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Parity, mode of birth, and long-term gynecological health: A follow-up study of parous and nonparous women in the Australian Longitudinal Study on Women's Health cohort

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Abstract

Background: Although gynecological health issues are common and cause considerable distress, little is known about their causes. We examined how birth history is associated with urinary incontinence (UI), severe period pain, heavy periods, and endometriosis.

Methods: We studied 7700 women in the Australian Longitudinal Study on Women's Health with an average follow-up of 10.9 years after their last birth. Surveys every third year provided information about birth history and gynecological health. Logistic regression was used to estimate how parity, mode of birth, and vaginal tears were associated with gynecological health issues. Presented results are adjusted odds ratios (OR) with 95% confidence intervals.

Results: UI was reported by 16%, heavy periods by 31%, severe period pain by 28%, and endometriosis by 4%. Compared with women with two children, nonparous women had less UI (OR 0.35 [0.26–0.47]) but tended to have more endometriosis (OR 1.70 [0.97–2.96]). Also, women with only one child had less UI (OR 0.77 [0.61–0.98]), but more severe period pain (OR 1.24 [1.01–1.51]). Women with 4+ children had more heavy periods (OR 1.42 [1.07–1.88]). Compared with women with vaginal birth(s) only, women with only cesarean sections or vaginal birth after cesarean section had less UI (ORs 0.44 [0.34–0.58] and 0.55 [0.40–0.76]), but more endometriosis (ORs 1.91 [1.16–3.16] and 2.31 [1.25–4.28]) and heavy periods (ORs 1.21 [1.00–1.46] and 1.35 [1.06–1.72]). Vaginal tear(s) did not increase UI after accounting for parity and birth mode.

Conclusion: While women with vaginal childbirth(s) reported more urinary incontinence, they had less menstrual complaints and endometriosis.

KEYWORDS

endometriosis, menstrual disorders, mode of birth, parity, urinary incontinence

1 | INTRODUCTION

Gynecological health issues such as urinary incontinence (UI), period pain, endometriosis, and heavy menstrual bleeding are conditions experienced by many women across the world.[1–4] All are underreported, partly because the diagnosis might be difficult, but primarily because women are reluctant to seek medical advice for these conditions,[1,5,6] even though they cause considerable physical, social, and psychological distress.

Childbirth history is among the numerous factors that affect women's gynecological health. Compared with cesarean delivery, spontaneous vaginal birth has been shown to increase the risk of UI[7–10] and delivery by forceps, but not vacuum, seems to further increase this risk.[11] On the other hand, vaginal birth seems to reduce severe period pain, heavy menstrual bleeding, and endometriosis.[12–15] In women with vaginal births, the long-term impact of obstetric tears and episiotomies on the risk of UI is not well established. It has been suggested that while episiotomies may have a protective effect on pelvic organ prolapse,[16,17] it does not protect against UI and may even increase risk.[17] Few studies have compared gynecological health in parous and nonparous women. While the birth of the first child has been shown to have the greatest impact on the risk of UI,[16,18,19] little is known about how parity is associated with endometriosis, heavy menstrual bleeding, and severe period pain.

The Australian Longitudinal Study on Women's Health has a long follow-up and covers a wide range of topics, including gynecological health.[20,21] The 1973–1978 cohort includes women from early adulthood, most of whom entered the study before first childbirth. Importantly, it includes women who have never given birth, which allows for comparison of parous and nonparous women. Thus, data from this cohort provide a unique opportunity to study self-reported gynecological health on a population level. The aim of this study was to examine associations between birth history and UI, severe period pain, heavy periods, and endometriosis, with a follow-up of 4–26 years.

2 | METHODS

2.1 | Study design and sample

The design was a prospective cohort study based on the Australian Longitudinal Study on Women's Health (ALSWH) 1973–1978 birth cohort. Participants were randomly selected from the Australian National Health Insurance database, which includes all Australian citizens and permanent residents. Consenting women were invited to fill out a baseline questionnaire in 1996 when they were 18–23 years old, which was done by 14,247 women, and to answer postal and online surveys approximately every third year thereafter. The surveys cover a broad range of physical and mental health issues, as well as social and psychological topics. Detailed information on the ALSWH methodology has been described elsewhere.[20,22]

For this study, we relied on the baseline survey (S1) from 1996 and the third (S3, 2003) to seventh (S7, 2015) surveys. Data from all women who participated in both S1 and at least one of the other surveys were included. To obtain the longest possible follow-up time, we identified women according to their latest completed survey. For 7186 women, this was S7, for 1442, it was S6 (2012), for 871, it was S5 (2009), for 1020, it was S4 (2006), and for 676, it was S3 (2003). We then measured the time between the last birth and the latest completed survey for all these women ($n = 11,195$) and excluded those with less than 4 years of follow-up ($n = 3362$). We also excluded women who reported having already given birth at baseline, but not since ($n = 63$), due to lack of information about their reproductive history. The initial analysis sample comprised 7770 women. A flowchart is presented in Figure 1.

