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Epidemiology of Urinary Incontinence in Pregnancy and Postpartum

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1. Introduction

Urinary incontinence is a common condition in pregnancy and postpartum. There are published more than a thousand articles on urinary incontinence (UI) in pregnancy. Incidence and prevalence figures of UI in association with pregnancy vary substantially.

Not many reviews have focused solely on incidence and prevalence of UI in association with pregnancy. One report gives a range of prevalence of UI in pregnancy from 32 to 64 % (Milsom et al., 2009). There are published few reviews on incident UI postpartum, most of them are based on a small number of studies. However, one systematically review (Thom & Rortveit, 2010) and several traditional reviews have been published on prevalence of UI postpartum.

This chapter on epidemiology of urinary incontinence in pregnancy and postpartum reviews the incidence and prevalence of UI in pregnancy and postpartum on the basis of a non-systematic PubMed search. The selected articles are chosen due to relevance, quality, citation and sample size.

Published articles will be listed in tables. Tables will contain data on author and article, country of origin of the study, type of study, number of participants, time point in pregnancy and postpartum of information gathering, means of information gathering (questionnaire, interview, objective testing), and prevalence and incidence figures. Parity is an established risk factor for UI. Tables will therefore be stratified for primiparous and parous women. Large studies of good quality are referred to in the text. We will summarize incidence and prevalence figures from single papers; both range of all figures and a more narrow range of figures without the two highest and lowest outliers will be given. We will also give estimates from former reviews.

Prevalence and incidence estimates of UI in association with pregnancy vary very much and with a factor of 7 – 10. We will discuss study design, characteristics of the study population, biases, definitions and other methodological reasons for the diverging estimates, and try to help the reader understand why estimates differ. Hopefully this will give a better

understanding of incidence and prevalence estimates of urinary incontinence in association with pregnancy.

2. Urinary incontinence in pregnancy

2.1 Incidence of urinary incontinence in pregnancy

Urinary incontinence (UI) is common also among women who have not given birth (nulliparous women). A Norwegian study found prevalence of UI among nulliparous women aged 20 – 34 and 35 – 44 to be 8 % and 15 %, respectively (Rortveit et al., 2001). Other studies have found that 11 % (Brown et al., 2010, MacLennan et al., 2000) of nulliparous women had UI before pregnancy. Prevalence of UI increases considerably in pregnancy due to increased incidence of stress and mixed UI (Solans-Domenech et al., 2010).

Incidence of UI is low in 1. trimester, rising rapidly in 2. trimester and continues to rise, though more slowly, in 3. trimester (Marshall et al., 1998, Morkved & Bo, 1999, Solans-Domenech et al., 2010).

The nulliparous continent pelvis represents the best available clinical model of the unexposed pelvis, thereby the best study-population to assess incident UI in pregnancy.

Among published cross-sectional studies, Glazener et al published in 2006 data on incident UI in pregnancy among 3,405 nulliparous women with mean age of 25 years (Glazener et al., 2006). They found an incidence of UI in pregnancy of 11 %. A cross sectional study of 7,771 women from UK used questionnaire data collected postpartum (Marshall et al., 1998). They found an incidence of UI in pregnancy of 50 % and 45 % among nulliparous and parous women, respectively.

Several large population-based cohorts have been published during the recent years. A large Spanish cohort study from 2010 consisting of 1,128 nulliparous women who were continent before pregnancy had questionnaire data from each trimester. The article reported a cumulative incidence of UI in pregnancy of 39 % (Solans-Domenech et al., 2010). An Australian cohort study from 2009 consisting of 1,507 nulliparous women had interview data from early and late pregnancy. The authors found an incidence of any UI of 45 % in pregnancy (Brown et al., 2010). Results from 43,279 pregnant women in the Norwegian mother and child cohort study show a cumulative incidence of any UI in week 30 of pregnancy among nulliparous and parous women of 39 % and 49 %, respectively (Wesnes et al., 2007). Stress UI was the most common type of UI.

Several studies on incident UI in pregnancy are cross sectional. The lowest incidence estimates are reported in the cross sectional studies and in studies with focus on stress UI only. Some studies use questionnaire data while others use interview and objective testing. This might explain the diverging estimates.

No systematic review has presented pooled incidence of UI in pregnancy. Epidemiologic data are somewhat scarce and differ substantially for cumulative incidence of UI in pregnancy; from 8 – 57 % in different studies (Table 1). The majority of studies report incidence estimate of any UI in pregnancy between 28 – 45 % among primiparous, and 45 – 54 % among parous women.

