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Urinary incontinence during pregnancy and postpartum pelvic floor muscle exercise: a prospective study

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Objectives: To investigate the incidence of urinary incontinence (UI) during pregnancy and after delivery, perceptions of UI, effectiveness of pelvic floor muscle exercise (PFME) on UI, and risk factors for UI among pregnant women.
Methods: Chinese women aged ≥18 years at 35 to 37 weeks of gestation were invited to participate. Perceptions of UI were assessed using a questionnaire that comprises seven statements. Urinary symptoms were assessed using the self-report six-item Urogenital Distress Inventory (UDI-6). Women were considered to have UI when they had positive scores on any of the incontinence items (items 2 to 4). Women who reported to have UI symptoms were assessed by a physiotherapist in the postnatal ward and were taught PFME. UI impact on QoL was assessed using the self-report seven-item Incontinence Impact Questionnaire (IIQ-7). Participants with UI during pregnancy who delivered in our hospital were followed up at 6 weeks postnatally through telephone. Their adherence to PFME was assessed in terms of the mean number of contractions performed per day.
Results: Of 1134 participants, the incidence of UI was 73.0% during pregnancy and 21.9% after delivery. Predictors for UI during pregnancy were a history of UI before pregnancy (odds ratio [OR]=14.40, p<0.001), higher pre-pregnancy body mass index (OR=1.04, p=0.034), and previous vaginal delivery (OR=2.06, p=0.001), whereas predictors for UI after delivery were vaginal delivery in the index pregnancy (OR=3.86, p<0.001), older age (OR=1.12, p<0.001), a history of UI before pregnancy (OR=1.86, p=0.028), and total score of items 2 to 4 on the UDI-6 during pregnancy (OR=1.20, p=0.015). 86.4% of participants reported poor or no adherence to PFME. Adherence to postnatal PFME was not associated with UI after delivery (p=0.477). Women with higher education levels adhered more to PFME (p=0.008). Perceptions of UI were not associated with adherence to postnatal PFME.
Conclusion: A history of pre-pregnancy UI is the main predictor for UI during pregnancy, whereas vaginal delivery is the main predictor for UI after delivery. The effect of postpartum PFME on UI after delivery is not significant, probably owing to the low rate of adherence to PFME.

Keywords: Pelvic floor; Pregnant women; Urinary incontinence

Introduction

The incidence of urinary incontinence (UI) among pregnant women ranges from 32% to 64%[1]. UI can be caused by hormonal changes, increased abdominal pressure or weight gain and can lead to decreased quality of life (QoL), embarrassment, depression, and social isolation[2]. UI during pregnancy is underreported and undertreated[3]. In a study of Hong Kong Chinese women, 78.3% of respondents were not aware of UI being a disease entity[4]. Only 14.8% of pregnant women sought professional help for urinary symptoms[5]. Screening for UI is not routinely performed during antenatal care.

Pelvic floor muscle exercise (PFME) is effective in reducing the incidence of UI during pregnancy[6]. However, its effects in the postnatal period yield conflicting results[7-9]. This study aimed to investigate the incidence of UI during pregnancy and after delivery, perceptions of UI, effectiveness of PFME on UI, and risk factors for UI among pregnant women.

Materials and methods

This prospective longitudinal observational study was carried out in the Princess Margaret Hospital in Hong Kong from June 2021 to April 2022. Chinese women aged ≥18 years who attended the antenatal group B streptococcus screening clinic at 35 to 37 weeks of gestation were invited to participate. Women who did not understand written Chinese were excluded.

Perceptions of UI were assessed using a questionnaire that comprises seven statements measured on a 4-point Likert scale (totally disagree, disagree, agree,

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totally agree). The questionnaire had been validated by nine obstetricians and gynaecologists in our hospital; both the item-level and scale-level content validity indices were 1.0, which meets Lynn's criteria[10]. Urinary symptoms were assessed using the self-report six-item Urogenital Distress Inventory (UDI-6). Women were considered to have UI when they had positive scores on any of the incontinence items (items 2 to 4). Women who reported to have UI symptoms were assessed by a physiotherapist in the postnatal ward and were taught PFME. UI impact on QoL was assessed using the self-report seven-item Incontinence Impact Questionnaire (IIQ-7). Both UDI-6 and IIQ-7 have been validated[11], and their Chinese versions have been validated in the Chinese population[12].