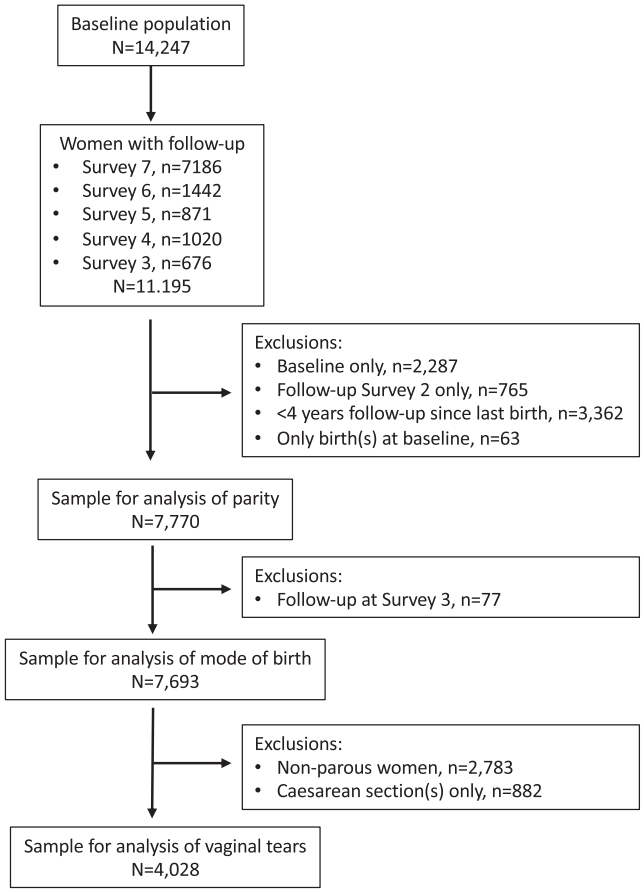

FIGURE 1 Flowchart of sample selection.

2.2 | Outcome measures.

We studied four gynecological health issues: UI, severe period pain, heavy periods, and endometriosis. Women were first asked about UI, severe period pain, and heavy periods at baseline and repeatedly in every survey thereafter. The specific questions were as follows: "In the last 12 months have you had any of the following: (1) Leaking urine, (2) Heavy periods, (3) Severe period pain?". The four answer categories (never, rarely, sometimes, or often) were dichotomized into "no" (never/rarely) and "yes" (sometimes/often). Questions about endometriosis were introduced in the second survey when women were asked: "In the last three years, have you been diagnosed or treated for endometriosis?"

2.3 | Exposure measures.

The study included three exposures: parity, mode of birth, and vaginal tears (including episiotomies), all based on self-reported information on reproductive history in the surveys. Parity was divided into five subcategories: P0, P1, P2, P3, and P4+. Multiple births counted as only one birth ($n = 102$). Mode of birth was divided into six categories: no births, spontaneous vaginal birth(s) only, vaginal birth(s) including instrumental birth(s), cesarean birth(s) only, a mixed category (both vaginal birth(s) and cesarean birth(s)) with the last birth by cesarean, and a mixed category with the last birth being a vaginal birth, also known as vaginal birth after cesarean (VBAC).

Information about vaginal tears was based on the following questions: "Did you experience any of the following: (1) Episiotomy (cutting of the vagina), (2) A vaginal tear requiring stitches?" For each item, women could respond "never experienced this" or tick a box for every child/birth in which they experienced the event in question. This led to the categories: no tear ever, spontaneous tear(s) only, episiotomy(ies) only, and both spontaneous tear(s) and episiotomy(ies).

2.4 | Covariates

Potential confounders were identified a priori based on self-reported information from the 1996 baseline survey and the follow-up surveys. Covariates measured at baseline included age, body mass index (BMI) (<18.5, 18.5–24.9, 25–29.9, 30–34.9, and 35+), smoking (never, less than weekly, weekly, and daily), area of residence (metropolitan, rural, and remote), education level (low [school only], middle [technical], and high [university degree]), and number of chronic diseases which included diabetes, heart disease, hypertension, low iron level, asthma, cancer, or other major illness diagnosed by a doctor (0, 1–2, and 3+). Covariates measured at follow-up included age, duration of follow-up since last birth, BMI, smoking, and educational level.

Other covariates comprised multiple birth ever, birth weight > 4000 g ever, and use of contraceptive pills (mini-pill and combination pill) or progestogen IUD at follow-up. Questions on progestogen IUD were included from S5 and onwards and birth weight > 4000 g in S6 and S7.

2.5 | Study samples

Different samples were available for the planned analyses. For the exposure parity, we included the entire analysis sample ($N = 7770$). For mode of birth, 7693 women were included in the analysis after excluding 77 parous women with follow-up at S3, where information about mode of birth was not available. For vaginal tears, the analysis sample only included parous women with vaginal births ($N = 4028$).