Authors, year	Origin	Design	N	Data collection	Time of UI	Nulli-parous	Parous
(Al-Mehaisen et al., 2009)	Jordan	Cohort	181	Interv. .	3. trimester	45 %	54 %
(Arrue et al., 2010)	Spain	Cohort	396	Ex., interv.	Delivery	31 %	
(Brown et al., 2010)	Australia	Cohort	1,507	Quest., interv.	3. trimester	45 %	
(Chiarelli & Campbell, 1997)	New - Zealand	Cross-S	304	Interv.	During pregn.		57 %
(Dimpfl et al., 1992)	Germany	Cross-S	180	Interv.	During pregn.		54 %
(Eliasson et al., 2005)	Sweden	Cohort	665	Quest.	3. trimester	45 %	
(Glazener et al., 2006)	UK, N.Z.	Cross-S	3,405	Quest.	During pregn.	11 %	
(Groutz et al., 1999)	Israel	Cross-S	300	Interv.	3 days PP	28 %	49-50%
(Hvidman et al., 2002)	Denmark	Cross-S	642	Quest.		17 %	8 %
(Iosif, 1981)	Sweden	Cohort	1,411	Ex, interv.	1-2 weeks PP		5 %(s)
(King & Freeman, 1998)	UK	Cohort	103	Ex, interv.	During pregn.	48 %	
(Kristiansson et al., 2001)	Sweden	Cohort	200	Quest.	3. trimester		14 % (s)
(Marshall et al., 1998)	UK	Cross-S	7,771	Quest.	3 days PP	50 %	45 %
(Morkved & Bo, 1999)	Norway	Cross-S	144	Ex., interv.	During pregn.		38 %(s)
(Sharma et al., 2009)	India	Cohort	240	Quest.	3. trimester		18 %
(Solans-Domenech et al., 2010)	Spain	Cohort	1,128	Quest.	During pregn.	39 %	
(Thomason et al., 2007)	USA	Cross-S	121	Ex., interv.	During pregn.	16 %	
(Viktrup et al., 1992)	Denmark	Cohort	305	Interv.	1 week PP	10 % (s)	
(Wesnes et al., 2007)	Norway	Cohort	43,279	Quest.	3. trimester	39 %	49 %

cross-s = cross sectional study, Quest. = Questionnaire, Interv. = interview, Ex. = examination, PP = postpartum, (s) = stress UI

Table 1. Incidence of urinary incontinence in pregnancy by parity.

2.2 Prevalence of urinary incontinence in pregnancy

Data from a large number of cross-sectional studies and cohort studies indicate that UI in women is highly prevalent in pregnancy. More than 50 % of all pregnant women experience UI. UI when running, jumping, coughing or laughing (stress UI) is the most common symptom of UI in association with pregnancy.

In a cross-sectional study from Ireland 7,771 women received a questionnaire on UI 2-3 days postpartum (Marshall et al., 1998). Prevalence of UI was 55 % and 66 % among primiparous and parous women, respectively. The study has somewhat insufficient descriptive data which makes it difficult to evaluate the external validity. In 1999 Hojberg et al found a prevalence of UI of 4 % and 14 % among 7,794 Danish nulliparous and parous women, respectively (Hojberg et al., 1999). The low prevalence might be due to UI was reported in early in pregnancy (week 16).

Several cohorts have investigated prevalence of UI during pregnancy. One of the first studies to put focus on UI in pregnancy was done by Francis in 1960 (Francis, 1960). In this cohort he found the prevalence of UI to be 52 % and 85 % among nulliparous and parous women, respectively. Similar results were found in an Australian cohort study that used a validated questionnaire on UI on 1,507 nulliparous women (Brown et al., 2010). Prevalence of UI at least once a month was found to be 56 % in week 31 of pregnancy. New cases of stress UI accounted for more than two thirds of the reported UI prevalence in pregnancy. A study from USA found by structured questionnaire interview on 553 women a prevalence 60 % for UI during pregnancy (Burgio et al., 2003). In the large Norwegian mother and child cohort the prevalence of any UI in third trimester was 48 % among nulliparous and 67 % among parous women (Wesnes et al., 2007). Stress UI was the most common type of UI, affecting 31 % and 41 % of all nulliparous and parous women. The majority of women leaked only small amounts.

Lower prevalence estimates are reported in other cohorts; Dolan et al investigated prevalence of any UI in week 32 to term in a cohort of 492 nulliparous women in England (Dolan et al., 2004). Prevalence of UI was 36 % in pregnancy. However, prevalence of UI before pregnancy was only 2.6 %, which might explain a somewhat low UI prevalence in pregnancy. The majority of the women reported little impact on quality of life. The highest prevalence estimates were reported from a very small cohort recruiting 113 women from an American tertiary care hospital (Raza-Khan et al., 2006). A prevalence of 70 % and 75 % were found among nulliparous and parous women, respectively.

Prevalence estimates for UI in pregnancy among nulliparous women vary from 4 – 70 %, while estimates for parous women vary from 14 – 85 % (Table 2). However, the majority of studies appear to report prevalence estimates between 35 – 55 % among primiparous women, and somewhat higher figures for parous women. No systematic review on UI in pregnancy has been published. The International consultation on incontinence published in 2009 their latest report "Epidemiology of Urinary (UI) and Faecal (FI) Incontinence and Pelvic Organ Prolapse (POP)" (Milsom et al., 2009). It describes period prevalence of any UI in pregnancy of 32 – 64% among all women.

