



Constipation and risk of urinary incontinence in women: a meta-analysis

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Abstract

Introduction and hypothesis Constipation is reported to be associated with urinary incontinence. However, the reported results have been inconsistent and contradictory. To evaluate the association between constipation and urinary incontinence in women, we performed a meta-analysis.

Methods A comprehensive search based on PubMed, EMBASE, and the Cochrane Library was performed up to July 2018 for eligible studies in relation to the influence of constipation on urinary incontinence in women. A random-effect model was used to calculate the pooled odds risk (OR) and corresponding 95% confidence interval (CI).

Results A total of 16 observational studies with 35,629 participants and 6054 urinary incontinence patients were identified in the meta-analysis. Constipation was significantly associated with the risk of urinary incontinence in women (OR 2.46, 95% CI 1.79–3.38).

Conclusions This meta-analysis suggests that constipation is significantly associated with urinary incontinence risk in women. However, further well-designed, large-scale prospective studies are needed to clarify the causality.

Keywords Constipation · Urinary incontinence · Meta-analysis

Introduction

Urinary incontinence (UI), defined as any involuntary loss of urine by the International Continence Society, is a common and costly problem affecting quality of life and overall health [1]. The three main types of UI include stress urinary incontinence, urgency urinary incontinence, and mixed urinary incontinence [2]. In 2008, an estimated 8.2% of the worldwide population (348 million) was affected by UI. The prevalence will increase to 8.5% by 2018 [3]. Nevertheless, these figures may well be an underestimate, as this problem remains a taboo subject for many patients because of a shame feeling or lack of information. Several factors may contribute to UI including age, multiparity, obesity, chronic disease, history of pelvic

surgery, and cigarette smoking [4–6]. Many of them are modifiable. Constipation is also a modifiable factor potentially affecting the risk of UI [7–9].

Constipation is a symptom-based gastrointestinal disorder affecting individuals of all ages, with a prevalence between 2% and 27% worldwide [10]. Gender-wise comparisons show that women suffer from constipation more often than men, with an estimated 5% of males and 15% of females being affected [11]. Recently, several epidemiologic researchers have tried to find the relationship between constipation and risk of UI in women [12–27]. However, the results have been inconsistent. Therefore, to evaluate the relationship between them, we conducted a meta-analysis based on the current literature.

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Materials and methods

Search strategy

We performed this meta-analysis in accordance with the PRISMA [28] and MOOSE guidelines [29]. We identified the literature from the PubMed, EMBASE, and Cochrane

Library databases up until July 2018 using the following search queries: constipation AND urinary incontinence. The relevant reference lists of all the retrieved articles were also screened to find additional applicable studies.

Inclusion and exclusion criteria

All included studies had to meet the inclusion criteria: (1) evaluate the relationship between constipation and UI risk; (2) use a cross-sectional, case-control, or cohort study design; (3) provide odds ratios (ORs) and 95% confidence intervals (CIs), or enough data to calculate them; (4) the patients were female. If multiple reports describing the overlapping population were published, only the most recent or complete one was used. Case reports, reviews, commentaries, editorials, and conference abstracts were excluded.

Data extraction and quality assessment

The following data were extracted independently from each eligible study by two of the authors (Wen-Qing Lian and Fa-Jiang Li): name of the first author, year of publication, country of origin, study design, ages of the participants, study period, sample size, and study quality. If more than one estimate was provided, we chose the one adjusted for the most variables. The methodologic quality of the included studies was assessed according to the nine-star Newcastle-Ottawa Scale (NOS) [30]. A high-quality study was considered one with a NOS score of 7–9 stars, and a score of 5–6 stars was regarded as moderate quality. Any disagreement was resolved by discussion.