For each specific analysis, we excluded women with missing information on the outcome. When the outcome was heavy periods, severe period pain, or endometriosis, women who reported hysterectomy and/or have had both ovaries removed were also excluded. The specific numbers included in the analyses for each outcome are presented in the tables.

2.6 | Statistical analyses

Population characteristics were presented according to parity, mode of birth, and vaginal tears with mean and standard deviation (SD) for continuous variables and frequencies and proportions (%) for categorical variables.

We used multiple logistic regression to estimate odds ratios (OR) with 95% confidence intervals (CI) for the association between the three exposures and four outcomes. As reference groups, we chose "parity 2" in the analysis of parity, "spontaneous vaginal birth(s)" in the analysis of mode of birth, and "no tear ever" in the analysis of vaginal tears. In the main adjusted model, which was identical for all three exposures, we adjusted for confounders defined a priori which included age and education, measured both at baseline and follow-up, and BMI, smoking, area of residence, and chronic disease, measured at baseline. Furthermore, we adjusted for length of follow-up since last birth. In a second adjusted model, we further controlled for some intermediate factors, specific for each exposure–outcome association: In the analyses of UI, parity,

mode of birth, and tears were mutually adjusted, and we also adjusted for multiple births ever. This analysis was restricted to parous women. In the analyses of heavy periods and endometriosis, we adjusted for contraception, and in the analyses of severe period pain, we adjusted for contraception and endometriosis.

To examine the influence of missing values on covariates, we repeated the analyses in imputed data sets where baseline variables (education level, BMI, smoking status, and residence) and education level at the end of follow-up were imputed using multiple imputations by chained equations generating 50 copies of the data set. The imputation models included exposure and outcome variables, covariate variables at baseline (education, smoking, BMI, age, residence, chronic disease, and sampling structure), and covariate variables at the end of follow-up (education, follow-up time in years, and age). The estimates based on imputed data sets came very close to those of the full case analysis and are added as Supplementary Material (Tables S1–S3).

In all analyses, a significance level of 0.05 was considered statistically significant. STATA16 (StataCorp LLC) was used to carry out all analyses.

3 | RESULTS

In this sample of 7770 Australian women, the average ages at baseline and at the last included survey were 20.9 and 37.8 years, respectively. The average follow-up, measured from a woman's last birth or from baseline in nonparous women, was 10.9 years (range 4–26). Of these women, 16% reported UI, 31% heavy periods, 28% severe period pain, and 4% had endometriosis.

Compared with all other women, women with only one birth were more likely to be daily smokers, both at baseline and follow-up (Table 1). With increasing parity, the proportion of women living in rural and remote areas at baseline increased. At follow-up, nonparous women were youngest and had longer follow-ups than parous women. They also had the highest educational level, while women who had given birth four times or more had the lowest.

At follow-up, the use of progestogen IUD as contraception was highest in women with two or three births, while the use of oral contraceptive pills was highest in nonparous women and lowest in women who had given birth four times or more. Women who had given birth only once were much more likely to have had multiple births. With increasing parity, more women had given birth to an infant with high birthweight, had only spontaneous vaginal births, and had experienced both tears and episiotomies, while fewer women had only cesarean birth(s) and had never experienced a vaginal tear.

3.1 | Parity

UI increased steadily from 9% for nonparous women to 24% for women who had given birth four times or more (Table 2). In the main adjusted analysis, we found 65% lower odds of UI in nonparous women and 23% lower odds in women who had only given birth once compared with women who had given birth twice. In women who had given birth four times or more, odds were increased by 37% (test for trend across parity groups, $p < 0.01$). The same pattern, however, slightly attenuated, was seen after adjustment for mode of birth, tears, and multiple pregnancies.

Of women who had given birth twice, 31% experienced heavy periods. The prevalence was lower in nonparous women (28%) and higher in other parous women (35%–39%). After adjustment for confounders, women with four or more births had 42% higher odds for heavy periods compared with women who had two births. The prevalence of severe period pain was lowest in women who had given birth twice (25%) and highest in nonparous women and women with only one birth (34% and 31%, respectively). After adjustment, higher odds of 24% were only present in women with one birth compared with women with two births. For both outcomes, further adjustment for intermediate factors such as contraception and endometriosis only resulted in small differences across parity groups.

The prevalence of endometriosis declined across parity groups from 6% in nonparous women to 1% in women who had given birth four times or more (test for trend across parity groups, $p < 0.01$). After adjustment, odds of endometriosis were higher in nonparous compared with women who had given birth twice, however, the difference was not statistically significant (OR 1.70 (0.97–2.96)).

