Acta Obstetricia et Gynecologica. 2010; 89: 1511–1522

ACTA REVIEW

Prevalence of postpartum urinary incontinence: a systematic review

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Abstract

Objective. To investigate the prevalence of urinary incontinence within the first year postpartum. *Design.* A systematic review of population-based studies. *Population.* General female populations up to 1 year postpartum. *Methods.* Studies on incontinence in population-based sample defined as from one or more district hospitals or from multiple clinics covering a defined geographic area. Studies of women from a single outpatient clinic or who were referred for care (e.g. for being high risk) were excluded. In addition, studies had to have a sample size of over 100 participants and a response rate 50% or over. *Main outcome measures.* Prevalence from individual studies as well as mean prevalence is given. Pooled prevalence is estimated for non-heterogenous studies. *Results.* During the first 3 months postpartum, the pooled prevalence of any postpartum incontinence was 33% (95% confidence interval (CI) 32–36%) in all women. The mean prevalence of weekly and daily incontinence was 12% (95% CI 11–13%) and 3% (95% CI 3–4%), respectively. The mean prevalence was double in the vaginal delivery group (31%, 95% CI 30–33%) compared to the cesarean section group (15%, 95% CI 11–18%). Longitudinal studies within the first year postpartum showed small changes in prevalence over time. *Conclusions.* The prevalence of postpartum incontinence was high. Prevalence was substantially less for more frequent incontinence. Urinary incontinence after cesarean section was half the prevalence after vaginal delivery.

Key words: *Delivery mode, population-based, postpartum period, prevalence, urinary incontinence*

Introduction

The reported prevalence of urinary incontinence in the postpartum period ranges from 3 to 40% (1–3). An accurate estimate of the prevalence of postpartum incontinence is important for several reasons including assessing the public health burden of postpartum incontinence and estimating sample sizes when designing research studies. In addition, investigating reasons for differences in prevalence estimates among studies may lead to identification of subsets of women at a higher risk for postpartum urinary incontinence.

There are several reasons why prevalence may differ between studies, including differences in populations being studied (e.g. country), differences in study design (e.g. method of ascertainment and choices of definition of incontinence by type and frequency) and differences in subgroups studied (e.g. delivery methods, number of prior births and history of prior incontinence). It is not known to what degree these differences in study methods or populations may explain the widely different prevalence reported.

We performed a systematic review of the literature to identify studies reporting the prevalence of incontinence during the postpartum period from >2 weeks to 1 year after the delivery. Using data from these studies, we aimed to provide pooled estimates of the prevalence of postpartum urinary incontinence for women by parity, method of delivery, and type and frequency of incontinence. We also investigated to what extent differences in reported prevalence can be explained by the above population, study design and

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(Received 28 June 2010; accepted 5 September 2010)

ISSN 0001-6349 print/ISSN 1600-0412 online © 2010 Informa Healthcare
DOI: 10.3109/00016349.2010.526188

sub-population characteristics. To our knowledge, no systematic review has been performed on this subject previously.

Materials and methods

Literature search

In late 2005 and early 2006, we performed a systematic search of articles in the Medline, EMBASE, Cochrane, CINAHL and Biosis databases. The search was assisted by librarians at the UCSF and the University of Bergen. We used the following MESH terms: urinary incontinence, postpartum period, epidemiology, prevalence, incidence and remission. Additional search in non-MESH search words were urinary incontinence, postpartum, puerperium, puerperal, postnatal, epidemiology, prevalence, incidence, remission and resolution. The limits for the searches were 'human' and 'female'. No language limit was set, as the authors understand English, German, French and Scandinavian languages. In addition to this systematic search, we did a manual search in bibliographies and the authors' previously collected articles on the topic, and we performed a final search on Medline in December 2009 based on the search words urinary incontinence, postpartum and prevalence.

Inclusion criteria

Inclusion criteria were defined as studies on urinary incontinence in population-based sample defined as from one or more district hospitals or from multiple clinics covering a defined geographic area. Studies of women from a single outpatient clinic and studies of women who were referred for care (e.g. for being high risk) were excluded. In addition, studies had to have a sample size of over 100 participants, a response rate 50% or over and prevalence reported at least one time point during the first year after the index delivery (excluding the first 2 weeks after delivery). Studies had to report urinary incontinence of any frequency or else specify the frequency (e.g. weekly or daily incontinence); thus, studies that only reported incontinence that was 'bothersome' or 'severe' were excluded. Inclusion criteria were applied by each author separately using the same form, which was developed in advance. When disagreement occurred, the article was further studied until agreement was achieved. When articles did not report a response rate, an attempt was made to estimate a response rate from the information provided. If the article reported that eligible consecutive women were enrolled without further information, we assumed that all eligible women were enrolled.