Statistical analysis

We used the OR and its 95% CI to assess the relationship between constipation and the risk of UI. When risk estimates were reported separately for subgroups according to UI type, we combined the results using an inverse-variance method. The Cochrane's Q test and I^2 statistic were used to measure the statistical heterogeneity across studies. When $P > 0.1$ and $I^2 < 50\%$, the heterogeneity was considered acceptable, and a fixed-effects model was used. If $P < 0.1$, heterogeneity was considered significant, and a random-effects model was used. We also performed subgroup analyses to detect the potential sources of heterogeneity based on study design, geographic region, and sample size. Sensitivity analyses were conducted to evaluate whether the final effect was strongly influenced by individual studies when significant heterogeneity was found. Begg's funnel plots were used to detect potential publication bias, together with Begg's and Egger's tests [31, 32]. All tests with p value < 0.05 were regarded as statistically significant except Cochrane's Q test. Meta-analyses were conducted

using STATA version 12.0 software (Stata Corp, College Station, TX).

Results

Literature search

We found 5396 potentially relevant reports from electronic databases by the search strategy (Fig. 1). After excluding 5362 studies based on title and abstract reading, we reviewed the full texts of the remaining 34 potentially pertinent articles. Finally, a total of 16 observational studies [12–27] were included.

Study characteristics

Table 1 shows the main characteristics of the 16 included studies. Among them, 11 were cross-sectional studies [12, 15–19, 22–24, 26, 27], 4 were case-control studies [13, 14, 20, 25], and 1 was a cohort study [21]. These studies were published between 2005 and 2018. The sample size ranged from 48 to 1384, comprising 35,629 participants and 6054 UI cases. As to geographic location, ten studies were conducted in Asia [12, 14–18, 22, 23, 26, 27], three in Europe [13, 19, 21], two in South America [20, 25], and one in Africa [24]. In the NOS, the score ranged from 6 to 8 stars (moderate-high quality).

Meta-analysis results

Meta-analysis of the 16 included studies indicated that constipation was significantly associated with risk of UI under the random-effects model (OR 2.46, 95% CI 1.79–3.38, $Q = 148.61$, $P_{\text{heterogeneity}} < 0.001$, $I^2 = 89.9\%$) (Fig. 2). Subgroup analysis was performed by study design, geographic location, and sample size (< 500 and ≥ 500) (Table 2). The results

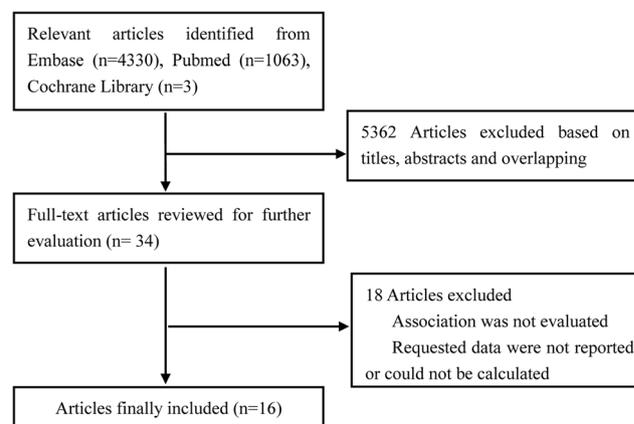


Fig. 1 Flowchart of literature search and study selection

Table 1 Characteristics of the studies included in the meta-analysis

Authors	Year	Country	Study design	Period	Age, years	Cases	Subjects	Quality
Barbosa L [25]	2018	Brazil	CC	2014–2016	10–19	329	658	8
Biswas B [23]	2017	India	CS	2016–2017	≥50	49	177	8
Dinç A [22]	2017	Turkey	CS	2013	17–42	300	750	8
Lu S [17]	2016	China	CS	2014	40–65	397	1067	8
Linde JM [19]	2016	Netherlands	CS	NR	18–85	332	678	7
Leroy Lda S [20]	2016	Brazil	CC	NR	13–45	77	344	7
Bekele A [24]	2016	Ethiopia	CS	2014	16–40	48	422	8
Liu B [18]	2014	China	CS	2010–2012	≥20	1266	5433	8
Prabhu SA [16]	2013	India	CS	2010–2011	≥20	90	353	8
Ahmed HM [27]	2013	Iraq	CS	2011	28–85	572	1107	8
Al-Badr A [26]	2012	Saudi Arabia	CS	2008	≥15	157	379	8
Zhu L [12]	2010	China	CS	NR	20–99	495	19,024	7
Torkestani F [14]	2009	Iran	CC	NR	40.03/33.2 ^a	125	250	6
Sobhgoal SS [15]	2008	Iran	CS	NR	15–49	182	330	6
van Gerwen M [13]	2007	Netherlands	CC	2001	≥25	1384	4105	6
Ewings P [21]	2005	UK	Cohort	2001–2002	NR	251	552	7