3.2 | Mode of birth

The prevalence of UI ranged from 9% in nonparous women and 12% in women with only cesarean birth(s) to 22%–23% in women with only vaginal birth(s) (Table 3). In the adjusted analyses, when compared with women with spontaneous vaginal birth(s) only, odds were decreased by 63% in nonparous women, by 56% in women with cesarean birth(s) only, and by 45% in women with cesarean(s), but last birth vaginal (VBAC). Adjusting further for parity and multiple births did not change these results.

Heavy periods were experienced by 32% of women with only spontaneous vaginal birth(s) compared to 28% of nonparous women and 37% and 38% in women with cesarean birth(s) only and women with VBAC, respectively. After adjustment, the odds in nonparous women were similar to those in women with spontaneous vaginal birth(s) only, whereas odds were increased by 21% in

TABLE 1 Characteristics of the study population by parity ($N = 7770$).

	Parity 0 ($n = 2783$)	Parity 1 ($n = 905$)	Parity 2 ($n = 2637$)	Parity 3 ($n = 1119$)	Parity 4+ ($n = 326$)
	n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
At baseline					
Age Mean (SD)	20.53 (1.45)	20.87 (1.50)	21.06 (1.41)	21.14 (1.41)	21.23 (1.42)
BMI kg/m^2					
<18.5	219 (8.67)	86 (10.72)	198 (8.35)	75 (7.83)	25 (9.19)
18.5-24.9	1671 (66.18)	515 (64.21)	1653 (69.75)	666 (69.52)	177 (65.07)
25-29.9	411 (16.28)	139 (17.33)	382 (16.12)	162 (16.91)	53 (19.49)
30-34.9	151 (5.98)	46 (5.74)	105 (4.43)	37 (3.86)	11 (4.04)
≥35	73 (2.89)	16 (2.0)	32 (1.35)	18 (1.88)	6 (2.21)
Smoking					
Never	1584 (59.24)	411 (48.01)	1357 (53.43)	555 (51.68)	160 (51.28)
Less than weekly	331 (12.38)	133 (15.54)	430 (16.93)	198 (18.44)	56 (17.95)
Weekly	310 (11.59)	86 (10.05)	306 (12.05)	115 (10.71)	33 (10.58)
Daily	449 (16.79)	226 (26.4)	447 (17.6)	206 (19.18)	63 (20.19)
Residence					
Metropolitan	1700 (61.33)	488 (54.22)	1364 (51.8)	519 (46.51)	131 (40.18)
Rural	1001 (36.11)	371 (41.22)	1169 (44.4)	535 (47.94)	175 (53.68)
Remote	71 (2.56)	41 (4.56)	100 (3.8)	62 (5.56)	20 (6.14)
Education					
Low (school only)	1966 (70.97)	636 (70.67)	1723 (65.71)	741 (66.4)	234 (72.0)
Middle (technical)	470 (16.97)	176 (19.56)	530 (20.21)	216 (19.35)	53 (16.31)
High (university)	334 (12.06)	88 (9.78)	369 (14.07)	159 (14.25)	38 (11.69)
Chronic disease					
0	1464 (52.61)	413 (45.64)	1366 (51.8)	533 (47.63)	150 (46.01)
1–2	1224 (43.98)	454 (50.17)	1190 (45.13)	553 (49.42)	158 (48.47)
3+	95 (3.41)	38 (4.2)	81 (3.07)	33 (2.95)	18 (5.52)
At follow-up					
Age Mean (SD)	35.87 (4.83)	38.04 (3.51)	38.93 (2.76)	39.11 (2.62)	39.45 (2.37)
Follow-up duration Mean (SD)	15.28 (4.53)	9.71 (4.59)	8.47 (3.41)	8.00 (3.13)	7.38 (2.85)
BMI kg/m^2					
<18.5	78 (3.0)	20 (2.38)	44 (1.74)	20 (1.88)	4 (1.29)
18.5–24.9	1197 (46.06)	311 (36.98)	1128 (44.62)	465 (43.79)	122 (39.23)
25–29.9	618 (23.78)	224 (26.64)	707 (27.97)	299 (28.15)	89 (28.62)
30–34.9	351 (13.51)	163 (19.38)	392 (15.51)	156 (14.69)	55 (17.68)
≥35	355 (13.66)	123 (14.63)	257 (10.17)	122 (11.49)	41 (13.18)
Smoking					
Never	2208 (81.54)	672 (77.51)	2234 (86.99)	925 (85.25)	257 (80.82)
Less than weekly	120 (4.43)	30 (3.46)	53 (2.06)	13 (1.2)	10 (3.14)
Weekly	47 (1.74)	13 (1.5)	22 (0.86)	11 (1.01)	5 (1.57)
Daily	333 (12.3)	152 (17.53)	259 (10.09)	136 (12.53)	46 (14.47)
Education					
Low (school only)	446 (16.79)	225 (26.95)	575 (23.07)	261 (24.65)	100 (32.15)
Middle (technical)	720 (27.11)	292 (34.97)	797 (31.98)	355 (33.52)	95 (30.55)
High (university)	1490 (56.1)	318 (38.08)	1120 (44.94)	443 (41.83)	116 (37.3)

