol-9.

Limitations

These analyses were restricted to a U.K. cohort of adolescent women born in the mid-1990s, limiting the generalizability of these findings to current cohorts of adolescent women. Contraceptive uptake patterns have changed dramatically over the past 30 years among adolescents, with increasing rates of use of other forms of contraception, including long-acting reversible forms of contraception [13]. We were unable to make conclusions around effects of long-acting reversible contraception or noncondom barrier contraceptives, as the use of these methods was not measured by age 17 in this cohort. Furthermore, we were unable to examine other important factors (OC dose, duration, progestin type, and reason for OC use) that may be associated with LUTS, as they were not measured at ages 15, 17, or 19. In addition, the study did not collect data on STIs or parity, both of which may mediate the associations between sexual behaviors and LUTS. It is possible the adolescents misattributed symptoms of STIs (dysuria) or menstruation (frequency) to LUTS [39]; future research is needed to determine how to measure LUTS most accurately in this population. Parity, however, is unlikely to have confounded our associations as adolescent women residing in England during this time had a low birth rate (~20 per 1,000 15–19 year old females) [40]. In addition, we would expect confounding by parity to lead to inverse rather than positive associations between OC use and LUTS. Future research is needed to further explore these associations and any childhood-onset factors (e.g., neurobehavioral issues) which may influence the associations between sexual health behaviors and LUTS. As with any longitudinal study, loss to follow-up diminished the sample size; however, multiple imputation allowed us to minimize bias due to selective loss to follow-up.

Conclusion

This study examined prospectively assessed associations between sexual behaviors during adolescence and LUTS in late adolescence. Additional research is needed to further explore these associations in prospective studies of contemporary cohorts of adolescent women. Research would also benefit from including more detailed assessments of contraceptive use, STIs, and sexual behaviors when studying LUTS in adolescent women.

Acknowledgments

We are extremely grateful to all the families who took part in this study, the midwives for their help in recruiting them, and the whole ALSPAC team, which includes interviewers, computer and laboratory technicians, clerical workers, research scientists, volunteers, managers, receptionists, and nurses.

Participating research centers at the time of this writing are as follows: Loyola University Chicago: Linda Brubaker, MD, MS, multi-PI; Elizabeth R. Mueller, MD, MSME, multi-PI; Colleen M. Fitzgerald, MD, MS, investigator; Cecilia T. Hardacker, RN, MSN, investigator; Jeni Hebert-Beirne, PhD, MPH, investigator; Missy Lavender, MBA. University of Alabama at Birmingham: Alayne D. Markland, DO, MSc, PI; Kathryn L. Burgio, PhD, investigator; Tamera Coyne-Beasley, MD, MPH, investigator; Cora E. Lewis, MD, MSPH, investigator; Gerald McGwin, PhD, investigator; Camille P. Vaughan, MD, MS, investigator; Beverly Williams, PhD, investigator. University of California San Diego: Emily S. Lukacz, MD, PI; Sheila Gahagan, MD, MPH, investigator; D. Yvette LaCoursiere, MD, MPH, investigator; Jesse N. Nodora, DrPH, investigator. University of Michigan: Janis M. Miller, PhD, MSN, PI; Lisa Kane Low, PhD, C.N.M., investigator. University of Minnesota, Scientific and Data Coordinating Center (SDCC): Bernard L. Harlow, PhD, multi-PI; Kyle Rudser, PhD, multi-PI; Sonya S. Brady, PhD, investigator; Haitao Chu, MD, PhD, investigator; Cynthia S. Fok, MD, MPH, investigator; Todd Rockwood, PhD, investigator. University of Pennsylvania–Urology: Diane K. Newman, DNP, ANPBC, FAAN, multi PI; Ariana L. Smith, MD, multi PI; Amanda Berry, PhD, CRNP, investigator; Ann E. Stapleton, MD, FIDSA, FACP, investigator; Jean F. Wyman, PhD, RN, FAAN, investigator. Washington University in St. Louis: Siobhan Sutcliffe, PhD, PI; Aimee James, PhD, MPH, investigator; Jerry Lowder, MD, MSc, investigator. Yale University: Leslie Rickey, MD, PI;

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Funding Sources

The Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium is supported by the National Institutes of Health (NIH) through cooperative agreements (grants U01DK106786, U01DK106853, U01DK106858, U01DK106898, U01DK106893, U01DK106827, U01DK106908, U01DK106892). Additional support is provided by the National Institute on Aging, NIH Office of Research on Women's Health, and NIH Office of Behavioral and Social Sciences Research. The content of this article is solely the responsibility of the authors and does not necessarily represent the official views of NIH. The UK Medical Research Council and Wellcome (Grant ref: 217065/Z/19/Z) and the University of Bristol provide core support for ALSPAC. This publication is the work of the authors who will serve as guarantors for the contents of this article. A comprehensive list of grants funding is available on the ALSPAC website (http://www.bristol.ac.uk/alspac/external/documents/grant-acknowledgements.pdf); These data collected for this research were specifically funded by the Wellcome Trust and MRC (Core) 76467/Z/05/Z & 86676/Z/08/Z, MRC G0701503/85179, and the International Urogynecological Association. Please note that the ALPSAC study website contains details of all the data that are available through a fully searchable data dictionary and variable search tool: http://www.bristol.ac.uk/alspac/researchers/our-data/.