Abbreviations: CC case-control, CS cross-sectional, NR not reported

^a The mean age of cases and controls

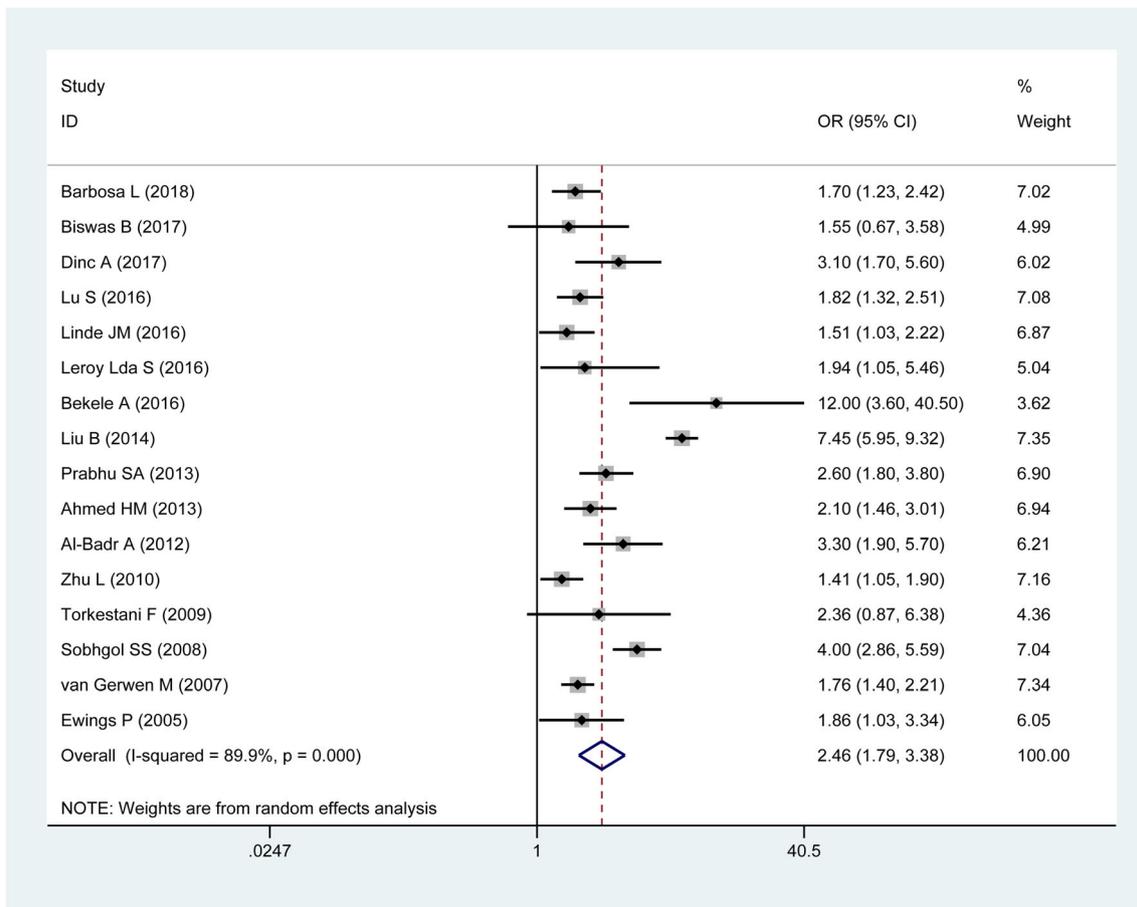


Fig. 2 Forest plot for constipation and risk of urinary incontinence

Table 2 Overall and subgroup analyses of the association between constipation and the risk of urinary incontinence