Author, year	Origin	Design	N	Data collection	Time of UI	Nulli-parous	Parous
(Burgio et al., 2003)	USA	Cohort	523	Interv.	2 days PP		60 %
(Brown et al., 2010)	Australia	Cohort	1,507	Quest, interv.	3. trimester	56 %	
(Chaliha et al., 1999)	UK	Cohort	549	Interv.	3. trimester	44 %	
(Dimpfl et al., 1992)	Germany	Cross-s	350	Interv	During pregn.		55 %
(Dolan et al., 2004)	UK	Cohort	492	Quest.	3. trimester	36 %	
(Francis, 1960)	England	Cohort	400	Ex, interv.	During pregn.	53 %	85 %
(Groutz et al., 1999)	Israel	Cross-s	300	Interv.	3 days PP	49 %	50 %
(Hojberg et al., 1999)	Denmark	Cross-s	7,795	Quest.	2. trimestr	4 %	14–16%
(Hvidman et al., 2003)	Denmark	Cross-s	376	Quest.			18 %
(Hvidman et al., 2002)	Denmark	Cross-s	642	Quest.		20 %	24 %
(Iosif, 1981)	Sweden	Cohort	1,411	Quest.	1-2 weeks PP		22 % (s)
(Kristiansson et al., 2001)	Sweden	Cohort	200	Quest.	3. trimester		26 % (s)
(Marshall et al., 1998)	Irland	Cross-s	7,771	Quest.	3 days PP	55 %	66 %
(Mason et al., 1999)	England	Cohort	717	Quest.	3. trimester	32 % (s)	59 % (s)
(Morkved & Bo, 1999)	Norway	Cross-s	144	Ex., interv.	8 weeks PP	35 %	37–70%
(Raza-Khan et al., 2006)	USA	Cohort	113	Quest.	3. trimester	70 %	75 %
(Scarpa et al., 2006)	Brasil	Cross-s	340	Interv.	3. trimester	46 % (s)	55–64%
(Thomason et al., 2007)	USA	Cross-s	121	Ex., interv.	During pregn.	55 %	
(van Brummen et al., 2006)	Netherland	Cohort	515	Quest.	2. trimester	42 % (s)	
(Viktrup et al., 1992)	Denmark	Cohort	305	Interv.	1 week PP	32 % (s)	
(Wesnes et al., 2007)	Norway	Cohort	43,279	Quest.	3. trimester	48 %	67 %

cross-s = cross sectional study, Ex. = examination, Quest. = questionnaire, Interv. = interview, PP = postpartum, (s) = stress UI.

Table 2. Prevalence of urinary incontinence in pregnancy by parity.

3. Urinary incontinence postpartum

3.1 Incidence of urinary incontinence postpartum

Prevalence of UI postpartum is a so called "mixed bag" of incident UI before pregnancy, incident UI in pregnancy and incident UI postpartum (Iosif, 1981, Nygaard, 2006). Risk factors for incident UI at the different time points vary. Mode of delivery; vaginal delivery, vacuum and forceps, are risk factors for incident UI postpartum compared to cesarean section (Glazener et al., 2006). Incident UI is also called *de novo UI* or *new onset UI*.

Cross-sectional studies on incident UI postpartum must rely on maternal recall of UI status during pregnancy. Several large cross-sectional studies have data on incident UI postpartum. A large population-based cross-sectional study from USA investigated incidence of UI postpartum among 5,599 primiparous women (Boyles et al., 2009). The incidence of UI 6 months postpartum was 10 %. About 25 % of the study population had delivered by cesarean section, which might explain the low incidence. Glazener et al published in 2006 cross-sectional data on incident UI in pregnancy among 3,405 primiparous women with mean age of 25 years (Glazener et al., 2006). They found an incidence of UI 3 months postpartum of 15 %. Wilson used questionnaires to investigate incident UI postpartum among 1,505 women who were resident in the Dunedin area, New Zealand (Wilson et al., 1996). The incidence of UI 3 months postpartum was 12 % and 21 % among primiparous and parous women, respectively.

Prospective data on incident UI among 595 primiparous Canadian women 6 months postpartum by a validated questionnaire showed an incidence of any UI of 26 % (Farrell et al., 2001). The use of a research nurse to clarify and complete the questionnaire with each participant might explain the high incidence. Several Scandinavian cohort studies have reported incidence of UI postpartum; in the 30 year old Swedish cohort of 1,411 primiparous women, 19 % reported incident stress UI 6 months post partum (Iosif, 1981). Wesnes et al found a similar incidence of any UI 6 months postpartum (21 %) among 12,679 primiparous women who were continent before pregnancy (Wesnes et al., 2009). Eliasson found an identical incidence of UI 12 months postpartum among 665 Swedish primiparous women (Eliasson et al., 2005). In a smaller Danish cohort of 305 primiparous women Viktrup et al found an incidence of stress UI of 7 % 3 months after vaginal delivery (Viktrup et al., 1992).