Appendix

Appendix

Table A1 –

Correlations between LUTS Outcomes

	Stress Incontinence	Any Urine Leakage	Urgency	Sensation of incomplete emptying	Bladder Pain	Urinary Tract Infections
Stress Incontinence	1.0	0.86	0.34	0.30	0.27	0.20
Any Urine Leakage		1.0	0.48	0.37	0.33	0.21
Urgency			1.0	0.56	0.44	0.34
Sensation of incomplete emptying				1.0	0.45	0.35
Bladder Pain					1.0	0.52
Urinary Tract Infections						1.0

Data Sharing

ALSPAC data access is through a system of managed open access. The steps below highlight how to apply for access to the data included in this article and all other ALSPAC data.

1. Please read the ALSPAC access policy (http://www.bristol.ac.uk/media-library/sites/alspac/documents/researchers/dataaccess/ALSPAC_Access_Policy.pdf) which describes the process of accessing the data and biological samples in detail and outlines the costs associated with doing so.
2. You may also find it useful to browse our fully searchable research proposals database (https://proposals.epi.bristol.ac.uk/), which lists all research projects that have been approved since April 2011.

3. Please submit your research proposal (https://proposals.epi.bristol.ac.uk/) for consideration by the ALSPAC Executive Committee using the online process. You will receive a response within 10 working days to advise you whether your proposal has been approved.

If you have any questions about accessing data, please alspac-data@bristol.ac.uk (data) or bbl-info@bristol.ac.uk (samples).

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IMPLICATIONS AND CONTRIBUTION

Oral contraceptives use by age 17 was associated with 1.4–1.7 higher odds of several lower urinary tract symptoms at age 19. These associations were attenuated after adjustment for condom use and number of sexual partners, suggesting that these findings may be related to alterations in microflora from sexually transmitted infections or multiple partners, not necessarily OC use per se. Having 3+ sexual partners by age 17 increased the odds of all lower urinary tract symptoms except stress incontinence. Thus, sexual activity may influence bladder health in younger women.

Table 1.

Prevalence of LUTS, Sexual Behaviors and Covariates

	% of Total Sample
LUTS at AGE 19	
Past-Month LUTS	
Stress Incontinence	26.8
Any urine leakage	22.1
Urgency	13.6
Sensation of Incomplete Emptying	11.2
Bladder Pain	26.3
Urinary Tract Infections	15.4
COVARIATES	
Age at Menarche, years	
≤10	6.6
11	19.6
12–13	60.0
14 or older	13.8
BMI at Age 12.5, kg/m^2	
<17.5	24.1
17.5-<19.5	19.2
19.5–22	30.9
>22	25.9
BMI at Age 17, kg/m^2	
<20	24.9
20-<22	23.9
22–25	20.4
>25	30.8
Difference in BMI between Ages 12 and 17	
<1.5	28.6
1.5-<2.5	17.9
2.5–4.0	25.8
>4.0	27.7
History of Constipation at Age 13	
No	76.2
Yes	23.8
History of Past-year UTI at Age 13	
No	96.1
Yes	3.9
SEXUAL HEALTH BEHAVIORS AT AGE 17 OR EARLIER	

	% of Total Sample
OC Use at Age 17 or Earlier	
No	44.1
Yes	55.9
Sexual Intercourse at Age 17 or Earlier	
No	48.1
Yes	51.9
Number Sexual Partner at Age 17 or Earlier	
1–2 partners	26.3
>= 3 partners	24.4
Condom Use at Age 17 or Earlier	
No Condom Use	20.3
Inconsistent	10.3
Consistent	21.2

J Adolesc Health. Author manuscript; available in PMC 2024 January 30.