Data abstraction

Data from each article was abstracted using a form which was developed and piloted beforehand. The form was used to record the prevalence of urinary incontinence for all subgroups reported by parity of the women, type and frequency of urinary incontinence, type of delivery, weeks postpartum and if continent prior to pregnancy. In addition, study year(s), study location, method of ascertainment (in person, phone or postal) and response rate were noted. The results were compared and any disagreement was resolved by reference to the article in question. Where data were ambiguous, an attempt was made to contact the primary author for clarification.

Data summary and analysis

For our primary analyses, we examined the prevalence of urinary incontinence in the first year postpartum among parous women (one or more deliveries) and performed further subgroup analyses in primiparous (only one delivery) and multiparous women (two or more deliveries). Also, prevalence was analyzed according to type of delivery, number of weeks postpartum and incontinence type (all, stress only, urge only) and frequency (any, weekly, daily). Too few studies reported incontinence by degree of bother to allow for a meaningful analysis. Time since delivery was divided into two periods: 2–13 weeks ('first 3 months postpartum') and 14–52 weeks ('4–12 months postpartum'). Prevalence within the first 2 weeks postpartum was not included to avoid counting transient incontinence following delivery. If more than one prevalence was reported by the same study for the same time period (e.g. at 6 and 12 weeks), we used the average of the reported prevalence. Median prevalence, mean prevalence and 95% confidence interval (CI) were calculated for all studies, and for subsets defined by parity, type of delivery, frequency of incontinence, type of incontinence and postpartum period. Mean prevalence was calculated by summing the numerator data (number of women with urinary incontinence in the subset) and dividing by the sum of the denominator data (all women in the subset). The 95% CI for the mean was calculated using the Wald method (4). Chi-square statistics was used to test for heterogeneity among studies with a threshold of $p < 0.10$ indicating

heterogeneity. When heterogeneity was found, studies at the end of the range of prevalence were dropped and heterogeneity was tested again; if this 'truncated' subset of at least three studies was no longer heterogeneous, then the mean and 95% CI were reported as well. We use the term 'non-heterogeneous prevalence' for this latter estimate, while the pooled estimate for all studies without regard to heterogeneity among them is called 'heterogeneous prevalence'.

We also used stratification to examine the relationship between prevalence of any incontinence for any method of delivery and the following study characteristics: study design (prospective or cross-sectional), study year (<2000 or 2000 or later), country (American, European, Asian), sampling frame (population-based vs. hospital-based), response rate (>80 vs. 50–80%) and survey method (telephone, mail or in person).

Results

The search located 353 unique articles for which abstracts were reviewed and 273 excluded. The remaining 80 articles were reviewed in full and yielded 33 studies which met our inclusion criteria. The results of the analyses of these studies are presented here.

A description of the 33 studies is provided in Table 1. Six studies were done in Sweden, five in the UK, four in the USA, four in Italy, four in Canada and two in Australia. Only three studies were done outside of Europe, Australia or North America (one in Israel, one in Turkey and one in Iran). Mailed questionnaires were used in 17 studies, phone calls in seven, in person interviews in seven studies, and a combination of in person and phone interviews in two studies. Seventeen studies included only primiparous women. Reported results were limited to women having only vaginal deliveries in eight studies and to women with cesarean sections only in one study (5). One study enrolled equal number of women with cesarean and vaginal deliveries by design (6). Among studies enrolling women without restriction by type of delivery, reported rates of cesarean section ranged from 9 to 25%, with the exception of the Iranian study which reported a cesarean section rate of 49% (7), which appears to be consistent with delivery practices in that country. Twelve studies reported data on stress incontinence only. Most studies included women regardless of their continence status prior to pregnancy or delivery and did not distinguish between women with and without prior incontinence.

Tables 2–5 summarize prevalence by parity, type of delivery, type of incontinence, frequency of incontinence and postpartum period for women without limitation by continence status prior to pregnancy and delivery, and therefore do not include the 11 studies limited to women continent prior to pregnancy or delivery (7–17). Results limited to women continent prior to pregnancy or delivery are summarized separately. Because all tables report prevalence only for 2–13 weeks postpartum, one study which only reported incontinence prevalence between 2 and 52 weeks postpartum (18) was not included in any table.