Mode of delivery affects the incidence estimates, as study populations with high CS rate is likely to report lower incidence of UI postpartum. Prolonged pressure from baby's head and trauma as baby passes through the vaginal canal may affect the pelvic floor and urethral support. These mechanisms are likely to be involved in incident UI postpartum. The reported incidence of UI among primiparous and parous women postpartum varies between 0 – 26 % and 4 – 21 %, respectively (Table 3). The majority of reported incident UI postpartum are in the range of 5 – 21 % among primiparous women, and 8 – 15 % among parous women. No systematic review on incident UI postpartum has been identified. In a review on the association between CS on UI postpartum Nygaard reported the range of incident UI postpartum to be 7 – 15 % among all women (Nygaard, 2006). For women who become incontinent postpartum, not many women achieve spontaneous continence during the first postpartum year (Thom & Rortveit, 2010)

Author, year	Origin	Design	N	Data collection	Time of UI PP	Primi-parous	Parous
(Arya et al., 2001)	USA	Cohort	315	Interv.	3 mth.	10 % (s)	
(Boyles et al., 2009)	USA	Cross-s	5,599	Quest.	6 mth	10 %	
(Burgio et al., 2003)	USA	Cohort	523	Interv.	3 mth		10 %
(Chaliha et al., 1999)	England	Cohort	549	Interv.	3 mth	6 %	
(Dimpfl et al., 1992)	Germany	Cross-s	350	Interv.	3 mth	4 % (s)	4 %
(Eliasson et al., 2005)	Sweden	Cohort	665	Quest.	12 mth	21 %	
(Farrell et al., 2001)	Canada	Cohort	595	Quest.	6 mth	26 %	
(Foldspang et al., 2004)	Denmark	cross-s	1,232	Quest.	> 12 mth		14 %
(Francis, 1960)	England	Cohort	400	Ex., interv.	3 mth	0 %	
(Glazener et al., 2006)	UK, N.Z.	Cross-S	3,405	Quest.	3 mth	15 %	
(Hvidman et al., 2003)	Denmark	Cross-S	642	Quest.	3 mth		8 %
(Iosif, 1981)	Sweden	Cohort	1,411	Quest.	6-12 mth		19 % (s)
(King & Freeman, 1998)	UK	Cohort	103	Ex, interv.	3 mth	4 %	
(Mason et al., 1999)	England	Cohort	717	Quest.	3 mth		15 %
(Morkved & Bo, 1999)	Norway	Cross-S	144	Ex., interv.	2 mth		19 %
(Raza-Khan et al., 2006)	USA	Cohort	113	Quest.	Postpartum		4 %
(Solans-Domenech et al., 2010)	Spain	Cohort	1,128	Quest.	2 mth	5 %	
(Thomason et al., 2007)	USA	Cross-S	121	Ex., interv.	6 mth	16 %	
(Stanton et al., 1980)	UK	Cohort	189	Interv.	Postpartum	6% (s), 9% (u)	11% (s), 7% (u)
(Viktrup et al., 1992)	Denmark	Cohort	305	Interv.	3 mth	7% (s), 4% (u)	
(Wesnes et al., 2009)	Norway	Cohort	12,679	Quest.	6 mth	21 %	
(Wilson et al., 1996)	New Zealand	Cross-S	1,505	Quest.	3 mth	12 %	21 %

Cross-s = cross sectional study, Ex. = examination, Quest. = questionnaire, Interv. = interview, PP = postpartum, (s) = stress UI, (u) = urgency UI, mth = month.

Table 3. Incidence of urinary incontinence postpartum by parity.

3.2 Prevalence of urinary incontinence postpartum

Vaginal delivery is an important and well documented risk factor for UI postpartum, also when compared with cesarean section. If a woman delivers by caesarean section only, a protective effect on UI compared with vaginal delivery is documented 12 years after delivery (MacArthur et al., 2011). The population based cross sectional EPINCONT study found that women aged 50– 64 years who had delivered by cesarean section or vaginal only had similar UI prevalence, suggesting that any protection from caesarean section might be lost with advancing age (Rortveit et al., 2003).

UI after delivery may affect women for the rest of their lives. Several studies have presented data on the long term prognoses of UI postpartum. Farrell found that prevalence of UI did not change from 6 weeks postpartum to 6 months postpartum (Farrell et al., 2001). A six year follow up study concluded that 24 % of the women had persisting UI from 3 months postpartum to 6 years postpartum (MacArthur et al., 2006). A 12 year prospective study indicates that onset of UI in pregnancy or postpartum increased the risk for UI 12 years later (Viktrup et al., 2006). A systematic review found only small changes in prevalence of UI over the first year postpartum (Thom & Rortveit, 2010). As prevalence figures of UI postpartum appear to be stable, time point of data collection postpartum may be of less importance. We will therefore limit our presentation to studies investigating prevalence of UI during the first year postpartum.