Participants with UI during pregnancy who delivered in our hospital were followed up at 6 weeks postnatally through telephone; they were asked to complete the UDI-6 and IIQ-7 again to assess any change in urinary symptoms and the impact on QoL. In addition, their adherence to PFME was assessed in terms of the mean number of contractions performed per day. The cut-off for high adherence to PFME was ≥60 contractions per day (≥420 contractions per week), based on a study that showed good results with 45 to 60 contractions per day[13]. Moderate adherence was defined as 210 to 419 contractions per week, and poor adherence was defined as <210 contractions per week.

The statistical analyses were performed using SPSS version 27. Women with or without UI during pregnancy and after delivery were compared using the Chi-squared test or Fisher's exact test for categorical variables and the Student's *t* tests or Mann-Whitney *U* test for continuous variables. Predictors for UI during pregnancy and after delivery were identified using multiple logistic regression with forward stepwise selection. Women with high, moderate, poor, or no adherence were compared using the one-way analysis of variance. A p value of <0.05 was considered statistically significant.

Results

Of 1134 participants aged 18 to 46 (mean, 32.5) years who completed the questionnaire, 826 reported UI, 306 reported no UI, and two had missing values on the UDI-6. Of 580 participants with UI during pregnancy who delivered in our hospital, 470 (81%) completed the follow-up questionnaire at a mean of 57 (range, 36-96) days after delivery.

With regard to perceptions of UI, 94.8% of participants agreed or totally agreed that 'PFME can treat UI effectively'; 79.2% agreed or totally agreed that 'severity of UI increases with age'; 74.8% agreed or totally agreed that 'pregnancy causes UI'; 74.4% agreed or totally agreed that 'UI is a physiological change of ageing'; 56.8% agreed or totally agreed that 'UI is a disease entity'; 51.1% agreed or totally agreed that 'UI resolves after delivery'; and 17.8% agreed or totally agreed that 'UI is not curable' (Table 1). Perceptions of UI were not associated with adherence to postnatal PFME.

The incidence of UI during pregnancy was 73.0% (826/1132). Compared with women with no UI during pregnancy, women with UI during pregnancy tended to have higher pre-pregnancy body mass index (22.27 vs 21.55 kg/m^2, p=0.033), a history of UI before pregnancy (21.1% vs 1.6%, p<0.001), higher number of parities (1 vs 0, p=0.015), higher number of vaginal deliveries (0.56 vs 0.35, p<0.001), higher UDI-6 score (26.3 vs 8.99, p<0.001), and higher IIQ-7 score (9.21 vs 3.66, p<0.001) and subscale scores (p<0.001) [Table 2].

Table 1. Women's perceptions of urinary incontinence (UI) [n=1134]

	No. (%) of participants			
	Totally disagree	**Disagree**	**Agree**	**Totally agree**
Q1: UI is a disease entity	42 (3.7)	448 (39.5)	547 (48.2)	97 (8.6)
Q2: Pregnancy cause UI	14 (1.2)	272 (24.0)	785 (69.2)	63 (5.6)
Q3: UI resolves after delivery	30 (2.6)	524 (46.2)	532 (46.9)	48 (4.2)
Q4: Pelvic floor muscle exercise can treat UI effectively	6 (0.5)	53 (4.7)	872 (76.9)	203 (17.9)
Q5: UI is a physiological change of ageing	14 (1.2)	276 (24.3)	725 (63.9)	119 (10.5)
Q6: Severity of UI increases with age	13 (1.1)	223 (19.7)	762 (67.2)	136 (12.0)
Q7: UI is not curable	98 (8.6)	834 (73.5)	174 (15.3)	28 (2.5)

The incidence of UI after delivery was 21.9% (103/470). Compared with women with no UI after delivery, women with UI after delivery tended to be older (33.80 vs 31.98 years, p=0.002), have a history of UI before pregnancy (32% vs 21.3%, p=0.023), have an episiotomy (53.4% vs 36.5%, p=0.003), and have normal vaginal delivery (73.8% vs 67.8%, p=0.001) and assisted vaginal delivery (17.5% vs 9.3%, p=0.001) [Table 2].