Table 2 shows the prevalence in the first 3 months postpartum of all urinary incontinence by method of delivery for primiparous and parous women. No studies were found which reported prevalence for multiparous women separately by specific method of delivery. There is generally little difference in the combined prevalence estimates using all studies or only non-heterogeneous studies. Among primiparous women, the heterogeneous prevalence for all urinary incontinence is the highest for instrumental vaginal deliveries (32%), followed by spontaneous vaginal deliveries (28%) and then by cesarean sections (15%). A similar pattern is seen for all parous women, though with less difference between instrumental and spontaneous vaginal deliveries.

While most studies reported the prevalence of 'any' incontinence, some studies reported prevalence for weekly and daily incontinence. Table 3 shows the combined prevalence for any, weekly and daily incontinence for all types of deliveries for primiparous only and all parous women. The heterogeneous prevalence of postpartum incontinence among primiparous women dropped substantially from 27% for any incontinence to about 13% for weekly incontinence and less than 3% for daily incontinence, with a similar pattern for parous women.

Most studies reported all urinary incontinence, or stress incontinence, but several also reported prevalence of urge incontinence. Of the 20 studies reporting stress incontinence, 16 used, with only a slight variation, a definition of urine leakage 'with laughing, coughing, sneezing or physical activity' (3,7,10–12,14–16,19–26), two used leakage 'with physical activity' (6,27) and two did not report the definition used (17,18). Similarly, of seven studies reporting urge incontinence, four used, with slight variations, a definition of urine leakage preceded or accompanied by a strong sense of physical urgency (6,11,26,27), one study used 'leakage on the way to the bathroom' (16) and two studies did not report a definition of urge incontinence (18,22). Table 4 shows the prevalence for any, stress and urge incontinence for all types of deliveries for primiparous and

Table 1. Description of studies used for pooled estimates.

Reference	*N*	Country	Year(s) data collected	Sampling frame	Type of survey	Inclusion criteria	Type of UI	Weeks postpartum
All parous women (1+ deliveries)								
Baydock (11)	632	Canada	1999	1 hospital	Phone	Vaginal delivery; no UI prior to pregnancy	Stress and urge	16
Burgio (38)	523[a]	USA	1990–1991	1 hospital	In person and phone	Live birth	Not by type	6, 13
Dimpfl (12)	350[a]	Germany	1986	1 hospital	Mailed	No UI prior to pregnancy; no symptoms of urgency/urge UI	Stress	6, 13
Eason (39)	949[a]	Canada	1994–1995	1 hospital	Mailed	No prior C-section after vaginal birth	Not by type	13
Ege (18)	1,749	Turkey	2006	7 health centers	In person	Not pregnant at time of survey	Stress, urge and mixed	31
Iosif (17)	1,411	Sweden	NR	1 hospital	Mailed	None stated	Stress	26–52
Kristiansson (40)	200	Sweden	1991	2 town districts	In person	Healthy, not on any continuous medication	Not by type	13
Mason (23)	572[a]	UK	NR	2 hospitals in NW England	Mailed	None stated	Stress	8
Morkved (2)	114	Norway	NR	1 hospital	In person	Norwegian speaking	Not by type	8
Pregazzi (27)	537	Italy	1999–2000	1 hospital	In person	Vaginal delivery; no history of bladder surgery, urinary tract disorder, UTI during pregnancy	Stress and urge	8
Schytt (19)	2,390	Sweden	1999–2000	National sample	Mailed	Singleton pregnancy	Stress	52
Serati (14)	336	Italy	2004	1 hospital	Phone	Vaginal delivery; no urinary or sexual symptoms prior to delivery; no pregnancy within 12 months following delivery	Stress	26, 52
Thompson (24)	1,295	Australia	1997	Population sample	Mailed	Residents of Australian Capital Territory; neither baby nor mother critically ill	Stress	8
Torrisi (25)	562[a]	Italy	2002–2003	1 hospital	Phone	Vaginal delivery at term, no history of recurrent urinary tract infections or malformations, pelvic floor surgery	Stress	12
Wilson (22)	1,505	New Zealand	1989–91	Population sample	Mailed	Resident of Dunedin, New Zealand	Stress and urge	13
Primiparous women								
Altman (21)	304[a]	Sweden	1995	1 hospital	Mailed	Singleton pregnancy; vaginal delivery; no history of incontinence surgery	Stress	22, 39
Arya (13)	315	USA	1999	1 hospital	Phone	Vaginal delivery; term; no diabetes or neurologic disease; no UI prior to or during pregnancy	Not by type	2, 13, 52
Borello-France (5)	124[a]	USA	2002–2004	7 hospitals	Phone	Elective C-section only; no history of inflammatory bowel disease, ano-rectal surgery or neurologic disorder that could affect bladder function	Not by type	6, 26
Bugg (8)	275	UK	2000	1 hospital	Mailed	Not pregnant at time of postpartum survey; not incontinent prior to pregnancy	Not by type	43
Chaliha (26)	549[a]	UK	1996–1997	1 hospital	In person and phone	Singleton pregnancy	Stress and urge	13