A large questionnaire based cross-sectional study of 5,599 primiparous American women investigated prevalence of UI postpartum (Boyles et al., 2009). The prevalence of any UI was 17 % 6 months postpartum. A similar questionnaire based cross-sectional study was performed in Turkey (Ege et al., 2008). One year postpartum 20 % of the parous women had UI. Stress and mixed UI were most common types of UI.

A large cohort study on 2,390 Swedish women recruited in pregnancy assessed stress UI at 2 and 12 months postpartum by questionnaire (Schytt et al., 2004). UI was defined as any UI last week. Data was linked to the Swedish birth registry. The authors found that 18 % of primiparous women and 24 % of multiparous women had stress UI 12 months postpartum. The largest study (by 2011) on UI during pregnancy and postpartum found a prevalence of UI of 31 % among 12,679 primiparous women 6 months postpartum. All the participants were continent before pregnancy (Wesnes et al., 2009).

There is a wide range of reported prevalences of any UI among primiparous women (6 – 67 %) and parous women (3 – 45 %) (Table 4). The majority of the studies report however estimates 15 – 31 % and 18 – 38 % among primiparous and parous women, respectively. This corresponds well with reports from several reviews on UI postpartum. In a review on UI and its precipitating factors postpartum Herbruck reported prevalences of stress UI of 22 – 33 % postpartum among all women (Herbruck, 2008). The ICI epidemiology report presented prevalence of 15 – 30 % among all women the 1. year postpartum (Milsom et al., 2009). In a review Nygaard reported the prevalence of UI postpartum to be 9 – 31 % among all women (Nygaard, 2006). Authors of a systematic review reported a pooled prevalence of UI of 29 % and 33 % 3 months postpartum among primiparous and parous women, respectively (Thom & Rortveit, 2010).

Author, year	Origin	Design	N	Data collection	Time of UI PP	Primi-parous	Parous
(Altman et al., 2006)	Sweden	Cohort	304	Quest.	5 mth	15 % (s)	
(Arrue et al., 2010)	Spain	Cohort	396	Ex., interv.	6 mth	15 %	
(Baydock et al., 2009)	Canada	Cross-S	632	Interv.	4 mth		23 %
(Bo & Backe-Hansen, 2007)	Norway	Cross-S	40	Quest.	6 weeks		29 %(s)
(Boyles et al., 2009)	USA	Cross-S	5,599	Quest.	6 mth	17 %	
(Burgio et al., 2003)	USA	Cohort	523	Interv.	6 mth		11 %
(Chaliha et al., 2002)	England	Cohort	161	Quest., urodyn	3 mth	30 %	
(Chaliha et al., 1999)	England	Cohort	549	Interv-	3 mth	15 %	
(Diez-Itza et al., 2010)	Spain	Cohort	352	Ex., quest.	12 mth	11 % (s)	
(Dimpfl et al., 1992)	Germany	Cross-S	350	Interv.	3 mth	6 % (s)	
(Dolan et al., 2004)	UK	Cohort	492	Quest.	3 mth	13 %	
(Eason et al., 2004)	Canada	Cohort	949	Quest.	3 mth		31 %
(Ege et al., 2008)	Turkey	Cross-S	1,749	Quest.	12 mth		20 %
(Ekstrom et al., 2008)	Sweden	Cohort	389	Quest.	3 mth	13% (s), 4% (u)	
(Eliasson et al., 2005)	Sweden	Cohort	665	Quest.	12 mth	49 %	
(Ewings et al., 2005)	England	Cohort	723	Quest.	6 mth		45 %
(Farrell et al., 2001)	Canada	Cohort	595	Quest.	6 mth	26 %	
(Foldspang et al., 2004).	Denmark	Cross-S	1,232	Quest.	> 12 mth	26 %	
(Francis, 1960)	England	Cohort	400	Ex, interv.	3 mth	24 %	29 % (s)
(Glazener et al., 2006)	UK, N.Z.	Cross-S	3,405	Quest.	3 mth	29 %	
(Hatem et al., 2005)	Canada	Cross-S	2,492	Quest	6 mth	30 %	
(Hvidman et al., 2003)	Denmark	Cross-S	642	Quest.	3 mth		3 %
(Jundt et al, 2010)	Germany	Cohort	112	Quest, ex.	6 mth	21 %	
(Iosif, 1981)	Sweden	Cohort	1,411	Quest.	6-12 mth		22 % (s)
(King & Freeman, 1998)	UK	Cohort	103	Ex, interv.	3 mth	22 %	
(Mason et al., 1999)	England	Cohort	717	Quest.	3 mth	10 % (s)	31 % (s)
(Morkved & Bo, 1999)	Norway	Cross-S	144	Ex., interv.	2 mth		38 %
(Pregazzi et al., 2002)	Italy	Cross-S	537	Ex., interv.	3 mth	8 %	20 %
(Raza-Khan et al., 2006)	USA	Cohort	113	Quest.	Postpartum	46 %	43 %
(Sampselle et al., 1996)	USA	Cohort	59	Quest., ex.	6 mth	67 % (s)	
(Schytt et al., 2004)	Sweden	Cohort	2,390	Quest.	12 mth	18 % (s)	24 % (s)
(Serati et al., 2008)	Italy	Cohort	336	Interv.	6/12 mth		27/23 %
(Stanton et al., 1980)	UK	Cohort	189	Interv.	3 mth	6 % (s), 8% (u)	
(Thomason et al., 2007)	USA	Cross-S	121	Ex., interv.	6 mth	45 %	
[Thompson 2002]	Australia	Cohort	1,295	Quest.	6 mth		18 %
(Torrisi et al., 2007)	Italy	Cohort	562	Ex., interv.	3 mth		11 % (s)
(Viktrup et al., 1992)	Denmark	Cohort	305	Interv.	3 mth	7 % (s)	
(Wesnes et al., 2009)	Norway	Cohort	12,679	Quest.	6 mth	31 %	
(Wijma et al., 2003)	Netherland	Cohort	117	Quest., ex.	6 mth	15 %	
(Wilson et al., 1996)	N.Z	Cross-S	1,505	Quest.	3 mth	29 %	34 %
(Yang et al, 2010)	China	cross-s	1,889	Quest.	6 mth	10 %	