In multiple logistic regression, predictors for UI during pregnancy were a history of UI before pregnancy (odds ratio [OR]=14.40, p<0.001), higher pre-pregnancy body mass index (OR=1.04, p=0.034), and previous vaginal delivery (OR=2.06, p=0.001), whereas predictors for UI after delivery were vaginal delivery in the index pregnancy (OR=3.86, p<0.001), older age (OR=1.12, p<0.001), a history of UI before pregnancy (OR=1.86, p=0.028), and

Table 2. Comparisons of women with or without urinary incontinence (UI) during pregnancy (n=1132) and after delivery (n=470)

	UI during pregnancy*		p Value	UI after delivery*		p Value
	No (n=306)	Yes (n=826)		No (n=367)	Yes (n=103)	
Age, y	32.33±4.64	32.60±5.02	0.402	31.98±5.06	33.80±5.32	0.002
Pre-pregnancy body mass index, kg/m^2	21.55±3.06	22.27±3.99	0.033	22.41±4.07	22.79±3.95	0.398
Employed	155 (50.7)	439 (53.1)	0.455	183 (49.9)	48 (46.6)	0.558
Education level			0.703			0.657
Primary	5 (1.6)	14 (1.7)		8 (2.2)	1 (1.0)	
Secondary	142 (46.4)	406 (49.2)		202 (55.0)	60 (58.3)	
Tertiary	159 (52.0)	406 (49.2)		157 (42.8)	42 (40.8)	
Smoking	35 (11.4)	103 (12.5)	0.890	57 (15.6)	12 (11.7)	0.512
Ex-smoker	30 (9.8)	89 (10.8)		48 (13.1)	11 (10.7)	
Active smoker	5 (1.6)	14 (1.7)		9 (2.5)	1 (1.0)	
History of UI before pregnancy	5 (1.6)	174 (21.1)	<0.001	78 (21.3)	33 (32.0)	0.023
Parity	0 (0-4)	1 (0-4)	0.015	1 (0-4)	1 (0-2)	0.183
Multiple pregnancy	5 (1.6)	16 (1.9)	0.737	8 (2.2)	1 (1.0)	0.691
Nulliparous	181 (59.2)	399 (48.3)	0.001	-	-	-
No. of vaginal deliveries	0.35±0.61	0.56±0.76	<0.001	-	-	-
Diabetes mellitus/gestational diabetes mellitus	57 (18.6)	127 (15.4)	0.188	-	-	-
Gestation at delivery, wk	-	-	-	38.65±1.22	38.77±1.25	0.375
Birth weight, g	-	-	-	3155±422	3138±423	0.713
Mode of delivery						0.001
Normal vaginal delivery	-	-	-	249 (67.8)	76 (73.8)	
Assisted vaginal delivery	-	-	-	34 (9.3)	18 (17.5)	
Caesarean section	-	-	-	84 (22.9)	9 (8.7)	
Episiotomy	-	-	-	134 (36.5)	55 (53.4)	0.003
Shoulder dystocia	-	-	-	3 (0.8)	0 (0.0)	1.000
Obstetric anal sphincter injury	-	-	-	2 (0.5)	0 (0.0)	1.000
Urogenital Distress Inventory score	8.99±6.66	26.30±13.78	<0.001	0.29±1.59	10.68±7.45	<0.001
Incontinence Impact Questionnaire score	3.66±11.57	9.21±15.57	<0.001	0.08±1.49	1.85±5.82	<0.001
Physical subscale	3.67±12.01	8.95±16.72	<0.001	0	0.65±3.24	<0.001
Travel subscale	3.62±12.30	8.34±16.38	<0.001	0	1.46±6.64	<0.001
Social subscale	3.39±12.74	8.89±18.41	<0.001	0	0.97±5.63	<0.001
Emotional subscale	3.84±14.16	10.48±19.44	<0.001	0.27±5.22	3.88±15.16	<0.001

* Data are presented as mean±standard deviation, No. (%) of participants, or median (range)

total score of items 2 to 4 on the UDI-6 during pregnancy (OR=1.20, p=0.015) [Table 3].