Table 1. (*Continued*).

Reference	*N*	Country	Year(s) data collected	Sampling frame	Type of survey	Inclusion criteria	Type of UI	Weeks postpartum
Diez-Itza (15)	352	Spain	2007	1 hospital	Phone	No UI prior to pregnancy, singletons, full term, no diabetes, no urogynecology surgery, malformations or neurologic disorders	Stress	52
Dolan (28)	362[a]	UK	2000–2001	1 hospital	Mailed	None stated	Not by type	13
Eftekhar (7)	702[a]	Iran	2003–2004	5 hospitals	Mailed	No UI prior to pregnancy, no prior UTIs or pelvic surgeries	Stress	17
Ekstrom (6)	435[a]	Sweden	2003–2005	1 hospital	Mailed	BMI ≤30; non-smoker; no pregnancy complications	Stress and urge	13, 39
Eliasson (16)	665	Sweden	Before 2002	9 clinics NW Stockholm	Mailed	Live birth	Stress and urge	52
Farrell (31)	595[a]	Canada	1996–1998	1 hospital	Mailed	No history of urinary tract abnormality or pelvic surgery; no significant illness; no medications that affect urinary tract	Not by type	6
Glazener (29)	3,405	New Zealand, Scotland, England	1994–1995	3 maternity clinics	Mailed	Singleton pregnancy	Not by type	13
Groutz (9)	145[a]	Israel	NR	1 hospital	Phone	Spontaneous vaginal delivery; no stress UI prior to pregnancy	Not by type	52
Hatem (30)	1,291	Canada	2002	Population sample	Mailed	Residents of Quebec Province	Not by type	26
King (10)	116[a]	Australia	NR	1 hospital	In person	No UI prior to pregnancy; no neurological disorder that could affect bladder function	Stress	10–14
Pregazzi (41)	218	Italy	2000	1 hospital	In person	Spontaneous vaginal delivery, singletons, OA position, no episiotomy; no history of vaginal or anal surgery	Not by type	13
Tincello (20)	150[a]	UK	NR	1 hospital	In person	No connective tissue disorder	Stress	39
Viktrup (3)	305	Denmark	1989	1 hospital	Phone	Danish speaking	Stress	13, 52

[a]Initial recruitment rate not reported.
Note: N, number of participants; UI, urinary incontinence; NR, not reported; UTI, urinary tract infection; BMI, body mass index; OA, occiput anterior.

Table 2. Prevalence of all urinary incontinence by method of delivery during the first 3 months postpartum by individual study and pooled median, mean and 95% CI.