(Continues)

TABLE 1 (Continued)

	Parity 0 ($n=2783$)	Parity 1 ($n=905$)	Parity 2 ($n=2637$)	Parity 3 ($n=1119$)	Parity 4+ ($n=326$)
	n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Contraception					
Progestogen IUD	70 (3.63)	68 (8.99)	346 (14.35)	149 (14.49)	31 (10.03)
Oral contraceptive pill	452 (22.19)	150 (18.4)	491 (19.52)	145 (13.45)	29 (9.09)
Multiple birth ever		72 (7.96)	23 (0.87)	5 (0.45)	2 (0.61)
Birthweight > 4000 g ever		40 (8.13)	362 (20.41)	216 (28.76)	93 (41.52)
Mode of birth					
No birth(s)	2783 (100.0)				
Vaginal, spontaneous only		374 (42.74)	1129 (43.46)	558 (50.09)	167 (51.7)
Vaginal, also instrumental		150 (17.14)	541 (20.82)	216 (19.39)	62 (19.2)
Caesarean birth(s) (CB) only		351 (40.11)	452 (17.4)	65 (5.83)	14 (4.33)
Mixed, last birth CB			214 (8.24)	106 (9.52)	34 (10.53)
Mixed, last birth vaginal			262 (10.08)	169 (15.17)	46 (14.24)
Vaginal tears					
No tear ever		507 (58.08)	1009 (38.81)	375 (33.66)	95 (29.32)
Tear(s) only		219 (25.09)	862 (33.15)	416 (37.34)	117 (36.11)
Episiotomy(ies) only		71 (8.13)	234 (9.0)	88 (7.9)	29 (8.95)
Tear(s) + episiotomy(ies)		76 (8.71)	495 (19.04)	235 (21.1)	83 (25.62)

Note: At baseline, proportion of women with missing information were for BMI (843; 10.8%), smoking (314; 4.0%), residence (23; 0.3%), and education (37; 0.5%). At follow-up, proportion of women with missing information were for BMI (429; 5.5%), smoking (224; 2.9%), and education (417; 5.4%).

women with cesarean birth(s) only and by 35% in women with VBAC. Severe period pain was reported by 27% in women with spontaneous birth(s) only, while prevalence was highest in women with no births (34%) and lowest in women with vaginal and instrumental birth(s) (23%). In adjusted analyses, these differences were attenuated and not statistically significant.

The prevalence of endometriosis ranged from 2% in women with vaginal births only to 5% in women with VBAC and 6% in nonparous women. After adjustment, odds were increased by 91% in women with cesarean birth(s) only and by 131% in women with VBAC when compared with women with spontaneous vaginal birth(s) only. Nonparous women also tended to have higher odds (65%) which was strengthened (to 83%) after further adjusting for contraception.

3.3 | Vaginal tears

The prevalence of UI ranged from 18% in women with no tears ever to 23% in women with a history of both spontaneous tears requiring stitches and episiotomies (Table 4). In adjusted analyses, when compared with women with no tears, women with episiotomy(ies) had no increased odds (OR 1.14 [0.82–1.58]) while odds were increased by 35% in women with spontaneous tears only and by 45% in women with a history of both spontaneous tears and episiotomies. After further adjustment for mode of birth, parity, and multiple births, the two latter estimates were attenuated to 16% in both groups and were no more statistically different from women with no tears.

4 | DISCUSSION

Our findings stress that UI, heavy periods, and severe period pain are very common conditions in women's lives. We observed more UI in parous than in nonparous women, and among parous women, those with cesarean birth(s) only or with VBAC had less UI than women with only vaginal birth(s). Women with only one child had more severe period pain, while heavy periods were most common in women with four or more children, in women with cesarean birth(s) only, and in women with VBAC. Endometriosis, which is a less frequent condition, decreased significantly with increasing parity and was lowest in women who had only given birth vaginally.

In line with other reports,[16,18] our data suggest that giving birth for the first time has the most substantial impact on a woman's risk of developing UI. We found the highest odds of endometriosis among nonparous women and the

TABLE 2 Gynaecological health issues by parity.