Table 2:

Prevalence of LUTS by Covariates and Sexual Behaviors

	LUTS Prevalence					
	Stress Incontinence	**Any Urine Leakage**	**Urgency**	**Sensation of Incomplete Emptying**	**Bladder Pain**	**Urinary Tract Infections**
Prevalence in Total Imputed Sample, %	26.8	22.1	13.6	11.2	26.3	15.4
Age at Menarche, years						
≤10	27.6	25.4	12.3	14.4	31.7	23.5
11	28.1	22.3	14.3	9.7	26.2	16.8
12–13	26.7	21.7	13.5	11.7	25.8	14.5
14 or older	25.1	22.2	13.7	9.8	25.7	13.8
BMI at Age 12.5, kg/m^2						
<17.5	25.5	19.5	13.4	9.2	27.0	14.6
17.5-<19.5	24.2	21.1	14.0	12.4	25.4	13.4
19.5–22	26.9	21.7	13.8	10.5	25.8	17.2
>22	30.3	25.8	13.1	12.8	26.9	16.4
BMI at Age 17, kg/m^2						
<20	24.3	18.5	14.8	11.1	27.7	15.6
20-<22	25.4	21.9	13.3	10.7	26.8	13.9
22–25	24.9	19.1	11.9	11.7	25.3	16.2
>25	32.7	29.1	14.6	11.4	25.4	16.0
Difference in BMI between Ages 12 and 17						
<1.5	24.5	20.2	15.5	14.0	27.9	15.8
1.5-<2.5	28.0	21.4	13.0	11.3	28.1	18.5
2.5–4.0	25.3	20.1	10.9	9.6	24.7	14.1
>4.0	29.8	26.4	14.5	10.0	25.0	14.3
History of Constipation at Age 13						
No	23.2	18.5	11.5	9.4	24.1	14.0
Yes	38.3	33.7	20.7	17.3	33.3	20.2
History of Past-year UTI at Age 13						

	LUTS Prevalence					
	Stress Incontinence	**Any Urine Leakage**	**Urgency**	**Sensation of Incomplete Emptying**	**Bladder Pain**	**Urinary Tract Infections**
No	26.4	21.5	12.6	10.6	25.2	14.5
Yes	36.9	36.3	37.5	26.2	52.6	39.9
OC Use at Age 17 or Earlier						
No	27.1	21.2	10.5	8.5	22.5	11.9
Yes	26.3	23.3	17.5	14.7	31.0	19.9
Number of Sexual Partners at Age 17 or Earlier						
0 (no history of intercourse)	26.6	20.1	9.7	8.1	21.7	8.9
1–2 partners	23.1	19.2	14.6	10.7	25.9	17.8
>= 3 partners	31.2	29.3	20.4	18.2	35.6	26.1
Condom Use *						
No Condom Use	23.8	23.2	16.9	14.6	33.1	21.5
Inconsistent Condom Use	34.2	29.2	24.10	17.9	38.5	30.5
Consistent Condom Use	26.8	22.8	14.9	12.4	25.2	18.3

*Among sample of adolescents with history of intercourse at age 17 or earlier

Table 3.

Associations between Oral Contraceptive Use and LUTS[a] at Age 19

	LUTS AT AGE 19[a]					
	Stress Incontinence	***Any Urine Leakage***	***Urgency***	***Sensation of Incomplete Emptying***	***Bladder Pain***	***Urinary Tract Infections***
Adj 1 [b]	0.86 (0.69–1.08)	1.01 (0.79–1.28)	1.62 (1.19–2.20)	1.62 (1.17–2.26)	1.45 (1.15–1.83)	1.68 (1.28–2.21)
Adj 2 [c]	0.90 (0.70–1.16)	0.99 (0.75–1.27)	1.39 (1.00–1.94)	1.41 (0.98–2.02)	1.24 (0.96–1.60)	1.19 (0.88–1.62)
Restrict 1 [d]	0.83 (0.64–1.07)	0.94 (0.72–1.23)	1.55 (1.08–2.22)	1.40 (0.95–2.05)	1.29 (0.99–1.70)	---
Restrict 2 [d]	0.92 (0.62–1.38)	1.03 (0.67–1.57)	1.44 (0.87–2.39)	1.18 (0.65–2.14)	1.39 (0.92–2.10)	1.38 (0.86–2.23)

[a] Urgency and sensation of incomplete emptying are those endorsing “sometimes or more;” Stress incontinence and frequency of leakage are those endorsing “ever;” Bladder pain and urinary tract infection are those endorsing “sometimes or more.”

[b] Adj 1: Adjusted for age at menarche, BMI at age 17, BMI difference, constipation at age 13, LUTS at age 13, and UTI at age 13.

[c] Adj 2: Additionally adjusted for condom use and number of sexual partners.

[d] Restrict 1: Restricted *to those not reporting UTI at age 19* and adjusted for age at menarche, BMI at age 17, BMI difference, constipation at age 13, LUTS at age 13, and UTI at age 13.

[e] Restrict 2: Restricted *to those not reporting sexual intercourse prior to age 17* and adjusted for age at menarche, BMI at age 17, BMI difference, constipation at age 13, LUTS at age 13, and UTI at age 13.

Table 4.