Type of delivery	Reference	Prevalence	Median	Mean	95% CI
All parous women (1+ deliveries)					
All deliveries	Burgio[a] (38)	10.3	31.2	26.2	25.3–27.8
	Thompson[c] (24)	18.3		**33.3**	**31.5–36.3**
	Eason[b] (39)	**31.2**			
	Wilson[c] (22)	**34.3**			
	Morkved[a] (2)	**37.5**			
Vaginal delivery	Thompson[c] (24)	21.0	34.9	31.2	29.6–32.8
	Eason[b] (39)	**33.7**		**35.4**	**33.4–38.6**
	Wilson[c] (22)	**36.1**			
	Morkved[a] (2)	**38.9**			
Spontaneous	Thompson[c] (24)	20.1	36.2	30.2	28.3–32.2
	Wilson[c] (22)	36.2			
	Morkved[a] (2)	40.2			
Instrumental	Morkved[a] (2)	**22.2**	26.9	**31.1**	**26.4–35.9**
	Thompson[c] (24)	**26.9**			
	Wilson[c] (22)	**35.3**			
Cesarean	Thompson[c] (24)	6.0	23.1	14.6	11.4–17.9
	Morkved[a] (2)	23.1			
	Wilson[c] (22)	23.6			
Primiparous women					
All deliveries	Dolan[a] (28)	13.0	27.6	26.6	25.5–27.7
	Chaliha[b] (26)	14.6		**28.7**	**27.4–29.9**
	Farrell[b] (31)	**26.5**			
	Eason[b] (39)	**27.7**			
	Glazener[c] (29)	**29.0**			
	Wilson[c] (22)	**29.7**			
	Morkved[a] (2)	40.4			
Vaginal delivery	Chaliha[b] (26)	16.5	31.2	29.9	28.9–31.9
	Farrell[b] (31)	**30.0**		**30.8**	**29.7–31.9**
	Glazener[c] (29)	**31.1**			
	Eason[b] (39)	**31.3**			
	Wilson[c] (22)	**32.9**			
Spontaneous	Chaliha[b] (26)	15.2	26.8	28.4	26.8–30.0
	Farrell[b] (31)	23.0			
	Glazener[c] (29)	30.5			
	Wilson[c] (22)	32.3			
Instrumental	Chaliha[b] (26)	19.4	32.8	31.5	28.9–34.1
	Glazener[c] (29)	**32.5**		**32.8**	**30.1–35.6**
	Wilson[c] (22)	**33.1**			
	Farrell[b] (31)	**34.9**			
Cesarean	Farrell[b] (31)	7.9	13.8	14.8	12.8–16.9
	Chaliha[b] (26)	9.2			
	Eason[b] (39)	11.5			
	Wilson[c] (22)	16.0			
	Glazener[c] (29)	16.2			
	Borello-France[a] (5)	25.0			
Multiparous women (2+ deliveries)					
All deliveries	Morkved[a] (2)	**35.9**	35.9	**36.6**	**32.2–41.0**
	Eason[b] (39)	**36.8**			

[a]Study size of 100–500.
[b]Study size of 501–1,000.
[c]Study size of >1,000.
Note: Pooled estimates with no significant heterogeneity are in bold. CI, confidence interval.

parous women. Stress incontinence was nearly four times as common as urge incontinence in primiparous women. For all parous women, urge incontinence was substantially more common, though still less common than stress incontinence. Only three studies reported both stress and urge incontinence, two of which also included a category of mixed incontinence (data not shown) (28,29).

Table 3. Prevalence of any, weekly and daily urinary incontinence during the first 3 months postpartum for all deliveries by individual study and pooled median, mean and 95% CI.

Any UI					Weekly UI					Daily UI				
Reference	Prev	Median	Mean	95% CI	Reference	Prev	Median	Mean	95% CI	Reference	Prev	Median	Mean	95% CI
All parous women (1+ deliveries)														
Burgio[a] (38)	10.3	31.2	26.2	25.3–27.8	Eason[b] (39)	9.2	13.6	12.0	10.8–13.3	Eason[b] (39)	2.8	3.3	3.3	2.6–4.0
Thompson[c] (24)	18.3		**33.3**	25.3–27.8	Wilson[c] (22)	13.6				Wilson[c] (22)	3.3			
Eason[b] (39)	**31.2**			**31.5–36.3**	Morkved[a] (2)	13.9				Morkved[a] (2)	6.9			
Wilson[c] (22)	**34.3**													
Morkved[a] (2)	**37.5**													
Primiparous women														
Dolan[a] (28)	13.0	27.6	26.6	25.5–27.7	Chaliha[b] (26)	4.9	8.6	12.5	11.5–13.5	Chaliha[b] (26)	**2.4**	2.5	**2.5**	**2.1–3.0**
Chaliha[b] (26)	14.6		**28.7**	**27.4–29.9**	Eason[b] (39)	8.6				Eason[b] (39)	**2.5**			
Farrell[b] (31)	**26.5**				Glazener[c] (29)	14.4				Glazener[c] (29)	**2.6**			
Eason[b] (39)	**27.7**													
Glazener[c] (29)	**29.0**													
Wilson[c] (22)	**29.7**													
Morkved[a] (2)	40.4													

[a]Study size of 100–500.
[b]Study size of 501–1,000.
[c]Study size of >1,000.
Note: Pooled estimates with no significant heterogeneity are in bold. UI, urinary incontinence; CI, confidence interval; Prev, prevalence.