cross-s = cross sectional study, Ex. = examination, PP = postpartum, (s) = stress UI, (u) = urgency UI, Urodyn = urodynamic testing, mth = months

Table 4. Prevalence of urinary incontinence postpartum by parity.

4. Why do estimates differ?

A wide range of prevalence estimates of UI in pregnancy and postpartum have been presented. There are several methodological reasons for these diverging incidence and prevalence estimates.

4.1 UI definition

The concept of UI can be based on:

- **symptoms** (a morbid phenomenon or departure from the normal in structure, function, or sensation, experienced by the woman and indicative of disease or a health problem) (Abrams et al., 1988, Abrams et al., 2002, Haylen et al., 2010)
- **signs** (observed by the physician to verify symptoms and quantify them) (Abrams et al., 1988, Abrams et al., 2002, Haylen et al., 2010)
- - **urodynamic findings** (observations made during urodynamic studies) (Abrams et al., 2002)
- **conditions** (the presence of urodynamic observations associated with characteristic symptoms or signs and/or non-urodynamic evidence of relevant pathological processes) (Abrams et al., 2002)

The ICS definitions and terminologies of UI according to the above descriptions have been revised several times (Abrams et al., 1988, Abrams et al., 2002, Haylen et al., 2010). The current definition of UI symptoms is "Complaint of involuntary loss of urine" (Haylen et al., 2010). In the 2002 definition, UI symptoms were not enough to set the UI diagnose; UI signs were needed. Today the majority of studies on UI define UI according to UI symptoms. Studies on UI have used the definitions at the time. As definitions change, prevalence estimates will also change.

4.2 Information gathering

Information on UI in pregnancy and postpartum is often gathered through questionnaires, but objective testing (Morkved & Bo, 1999), personal structured interviews (Chiarelli & Campbell, 1997, Morkved & Bo, 1999) or semi structured interviews (Farrell et al., 2001, Spellacy, 2001) or phone interviews (Baydock et al., 2009) by doctors or assistants, or reviews of existing medical records (Spellacy, 2001) are also used. Information collected by interview makes it possible to clarify and gather more and better information regarding UI. Thom found higher prevalence figures of UI when data was gathered by structured interview compared to questionnaire (Chiarelli & Campbell, 1997, Thom, 1998). Medical records often lack important information, leading to low prevalence estimates. Studies have found low agreement between self reported UI and clinical assessment (Diokno et al., 1988, Milsom et al., 1993). A review on variations in estimates of UI found that objective testing according to the "UI sign" definition led to lower prevalence estimates than questionnaire based studies using the "UI symptom" definition (Thom, 1998).

4.3 Type of study

A large proportion of studies on UI in pregnancy or postpartum are cross sectional (Table 1 – 4) or retrospective. If a woman has UI when answering a retrospective study, this may

affect her reporting of UI by improving her memory about earlier UI leading to a recall bias. Cross sectional studies have less valid incidence figures than prospective cohorts. Cross-sectional studies can gather information about the prevalence of UI, but they cannot distinguish between incident and long-established UI. Therefore, cross-sectional studies can usually only measure prevalence of UI. Also, they cannot identify cause-and-effect relationships as exposure and outcome information are gathered at the same time.