	Parity 0	Parity 1	Parity 2	Parity 3	Parity 4+
Urinary incontinence					
Participants ($N=7547$)	2708	868	2571	1085	315
Cases (%)	246 (9.1)	146 (16.8)	492 (19.1)	216 (19.9)	75 (23.8)
Crude model, OR (95% CI)	0.42 (0.36; 0.50)	0.85 (0.70; 1.05)	1 (reference)	1.05 (0.88; 1.26)	1.32 (1.00; 1.74)
Main adjusted model[a] ($N=6233$), OR (95% CI)	0.35 (0.26; 0.47)	0.77 (0.61; 0.98)	1 (reference)	1.02 (0.83; 1.25)	1.37 (0.99; 1.88)
Additional adjustment[b] ($N=3891$), OR (95% CI)		0.87 (0.67; 1.13)	1 (reference)	0.98 (0.79; 1.20)	1.28 (0.93; 1.77)
Heavy periods					
Participants ($N=7280$)	2661	837	2454	1038	290
Cases (%)	750 (28.2)	297 (35.5)	769 (31.3)	362 (34.9)	113 (39.0)
Crude model, OR (95% CI)	0.86 (0.76; 0.97)	1.21 (1.02; 1.42)	1 (reference)	1.17 (1.01; 1.37)	1.40 (1.09; 1.80)
Main adjusted model[a] ($N=6026$), OR (95% CI)	1.02 (0.81; 1.29)	1.20 (0.99; 1.45)	1 (reference)	1,13 (0.95; 1.35)	1.42 (1.07; 1.88)
Additional adjustment[c] ($N=5227$), OR (95% CI)	0.95 (0.73; 1.24)	1.11 (0.90; 1.36)	1 (reference)	1.05 (0.87; 1.26)	1.21 (0.90; 1.63)
Severe period pain					
Participants ($N=7285$)	2668	836	2455	1038	288
Cases (%)	898 (33.7)	255 (30.5)	610 (24.9)	273 (26.3)	79 (27.4)
Crude model, OR (95% CI)	1.53 (1.36; 1.73)	1.33 (1.12; 1.58)	1 (reference)	1.08 (0.91; 1.27)	1.14 (0.87; 1.50)
Main adjusted model[a] ($N=6032$), OR (95% CI)	1.22 (0.96; 1.55)	1.24 (1.01; 1.51)	1 (reference)	1.07 (0.88; 1.29)	1.24 (0.91; 1.69)
Additional adjustment[d] ($N=5194$), OR (95% CI)	1.05 (0.80; 1.38)	1.18 (0.95; 1.46)	1 (reference)	0.99 (0.81; 1.21)	1.10 (0.80; 1.52)
Endometriosis					
Participants $N=7284$)	2649	866	2561	1091	317
Cases (%)	159 (6.0)	29 (3.3)	75 (2.9)	27 (2.5)	4 (1.3)
Crude model, OR (95% CI)	2.12 (1.60; 2.80)	1.15 (0.74; 1.78)	1 (reference)	0.84 (0.54; 1.31)	0.42 (0.15; 1.17)
Main adjusted model[a] ($N=6113$), OR (95% CI)	1.70 (0.97; 2.96)	1.32 (0.81; 2.15)	1 (reference)	1.12 (0.69; 1.81)	0.44 (0.14; 1.43)
Additional adjustment[c] ($N=5360$), OR (95% CI)	1.79 (0.96; 3.31)	1.27 (0.75; 2.14)	1 (reference)	1.15 (0.70; 1.86)	0.31 (0.07; 1.29)

[a]Adjusted for age, education, BMI, chronic disease, smoking and residence at baseline, for age and education at follow-up, and for length of follow-up since last birth.

[b]Analysis restricted to parous women only. Adjusted as the main adjusted model and for mode of birth, vaginal tears, and multiple birth ever.

[c]Adjusted as the main adjusted model and for contraceptive pills and progestogene IUD.

[d]Adjusted as the main adjusted model and for contraceptive pills, progestogene IUD, and endometriosis.

TABLE 3 Gynaecological health issues by mode of birth.