Table 4. Prevalence of any, stress and urge urinary incontinence during the first 3 months postpartum for all deliveries by individual study and pooled median, mean and 95% CI.

All UI					Stress UI					Urge UI				
Reference	Prev	Median	Mean	95% CI	Reference	Prev	Median	Mean	95% CI	Reference	Prev	Median	Mean	95% CI
All parous women (1+ deliveries)														
Burgio[a] (38)	10.3	31.2	26.2	25.3–27.8	Kristiansson[a] (40)	8.8	23.9	24.6	22.9–26.4	Wilson[c] (22)	14.8	14.8	14.8	13.0–16.6
Thompson[c] (24)	18.3		**33.3**	**31.5–36.3**	Wilson[c] (22)	23.9								
Eason[b] (39)	**31.2**				Mason[a] (23)	31.3								
Wilson[c] (22)	**34.3**													
Morkved[a] (2)	**37.5**													
Primiparous women														
Dolan[a] (28)	13.0	27.6	26.6	25.5–27.7	Dolan[a] (28)	3.9	10.6	12.6	11.7–13.5	Dolan[a] (28)	0.8	2.7	3.0	1.8–4.3
Chaliha[b] (26)	14.6		**28.7**	**27.4–29.9**	Viktrup[a] (3)	6.1				Chaliha[b] (26)	2.7			
Farrell[b] (31)	**26.5**				Tincello[a] (20)	8.7				Glazener[c] (29)	6.5			
Eason[b] (39)	**27.7**				Chaliha[b] (26)	12.4								
Glazener[c] (29)	**29.0**				Glazener[c] (29)	13.5								
Wilson[c] (22)	**29.7**				Mason[a] (23)	24.6								
Morkved[a] (2)	40.4													

[a]Reference size of 100–500.
[b]Reference size of 501–1,000.
[c]Reference size of >1,000.
Note: Pooled estimates with no significant heterogeneity are in bold. UI, urinary incontinence; CI, confidence interval; Prev, prevalence.

Table 5. Comparison of prevalence of urinary incontinence in the first 3 months postpartum and in postpartum months 4–12 by type of delivery and type of urinary incontinence.

Type of delivery	Type of UI	Reference	Weeks postpartum	Prevalence (%)	Weeks postpartum	Prevalence (%)	Difference (%)
All parous women (1+ deliveries)							
All deliveries	Any	Burgio (38)	6 and 13	10.3	26 and 52	11.8	-0.9
	Any	Thompson (24)	8	18.3	16 and 24	10.8	-7.5
Spontaneous VD	Any	Thompson (24)	8	20.1	16 and 24	9.9	-10.2
Instrumental VD	Any	Thompson (24)	8	25.7	16 and 24	11.5	-14.2
Cesarean	Any	Thompson (24)	8	6.0	16 and 24	7.1	+1.1
Primiparous women							
All deliveries	Any	Farrell (31)	6	26.5	26	20.1	-6.4
	Stress	Viktrup (3)	13	6.1	52	2.7	-3.4
Vaginal delivery	Stress	Ekstrom (6)	13	20.3	39	15.3	-5.0
	Urge	Ekstrom (6)	13	4.1	39	6.3	+2.2
Spontaneous VD	Any	Farrell (31)	6	23.0	26	21.5	-1.5
Instrumental VD	Any	Farrell (31)	6	34.9	26	32.4	-2.5
Cesarean	Any	Farrell (31)	6	7.9	26	9.6	+1.7
	Any	Borello-France (5)	6	25.0	26	22.9	-2.1
	Stress	Borello-France (5)	6	20.7	26	21.9	+1.2
Elective cesarean	Stress	Ekstrom (6)	13	4.2	39	5.4	+1.2
	Urge	Ekstrom (6)	13	3.1	39	4.8	+1.7

Note: UI, urinary incontinence; VD, vaginal delivery.

Table 5 compares incontinence prevalence in the first 3 months postpartum to 4–12 months postpartum for incontinence of any type among primiparous and parous women from the six studies which reported prevalence for both time periods. What is most remarkable is the relative stability in prevalence between these two time periods, with 10 of the 16 groups showing a difference of 3% or less. Not included in the table are five studies that reported the prevalence of stress incontinence only for the later postpartum time period (16,19–21,30) in primiparous women. Prevalence from these five studies was heterogeneous, ranging from 7.3 to 32.3% with a mean of 18.8% (95% CI 17.5–20.2).