4.4 Timing of data collection

Timing of data collection can affect prevalence estimates of UI in pregnancy. Some studies question women about UI during each trimester, but most studies question women at one certain time point in pregnancy (Brown et al., 2010, Lewicky-Gaupp et al., 2008) or just after birth (Sottner et al., 2006). Some studies do not report what time in pregnancy the women reported UI (Sharma et al., 2009). As prevalence of UI increases in pregnancy, the time of information gathering will affect the prevalence estimates of UI during pregnancy. When it comes to data collection postpartum, some studies report on UI at 6 - 9 weeks postpartum (D'Alfonso et al., 2006, Lewicky-Gaupp et al., 2008, Meyer et al., 1998), 3 months (Eason et al., 2004, Hannah et al., 2002), 4 months (Baydock et al., 2009), 6 months (Thomason et al., 2007), 12 months (Serati et al., 2008) or > 12 months (Foldspang et al., 2004, Fritel et al., 2004) postpartum. The time of information gathering postpartum might affect incidence and prevalence estimates of UI. However, a recent review indicates that prevalence of UI is stable first year postpartum (Thom & Rortveit, 2010), and time of data collection postpartum may therefore be of less importance.

4.5 Threshold

Permanence, frequency and volume are used by authors as threshold to define women with UI in association with pregnancy. Permanence or duration can be defined as one or more episodes of UI in the previous month (Brown et al., 2010, Wilson et al., 1996). Some authors use longer periods, like trimesters (Schytt et al., 2004) or the 6 months postpartum period (Schytt et al., 2004). Some authors investigate severe UI defined by weekly or daily leakage (Al-Mehaisen et al., 2009) while others do not report any cut-off (van Brummen et al., 2006). Prevalence estimates are lower for daily UI compared to weekly or monthly UI (Thom, 1998). Some studies have a cut-off for minimum frequency, amount or severity of UI for women to be included in the study as incontinent. A high cut-off decreases the number of women who fulfil the UI criteria in a study. Differing thresholds may explain differing incidence and prevalence estimates of UI.

4.6 Type of UI

Stress UI predominates in young women. Stress UI is more common in pregnancy and postpartum than urgency UI and mixed UI. Also, the incidence of pure urgency UI in pregnancy or postpartum is low compared with incidence of stress UI and mixed UI. The prevalence of pure stress UI is reported to be 2 – 8 times higher than the prevalence of pure urgency UI in pregnancy (Brown et al., 2010, Goldberg et al., 2005, Raza-Khan et al., 2006). Prevalence of mixed UI is reported to be 0.3 – 1.5 times of the prevalence of pure stress UI in pregnancy (Brown et al., 2010, Goldberg et al., 2005, Raza-Khan et al., 2006). The

stress/urgency ratio is reduced postpartum as prevalence of stress UI decline. Several studies focus solely on stress UI (Mason et al., 1999, Torrisi et al., 2007, Viktrup et al., 1992). Prevalence figures in these studies are likely to be lower than in studies that include both urgency UI and mixed UI in their analyses (Thom, 1998).

4.7 Characteristics of study population

The study population influences prevalence of UI. Some studies on UI in association with pregnancy use study populations from tertiary care hospitals (Baydock et al., 2009, Raza-Khan et al., 2006), leading to recruitment of highly selected participants. BMI distribution, age distribution, parity distribution, proportion of European or Hispanic population, proportion of women having vaginal delivery all influence prevalence figures of UI. Mothers BMI and age at first delivery have risen the 50 years. These demographic variables might partly explain why studies from 1970-1980 tend to report lower UI estimates compared to recent studies. Some studies include only women having SVD (Altman et al., 2006, Arrue et al., 2010, Baydock et al., 2009), which will give a higher prevalence estimate of UI than if the study also had included CS. Many studies on UI in association with pregnancy either adjust or report stratified analyses for age (Solans-Domenech et al., 2010), BMI (Eason et al., 2004), race (Connolly et al., 2007) and mode of delivery (Eason et al., 2004). Effect estimates are thereby controlled for baseline imbalances in these important patient characteristics. However, dissimilar use of statistical stratification and adjustment makes it difficult to compare findings. Pooled prevalences figures can be misleading and readers should be careful in generalising the findings to a population outside the study population.

4.8 Bias

Many studies on UI in pregnancy try to gather information from all pregnant women in the community; so called population based studies (Boyles et al., 2009, Thompson et al., 2002). Participation rates for epidemiologic studies have been declining during the decades with even steeper declines in recent years (Galea and Tracy, 2007). Several large surveillance surveys in USA report overall decrease in participation rates well below 50 %. Population based studies on UI in association with pregnancy are challenged with the same problems. Boyles reported a response rate of 39 % (Boyles et al., 2009), Wesnes of 45 % (Wesnes et al., 2007). These studies are prone to a biased response rates/selection bias which may invalidate the prevalence estimates. Nulliparous women are more likely to participate and tell their pregnancy stories in studies compared with parous women (Magnus et al., 2006). Declining participation rates and the growing complexity of reasons for study nonparticipation add unpredictability about who is participating in a study and who is not. It challenges the ability of these studies to confidently obtain a population-representative sample (Galea and Tracy, 2007).