	No birth	Vaginal birth(s), spontaneous only	Vaginal birth(s), also instrumental	Caesarean birth(s) only	Mixed, last birth cesarean birth	Mixed, last birth vaginal
Urinary incontinence						
Participants ($N=7470$)	2708	2159	942	849	346	466
Cases (%)	246 (9.1)	468 (21.7)	214 (22.7)	98 (11.5)	76 (22.0)	62 (13.3)
Crude model OR (95%CI)	0.36 (0.31; 0.43)	1 (reference)	1.06 (0.88; 1.28)	0.47 (0.37; 0.60)	1.02 (0.77; 1.34)	0.55 (0.42; 0.74)
Main adjusted model[a] ($N=6190$), OR (95% CI)	0.37 (0.27; 0.49)	1 (reference)	1.22 (0.99; 1.50)	0.44 (0.34; 0.58)	0.97 (0.71; 1.33)	0.55 (0.40; 0.76)
Additional adjustment[b] ($N=3892$), OR (95% CI)		1 (reference)	1.22 (0.99; 1.50)	0.47 (0.35; 0.62)	0.95 (0.69; 1.31)	0.54 (0.39; 0.75)
Heavy periods						
Participants ($N=7203$)	2661	2076	900	806	323	437
Cases (%)	750 (28.2)	659 (31.7)	292 (32.4)	296 (36.7)	104 (32.2)	165 (37.8)
Crude model, OR (95% CI)	0.84 (0.74; 0.96)	1 (reference)	1.03 (0.87; 1.22)	1.25 (1.05; 1.48)	1.02 (0.79; 1.31)	1.30 (1.05; 1.62)
Main adjusted model[a] ($N=5983$), OR (95% CI)	0.96 (0.76; 1.21)	1 (reference)	0.97 (0.80; 1.18)	1.21 (1.00; 1.46)	0.94 (0.71; 1.25)	1.35 (1.06; 1.72)
Additional adjustment[c] ($N=5220$), OR (95% CI)	0.96 (0.74; 1.24)	1 (reference)	1.02 (0.83; 1.24)	1.26 (1.03; 1.54)	1.09 (0.81; 1.47)	1.39 (1.08; 1.78)
Severe period pain						
Participants $N=7208$)	2668	2073	900	806	323	438
Cases (%)	898 (33.7)	552 (26.6)	210 (23.3)	235 (29.2)	80 (24.8)	112 (25.6)
Crude model, OR (95% CI)	1.40 (1.23; 1.59)	1 (reference)	0.84 (0.70; 1.01)	1.13 (0.95; 1.36)	0.91 (0.69; 1.19)	0.95 (0.75; 1.20)
Main adjusted model[a] ($N=5989$), OR (95% CI)	1.13 (0.90; 1.43)	1 (reference)	0.83 (0.67; 1.02)	1.16 (0.95; 1.42)	0.92 (0.68; 1.25)	1.13 (0.86; 1.47)
Additional adjustment[d] ($N=5187$), OR (95% CI)	0.99 (0.76; 1.29)	1 (reference)	0.83 (0.67; 1.03)	1.12 (0.90; 1.39)	1.01 (0.74; 1.39)	1.09 (0.83; 1.43)
Endometriosis						
Participants ($N=7408$)	2649	2165	933	848	345	468
Cases (%)	159 (6.0)	50 (2.3)	21 (2.3)	30 (3.5)	9 (2.6)	22 (4.7)
Crude model, OR (95% CI)	2.70 (1.96; 3.73)	1 (reference)	0.97 (0.58; 1.63)	1.55 (0.98; 2.46)	1.13 (0.55; 2.33)	2.09 (1.25; 3.48)
Main adjusted model[a] ($N=6070$), OR (95% CI)	1.65 (0.96; 2.82)	1 (reference)	1.12 (0.63; 1.97)	1.91 (1.16; 3.16)	1.20 (0.53; 2.73)	2.31 (1.25; 4.28)
Additional adjustment[c] ($N=5353$), OR (95% CI)	1.83 (1.01; 3.32)	1 (reference)	1.19 (0.67; 2.13)	2.03 (1.21; 3.41)	1.26 (0.55; 2.90)	2.27 (1.20; 4.30)

[a]Adjusted for age, education, BMI, chronic disease, smoking and residence at baseline, for age and education at follow-up, and for length of follow-up since last birth.

[b]Analysis restricted to parous women only. Adjusted as the main adjusted model and for parity, vaginal tears, and multiple birth ever.

[c]Adjusted as the main adjusted model and for contraceptive pills and progestogene IUD.

[d]Adjusted as the main adjusted model and for contraceptive pills, progestogene IUD, and endometriosis.

TABLE 4 Urinary incontinence by type of vaginal tear[a] in women with vaginal birth(s).

	No tear, ever	Spontaneous tear(s) only	Episiotomy(ies) only	Both spontaneous tears and episiotomies
Urinary incontinence				
Participants $N = 3913$	1085	1561	412	855
Cases (%)	197 (18.2)	347 (22.2)	81 (19.7)	195 (22.8)
Crude model OR (95% CI)	1 (reference)	1.29 (1.06; 1.57)	1.10 (0.83; 1.47)	1.33 (1.07; 1.66)
Main adjusted model[b] ($N = 3181$), OR (95% CI)	1 (reference)	1.35 (1.08; 1.68)	1.14 (0.82; 1.58)	1.45 (1.13; 1.87)
Additional adjustment[c] ($N = 3181$), OR (95% CI)	1 (reference)	1.16 (0.92; 1.47)	0.95 (0.67; 1.34)	1.16 (0.88; 1.53)

[a]Defined as vaginal tear ever including information from all vaginal births in a woman's birth history. A spontaneous vaginal tear was defined as a vaginal tear requiring stiches.

[b]Adjusted for age, education, BMI, chronic disease, smoking and residence at baseline, for age and education at follow-up, and for length of follow-up since last birth.

[c]Adjusted as the main adjusted model, and for mode of birth, parity, and multiple birth ever.

lowest among women who had given birth four or more times. This association should be interpreted with caution. High progestogen levels during pregnancy(ies) might relieve the symptoms of endometriosis and thereby lead to lower prevalence in women who have given birth at least once.[23] However, women with endometriosis deal with fertility issues more often, which might explain the high prevalence of endometriosis in nonparous women.[24] In accord with previous findings,[25] we found heavy periods to be more frequent in women with four or more children, whereas the association between parity and severe period pain was less clear.