A total of 13 studies reported incontinence prevalence for women who were continent prior to pregnancy (2,3,7–12,15–17,29,31). Pooled estimates of any incontinence between 2 and 13 weeks postpartum for primiparous women were 25.5% (95% CI 24.1–26.8) for all types of deliveries (10,29,31), 27.8% (95% CI 25.9–29.7) for spontaneous vaginal deliveries (29,31) and 11.4% (95% CI 9.0–13.7) for cesarean section (29,31). For stress incontinence, the pooled estimate for all types of deliveries was 11.8% (95% CI 9.8–13.8) (3,7) and 11.0% (95% CI 7.7–14.2) for spontaneous vaginal deliveries (9,15). In addition, eight studies reported incontinence prevalence for women who were continent prior to delivery (de novo postpartum incontinence) (3,10,12,13,15–17,29). Pooled estimates of any incontinence between 2 and 13 weeks for primiparous women with all types of deliveries was 17.4% (95% CI 16.1–18.7) (16,29) and 2.9% (95% CI 1.1–4.6) for stress incontinence (3,10).

The three studies reporting prevalence separately by continence status prior to pregnancy found substantially lower prevalence of postpartum incontinence in women who were continent prior to pregnancy (3,16,22). Wilson et al. found the prevalence of any incontinence at 3 months to be 44% among 835 parous women with incontinence some time prior to pregnancy and 23% among 667 parous women without incontinence prior to pregnancy (22). Eliasson et al. in a study of primiparous women reported the prevalence of any incontinence at 1 year to be 70% among 256 women with incontinence prior to pregnancy and 35% among 409 women without incontinence prior to pregnancy (16). Viktrup et al. reported stress incontinence at 3 months postpartum in 3 of 11 primiparous women (27%) with stress incontinence prior to pregnancy compared to 15 of 282 women (5%) without stress incontinence prior to pregnancy (3).

Additional analyses using stratification to examine the prevalence of incontinence by study design, study year, country, sampling frame, response rate and survey method (telephone, mail or in-person) did not substantially reduce the heterogeneity in prevalence estimates. The data for these analyses are not presented.

Discussion

To our knowledge, this is the first study to systematically examine the prevalence of postpartum

incontinence in population-based studies. We were able to calculate the median, mean and 95% CI for prevalence among several subgroups defined by parity, type of delivery, type of incontinence, frequency of incontinence and time from delivery. Overall, the prevalence seems to be around 30% within the first 3 months. Our study confirms the impression that cesarean sections may reduce the prevalence of urinary incontinence (22,31,32). We found that stress incontinence was more common than urge incontinence among women postpartum, which corresponds well with data from the general female population in this age group. Women with postpartum incontinence generally have low frequency of symptoms.

Two recent large population-based studies of primagravidae, which were not included due to response rates below 50, reported results which were generally consistent with our report. The first, a study of over 12,000 Norwegian primiparous women, reported the prevalence of postpartum incontinence at 6 months to be 31% (1). Incontinence was the most common among women with an instrumental (36%) or spontaneous (34%) vaginal delivery, and lowest among women with acute (17%) or elective (13%) cesarean section, which is similar to our pooled prevalence estimates. This study also found the prevalence of stress incontinence to be about twice that of urge incontinence, also very similar to our findings. A second study in the United States of nearly 6000 women found lower rates of incontinence overall, possibly because it was assessed with a single question in a list of medical conditions. However, the relative prevalence by delivery method at 3–6 months postpartum was similar to our findings, being the highest for instrumental vaginal deliveries (25%) and the lowest for cesarean sections (6%) (33).

Our efforts to reduce or explain the heterogeneity in prevalence estimates by stratifying on parity, delivery method, type of incontinence, frequency of incontinence and length of time from delivery were partially successful, but significant heterogeneity was still frequent even within these presumably more homogenous strata. It is likely that there are still important characteristics of different populations, as well as differences in study methods, that are not well characterized and reported which affect the measure of prevalence of postpartum incontinence. While a pooled prevalence estimate is arguably a better estimate than using any single study, it is difficult to compare prevalence between subgroups among studies due to heterogeneity. Thus, where data on subgroups from good quality studies are available, it may be preferable to compare subgroups with those studies rather than across studies.