Known differences between responders and non-responders may be compensated during analyses. The major problem is unknown response bias, such as the possibility of different response rates between continent and incontinent women (Cartwright, 1983). Due to embarrassment and feeling uncomfortable about reporting UI, incontinent women may deny or not answer questions about UI. Conversely, incontinent women may find the subject particularly relevant, and therefore respond to a greater extent than continent women. At present, we do not know how these factors may affect the response rates. To minimize selection bias one should always aim at the highest possible response rates.

4.9 Questionnaire

It is essential to research on UI that incidence and prevalence estimates can be properly assessed and recorded. As clinicians objective testing and patients' symptoms often differ in their perspective of UI (Milsom et al, 2009), the use of questionnaires to approach patients symptoms are more used recent years. There are an increasing number of questionnaires to assess UI. The Symptom and Quality of Life Committee of the International Consultation on Incontinence performed a systematic review of questionnaires related to urinary incontinence (Avery et al, 2007). They identified 17 questionnaires on UI in women (assessing symptoms, quality of life or both) that were highly recommended; that is questionnaires that were seen as an established measure with documented, rigorous validity, reliability and responsiveness in several clinical studies. However, only 38 % of all clinical trials use these questionnaires (Avery et al, 2007). The proportion in descriptive studies using robust validated questionnaires is likely to be even lower. Some of the variability in UI incidence and prevalence estimates is likely to be related to the range of different questionnaires used.

All the above methodological factors can influence UI estimates in a study. Unfortunately we do not know all factors that influence UI estimates. Some variation in prevalence estimates between studies will always remain.

5. Conclusion

Reported incidence and prevalence estimates in pregnancy and postpartum vary (Table 5). Incidence of UI is high during pregnancy. Close to 50 % of all women experience UI during pregnancy. Delivery is one of many factors that lead to a high incidence of UI postpartum. About 1/3 women experience UI postpartum. This is the first review trying to summarize the UI estimates in association with pregnancy.

Time point	Source of data	Primiparous	Parous
Incidence in pregnancy	Range Table 1	11 – 50 %	8 – 57 %
	Narrow range Table 1	17 – 45 %	45 – 54 %
Prevalence in pregnancy	Range Table 2	4 – 70 %	14 – 85 %
	Narrow range Table 2	35 – 55 %	24 – 67 %
	Report (Milsom et al., 2009)		32 – 64 %
Incidence postpartum	Range Table 3	0 – 26 %	4 – 21 %
	Narrow range Table 3	5 – 21 %	8 – 15 %
	Review (Nygaard, 2006)		7 – 15 %
Prevalence postpartum	Range Table 4	6 – 67 %	3 – 45 %
	Narrow range Table 4	15 – 45 %	18 – 38 %
	Report (Milsom et al., 2009)		15 – 30 %
	Review (Nygaard, 2006)		9 – 31 %
	Systematic review (Thom & Rortveit, 2010)	29 %	33 %

Table 5. Range of incidence and prevalence estimates for any UI by parity.

Many factors contribute to the wide range of incidence and prevalence estimates. The different use of definitions, type of study, methods of data collection, time point of information gathering information gathering, threshold used to define UI, UI type, study population, questionnaire and selection bias are some of the factors that may explain the wide range of estimates.

There is need for systematic reviews giving pooled estimates, preferably for subsets defined by parity, type of delivery and type of incontinence. Future studies ought to follow reporting guidelines for observational studies, like the Strobe criteria (von Elm et al, 2007), as poor reporting hinders the assessment of the strengths and weaknesses of a study and the generalizability of its results.

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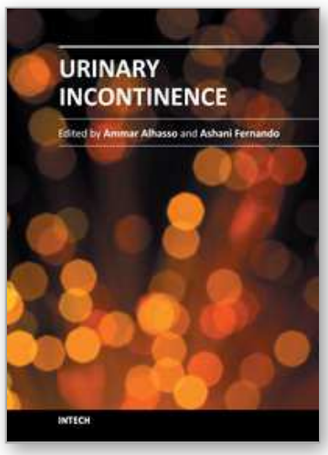

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Management strategies are framed within a multidisciplinary team structure and as such a range of specialists ranging from psychologists, specialist nurses, gynaecologists and urologists author the chapters. There are some novel methods outlined by the authors with their clinical application and utility described in detail, along with exhaustive research on epidemiology, which is particularly relevant in planning for the future.

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