With regard to adherence to postnatal PFME, 4.3% of participants reported high adherence, 9.4% reported moderate adherence, and 86.4% reported poor or no adherence. Adherence to postnatal PFME was not associated with UI after delivery (p=0.477, Table 4). Improvement in the UDI-6 score was highest (but not significantly) in women with high adherence (p=0.396). Women with higher education levels adhered more to PFME (p=0.008).

Discussion

In the present study, the incidence of UI during pregnancy was 73.0%, which was higher than the 40% to 68.8% reported in other studies[14-16] and similar to the 73.2% in a cross-sectional study[17]. The higher incidence of

Table 3. Predictors for urinary incontinence (UI) during pregnancy and after delivery

Variables	Odds ratio (95% confidence interval)	p Value
UI during pregnancy		
History of UI before pregnancy	14.40 (5.82-35.62)	<0.001
Pre-pregnancy body mass index	1.04 (1.00-1.09)	0.034
Previous vaginal delivery	2.06 (1.34-3.17)	0.001
UI after delivery		
Age	1.12 (1.06-1.17)	<0.001
History of UI before pregnancy	1.86 (1.07-3.24)	0.028
Vaginal delivery	3.86 (1.81-8.23)	<0.001
Total score of items 2 to 4 on the six-item Urogenital Distress Inventory during pregnancy	1.20 (1.04-1.40)	0.015

Table 4. Adherence to pelvic floor muscle exercise after delivery (n=470)

Characteristic	Adherence to pelvic floor muscle exercise				p Value
	No (n=135)	Poor (n=271)	Moderate (n=44)	High (n=20)	
Age, y	32.29±5.61	32.40±5.05	32.55±4.31	32.40±5.80	0.999
Pre-pregnancy body mass index, kg/m^2	21.74±3.96	22.96±3.95	21.95±4.64	22.47±3.86	0.027
Employed	56 (41.5)	142 (52.4)	21 (47.7)	12 (60.0)	0.151
Education level					0.008
Primary	5 (3.7)	4 (1.5)	0 (0.0)	0 (0.0)	
Secondary	90 (66.7)	144 (53.1)	19 (43.2)	9 (45.0)	
Tertiary	40 (29.6)	123 (45.4)	25 (56.8)	11 (55.0)	
Days from delivery to follow-up	56.78±8.41	57.46±10.11	58.09±8.90	53.55±6.53	0.277
Urinary incontinence after delivery	25 (18.5)	63 (23.2)	12 (27.3)	3 (15.0)	0.477
Change in six-item Urogenital Distress Inventory score	-23.58±15.90	-24.31±14.25	-25.38±13.68	-29.44±14.54	0.396
Change in seven-item Incontinence Impact Questionnaire score	-7.62±14.17	-8.52±16.53	-10.39±16.95	-11.90±18.05	0.590
Physical subscale	-8.77±16.77	-8.61±17.56	-10.23±16.16	-12.50±19.40	0.752
Travel subscale	-7.16±14.76	-8.18±18.08	-9.47±19.15	-9.17±16.64	0.860
Social subscale	-7.65±18.18	-8.49±19.61	-9.09±19.51	-15.00±27.52	0.479
Emotional subscale	-6.91±20.20	-8.79±20.53	-12.12±19.48	-12.50±21.54	0.396

UI may be the result of a selection bias, whereby women experiencing UI symptoms were more likely to participate in the study. Moreover, UI tends to worsen as pregnancy progresses and as the weight of the uterus increases[18]. Our participants were recruited during late pregnancy; this could result in the higher incidence of UI.