We are not aware of any standardized criteria for assessing the quality of studies reporting prevalence, although we adhered to the PRISMA guidelines for systematic reviews (34) as far as possible. The selection criteria we used for the current review included several quality measures based on commonly accepted principles of study quality: population-based sampling, high response rate and use of standard measures to assess prevalence. The additional selection criteria of size of at least 100 subjects is often considered a proxy for quality as well, though the association between size and quality is not clear, provided the selection of participants is otherwise unbiased. Nonetheless, differences in the quality of the data reported undoubtedly remain. One of our inclusion criteria was a response rate over 50%. We still included 14 studies that did not report a response rate. These studies are all prospective studies that recruited patients in person at a clinic visit or during their parturition hospital stay. Of the 10 studies with similar methodology that did report recruitment rate, all reported rates higher than 70% and eight reported response rates above 85%. Also, preliminary analyses of the 14 studies that did not report recruitment rates showed that these studies consistently reported higher prevalence in the first 3 months compared to the studies that did not report recruitment rate. We decided to include the non-reporting studies both because this seems to be common for this type of study and because we expect the recruitment rates to be acceptable based on recruitment rates in comparable studies. To the extent that reporting recruitment rates indicates a higher quality study, it suggests that our summary prevalence estimates may be conservative.

A crucial problem is the dearth of studies on prevalence of urinary incontinence in developing countries. Low access to qualified assistance at delivery is a problem in many countries (35), and problems with incontinence both in the postpartum period and in a longer perspective may be considerable. The need for research in this field is substantial.

Another limitation of the current review is a lack of standardized report of study results. When study results were published in multiple papers, we reviewed all papers to obtain the most complete definition of the study characteristics. Prevalence based on calculations from available data was double-checked. In a few cases where the reporting was ambiguous, we attempted to contact the authors for clarification.

Accurately estimating the prevalence of postpartum urinary incontinence is inherently challenging due to the nature of the condition. Women who are incontinent after delivery constitute a group with onset of

incontinence at different periods of life; some have had incontinence since before their first pregnancy, while others have incontinence periodically without a clear relation to the latest pregnancy. Many women become incontinent during pregnancy, and the healing process may take some time after the delivery. Another subgroup of incontinent women postpartum is comprised by those who became incontinent after (and possibly as a result of) the delivery. Various etiologic factors may well correspond to different prognosis among these subgroups of women, even though they share the same symptom. In this review, we identified those studies that distinguished new incontinence postpartum from pre-existing incontinence. However, excluding incontinence that developed during pregnancy is problematic because the cumulative incidence of incontinence (usually stress incontinence) during pregnancy is very high, with over two-thirds of women reporting at least occasional stress incontinence at some point during pregnancy, usually in the third trimester (36). Excluding incontinence prior to pregnancy is somewhat more straightforward but risks missing women with mild, infrequent incontinence prior to pregnancy who develop more severe or frequent incontinence after delivery.

For primiparous women, there appear to be a sufficient number of studies without significant heterogeneity to provide reasonably stable estimates of the prevalence of postpartum incontinence by type of delivery. Fewer studies are available for women with higher parity, but the pattern is similar as for primiparous women. For primiparous women, stress incontinence is approximately twice as common as urge incontinence, while this difference is less pronounced for parous women. As expected, prevalence is substantially less for more frequent incontinence. Perhaps unexpectedly, there appears to be little difference in the prevalence of postpartum urinary incontinence from the period of 2–13 weeks postpartum compared to 14–52 weeks. Despite a large number of studies reporting, we still lack reliable estimates for some subgroups because data are often not reported for subgroups even when available or are reported in ways that do not allow pooling with results from other studies. Future population-based prospective studies reporting the prevalence of postpartum incontinence should distinguish incontinence by type, frequency and impact and should report prevalence in subgroups defined, at a minimum, by parity and type of delivery. Papers reporting results should follow the STROBE guidelines for reporting observational data (37). Such data will be useful in estimating the burden of postpartum incontinence and in designing intervention studies for preventing or treating postpartum incontinence. In addition, results from such studies should be included when advising pregnant women regarding the risk of postpartum incontinence.

Funding Support: David Thom was partly funded by the National Institutes of Diabetes and Digestive and Kidney Diseases Grant # R01- DK53335. Guri Rortveit was partly funded by the Norwegian Research Council during the work with this study. The researchers had full independence from funders in the current work.

No ethical approval was required for this kind of research.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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