Associations between Sexual Behaviors and LUTS[a] at Age 19

		LUTS AT AGE 19[a]					
		Stress Incontinence	**Any Urine Leakage**	**Urgency**	**Sensation of Incomplete Emptying**	**Bladder Pain**	**Urinary Tract Infections**
Ever had intercourse?							
Yes vs. No	*Adj 1* [b] *Adj 2* [c] *Restrict* [d]	0.91 (0.73–1.13) 0.95 (0.75–1.21) 0.86 (0.67–1.10)	1.11 (0.88–1.42) 1.13 (0.87–1.46) 1.00 (0.76–1.30)	1.72 (1.27–2.33) 1.53 (1.10–2.12) 1.41 (1.00–2.00)	1.65 (1.19–2.29) 1.45 (1.02–2.06) 1.28 (0.88–1.86)	1.46 (1.17–1.83) 1.33 (1.04–1.69) 1.19 (0.92–1.55)	2.65 (1.96–3.59) 2.45 (1.78–3.39) ---
Number of partners							
1–2 vs 0 (no intercourse)	*Adj 1* [b] *Adj 2* [c] *Restrict* [d]	0.80 (0.62–1.05) 0.84 (0.64–1.11) 0.78 (0.58–1.05)	0.92 (0.69–1.23) 0.94 (0.70–1.27) 0.85 (0.61–1.17)	1.57 (1.11–2.22) 1.44 (1.00–2.07) 1.31 (0.87–1.96)	1.34 (0.90–1.99) 1.23 (0.82–1.85) 1.12 (0.72–1.76)	1.21 (0.93–1.58) 1.14 (0.87–1.50) 0.98 (0.72–1.34)	2.20 (1.55–3.10) 2.10 (1.47–3.00) ---
≥3 vs 0 (no intercourse)	*Adj 1* [b] *Adj 2* [c] *Restrict* [d]	1.04 (0.79–1.36) 1.12 (0.83–1.51) 0.96 (0.71–1.31)	1.35 (1.02–1.79) 1.41 (1.03–1.92) 1.18 (0.85–1.64)	1.90 (1.33–2.72) 1.64 (1.11–2.42) 1.53 (0.99–2.36)	2.00 (1.37–2.93) 1.73 (1.14–2.64) 2.54 (1.44–4.47)	1.79 (1.37–2.35) 1.61 (1.20–2.17) 1.49 (1.07–2.05)	3.23 (2.29–4.55) 2.99 (2.05–4.36) ---
Condom Use							
Consistent vs. no condom Use [*]	*Adj 1* [b] *Adj 2* [c] *Restrict* [d]	1.28 (0.89 – 1.83) 1.25 (0.87 – 1.80) 1.19 (0.79 – 1.80)	1.07 (0.74 – 1.54) 1.07 (0.74 – 1.56) 1.14 (0.74 – 1.74)	1.00 (0.65 – 1.55) 1.05 (0.68 – 1.63) 1.09 (0.63 – 1.90)	0.93 (0.58 – 1.47) 0.97 (0.60 – 1.56) 0.86 (0.48 – 1.52)	0.73 (0.52 – 1.04) 0.78 (0.55 – 1.12) 0.84 (0.55 – 1.27)	0.88 (0.60 – 1.30) 0.94 (0.63 – 1.39) ---
Inconsistent vs. No Condom Use [*]	*Adj 1* [b] *Adj 2* [c] *Restrict* [d]	1.59 (1.01 – 2.51) 1.62 (1.02 – 2.58) 1.92 (1.11 – 3.30)	1.28 (0.79 – 2.05) 1.27 (0.79 – 2.06) 1.36 (0.76 – 2.42)	1.46 (0.83 – 2.56) 1.39 (0.79 – 2.46) 1.77 (0.87 – 3.58)	1.14 (0.60 – 2.16) 1.09 (0.57 – 2.08) 1.09 (0.47 – 2.50)	1.23 (0.77 – 1.95) 1.15 (0.71 – 1.85) 1.33 (0.75 – 2.34)	1.49 (0.93 – 2.38) 1.40 (0.86 – 2.26) ---

[a] Urgency and sensation of incomplete emptying are those endorsing “occasional, some or more use;” Stress incontinence and frequency of leakage are those endorsing “ever;” Bladder pain and urinary tract infection are those endorsing “sometimes or more.”

[b] Adj1: Adjusted for age at menarche, BMI at age 17, BMI difference, constipation at age 13, LUTS at age 13, UTI and at age 13

[c] Adj2: Additionally adjusted for OC use prior to age 17.

[d] Restricted: *Restricted to those not reporting UTI at age 19* and adjusted for age at menarche, BMI at age 17, BMI difference, constipation at age 13, LUTS at age 13, and UTI at age 13.

[*] Among sample of adolescents with history of intercourse AT AGE 17 OR EARLIER