94.8% of the participants agreed that PFME can treat UI effectively, and 82.2% of participants agreed that UI can be cured. These findings indicated that most women were knowledgeable about the PFME to alleviate their UI symptoms. 51.1% of participants agreed that UI symptoms will resolve spontaneously after delivery; they tended to adhere less to postnatal PFME. 56.8% of the participants agreed that UI is a disease entity; this may explain the lack of help-seeking behaviour for UI symptoms in pregnancy[4].

UI during pregnancy was more common in multiparous than in nulliparous women. This could be due to pelvic structural changes after delivery. A higher number of previous vaginal deliveries was associated with UI during pregnancy. Vaginal delivery is a predictor for postpartum UI[19] and increases the risk of pelvic floor dysfunction secondary to damages to pelvic innervation and laceration of the pelvic musculature[20]. Instrumental delivery can result in more laceration and mechanical stress and thus further increases the risk of pelvic floor dystundtion[21].

A history of UI before pregnancy was a strong predictor for UI during pregnancy and after delivery. It is associated with both antepartum and postpartum UI[5,7,14]. Women with an episiotomy were associated with UI after delivery. A systemic review on the long-term effects of episiotomy concluded that episiotomy is not protective against UI symptoms[22]. This may be confounded by vaginal delivery, which is a risk factor for postpartum UI. The use of an episiotomy reflects the anticipation of a difficult delivery, which is also a risk factor for postpartum UI. In our study, multiple logistic regression analysis showed no significant association between episiotomy and postpartum UI. A higher total score of items 2 to 4 on the UDI-6 during pregnancy was associated with postpartum UI, consistent with a study[7].

Understanding the risk factors for UI helps in antenatal counselling and may increase women's adherence to PFME. Targeted interventions may be offered to high-risk women. Healthcare professionals can implement early intervention and prevention strategies such as PFME and healthy bladder habits for high-risk women.

In our study, postpartum PFME did not significantly reduce the incidence of postpartum UI or improve UI symptoms or QoL. This could be due to a lack of regular supervised instruction. Supervised PFME is more effective than unsupervised PFME[23], and intensive training with close follow-up is more likely to achieve beneficial effects[24]. Despite good adherence to PFME, women may inadvertently perform PFME incorrectly. Consistent input from healthcare professionals and close follow-up may help women to achieve effective PFME. Furthermore, the training period of 6 weeks (median, 56 days) may be too short to strengthen the pelvic floor muscles. Supervised training protocol lasting at least 8 weeks is recommended for effective PFME[6].

Although the effect of postpartum PFME was not significant, improvements in UDI-6 and IIQ-7 scores were associated with higher adherence to PFME. Only 13.6% of participants adhered to PFME moderately or highly; this may be due to inadequate promotion by medical staff[25]. Regular follow-up or training sessions can remind the participants of the importance of adherence to PFME. The proportion of pregnant women adhere to PFME increases from 5.8% to 37.2% after two sessions of education classes[25]. Physiotherapists may customise the PFME programme for each woman and integrate PFME into women's daily routines, particularly for women with lower education levels, which was associated with lower adherence.

There were limitations to this study. The study was not randomised or controlled owing to resource constraints and ethical concerns. There may be selection bias, as pregnant women with UI are more likely to participate in the study. Follow-up at 6 weeks after delivery may be too short to observe the effects of PFME. The lack of interval follow-ups or training sessions may result in the poor adherence to PFME.

Conclusions

A history of pre-pregnancy UI is the main predictor for UI during pregnancy, whereas vaginal delivery is the main predictor for UI after delivery. The effect of postpartum PFME on UI after delivery is not significant, probably owing to the low rate of adherence to PFME.

Contributors

WSC and LYT designed the study. WSC and HLF acquired the data. WSC analysed the data and drafted the manuscript. All authors critically revised the manuscript for important intellectual content. All authors had full

access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

All authors have no conflicts of interest to disclose.

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Data availability

All data generated or analysed during the present study are available from the corresponding author on reasonable request.

Ethics approval

The study was approved by the Kowloon West Cluster Research Ethics Committee (reference: EX-20-107(150-01)). The patients were treated in accordance with the tenets of the Declaration of Helsinki. The patients provided written informed consent for all treatments and procedures and for publication.

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