Our findings of more UI in women with vaginal birth(s) confirm reports from previous studies.[18,26] These associations deserve more detailed studies, as other factors typically not accounted for, neither in our study nor in previous studies, should be considered. This includes length of second stage of labor or practices such as early and directed pushing in the second stage of labor. According to a Cochrane review,[27] delayed pushing in the second stage of labor may increase the duration of this stage by reducing duration of pushing, but little is known about long-term outcomes for women of pushing techniques. In another study, spontaneous pushing versus directed did not reduce the incidence of UI 12 months postpartum, but the sample size was small, and the study was impacted by high crossover between randomized groups.[28]

In contrast to others,[16,29] we only found slightly more UI in women with instrumental births, compared with women who only had spontaneous births. Instrumental birth was a mixture of forceps and vacuum, where only the former seems to increase risk.[11] Merging women with only instrumental birth and women with both spontaneous and instrumental vaginal birth into one exposure group, as we did, may have diluted a stronger association.

In accordance with other reports,[13,25] our findings indicate higher odds of heavy periods and endometriosis in women with cesarean birth(s) than in women with only vaginal birth(s). Suggested mechanisms include a scar-related pouch, also called uterine isthmocele, in the lower uterine segment that causes delayed menstrual bleeding and myometrial hypertrophy of the anterior uterine wall above the scar, potentially leading to intermenstrual bleeding, dysmenorrhea, dyspareunia, and chronic pelvic pain.[14,15] In a recent review of cesarean scar endometriosis, the authors described how iatrogenic deposition of endometrial cells on the abdominal wall, and maybe the peritoneum, during cesarean surgery can increase risk of chronic pain, and in very rare cases, malignant tumors.[30]

To our knowledge, no other studies on this topic have separated women with a history of both vaginal and cesarean birth into two exposure groups, according to the order of mode of birth. We observed lower odds of UI in women with VBAC, but not in women with cesarean after vaginal birth. This might reflect better overall health in women with VBAC, but also that the group of women with cesarean birth after vaginal birth may include some with childbirth trauma. Women with VBAC had higher odds of heavy periods and endometriosis which was not seen in women with cesarean birth after vaginal birth, which is hard to explain. The two groups were heterogenous in terms of numbers and types of birth, and although we adjusted for parity and vaginal tearing, residual confounding may still be present.

Several studies have identified a positive association between vaginal tears requiring sutures and UI in the first year after birth,[31] but long-term studies mainly report on vaginal birth as a risk factor,[10,11] suggesting that an association with vaginal tears may diminish over time which is in line with our findings when accounting for parity and mode of birth. The term "vaginal tear requiring stitches" covered all spontaneous vaginal tears from first to fourth degree, which might have impaired our ability to observe differences in UI across vaginal tear groups.

4.1 | Strengths and limitations

A major strength of this study was that it was based on a population survey with long-term follow-up including both parous and nonparous women. Of baseline respondents, 55% were included in this study. ALSWH investigators have assessed that there should be no serious bias due to attrition.[32] Thus, we expect any nonparticipation to be nondifferential and not lead to selection bias. As the study was carried out in Australia, any generalization of the findings should be limited to other Western or European settings.

The study provides valuable knowledge about gynecological health issues in women who may never have sought medical advice or received treatment. As the information was self-reported and the questions were not based on clinical definitions, we relied on the women's own assessment of whether their bleeding was to be categorized as heavy or their period pain to be classified as severe. This might explain the slightly higher prevalence of these conditions in our study than reported in the literature.[1,12,33] For UI, our prevalence was somewhat lower than in studies of the same age group that used validated questionaries,[18,34] but in general, reports on the prevalence of UI vary widely.[35] We had detailed information to examine the studied associations in more detail than in most other studies. However, caution is necessary when presenting results derived from models including intermediate factors as they may be overadjusted and difficult to interpret.

5 | CONCLUSION

Acknowledging the high prevalence of gynecological health issues in women of childbearing age may contribute to breaking taboos and allowing women to seek medical advice and treatment if they wish to. The high prevalence of UI has implications for primary health and antenatal care, and women should be screened and referred to physiotherapists who specialize in gynecological health when appropriate. Also, pregnant women should know that pregnancy and birth have potential impact on their gynecological health, including UI, the risk of which increases with increasing parity. However, more research is required with long-term follow-up and with more details about second stage of labor before we can confidently inform women of the gynecological impacts of childbirth.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

Researchers can access data from the Australian Longitudinal Study on Women's Health on application to the Data Access Committee via an online Expression of Interest form. The following link provides more information https://alswh.org.au/for-data-users/applying-for-data/quick-guide/

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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