Subgroup	Studies, <i>n</i>	OR (95% CI)	Study heterogeneity			
			<i>Q</i>	<i>P</i>	<i>I</i> ² , %	
Overall	16	2.46 (1.79–3.38)	148.61	< 0.001	89.9	
Study design	Cross-sectional study	11	2.77 (1.82–4.22)	124.28	< 0.001	92
	Case-control study	4	1.77(1.47–2.12)	0.42	0.936	0
	Cohort study	1	1.86 (1.03–3.35)	–	–	–
Geographic region	Asia	10	2.67(1.74–4.10)	106.84	< 0.001	91.6
	Europe	3	1.71(1.42–2.06)	0.54	0.762	0
	South America	2	1.73 (1.27–2.37)	0.08	0.7711	0
	Africa	1	12 (3.58–40.25)	–	–	–
Sample size	< 500	7	3 (2.16–4.19)	12.09	0.006	50.4
	≥ 500	9	2.17 (1.39–3.38)	131.74	< 0.001	93.9

showed constipation was significantly associated with risk of UI regardless of the effect on the estimates by study design, geographic location, and sample size.

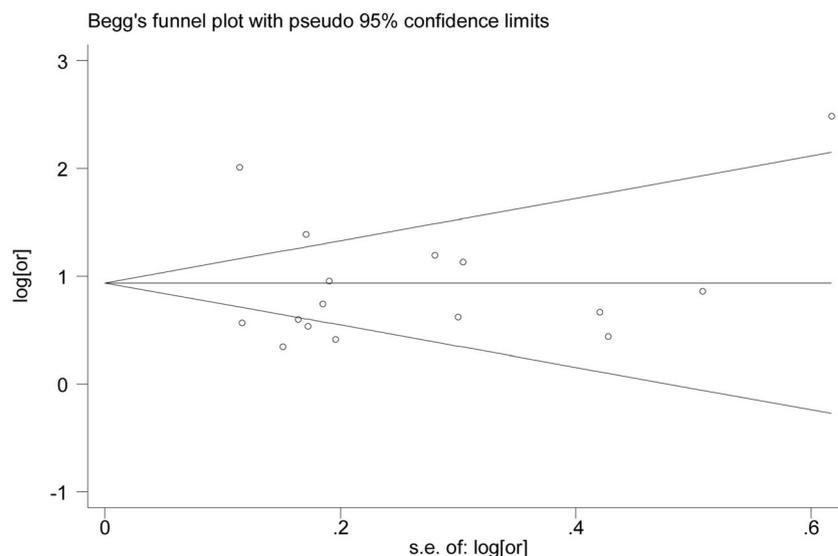
Sensitivity analysis

Because of the significant heterogeneity across the included studies, we performed a sensitivity analysis. We excluded each single study in turn and conducted repeated meta-analyses. The overall combined ORs did not materially change, indicating that our conclusion was robust.

Publication bias

Begg's funnel plots did not suggest obvious asymmetry (Fig. 3), and Begg's and Egger's test results showed no publication bias exists ($P_{\text{Begg's}} = 0.260$, $P_{\text{Egger's}} = 0.691$).

Fig. 3 Begg's funnel plot of constipation and urinary incontinence risk



Discussion

To our knowledge, the present meta-analysis was the first to explore the relationship between constipation and UI risk in women. Sixteen observational studies were identified in this meta-analysis, including 35,629 participants and 6054 UI patients. The results demonstrated that constipation was significantly associated with risk of UI. Although substantial heterogeneity was detected across the included studies, all the results of subgroup analyses were consistent with the overall findings. Furthermore, sensitivity analysis showed the robustness of our conclusion.

In subgroup analyses, we first explored the association between constipation and UI by study design. However, the results of the cross-sectional study can only support the potential association between constipation and UI but not their causal relationship. Whether constipation increases the risk of UI or UI has an effect on constipation is unclear. In the present meta-analysis, four case-control studies were included, and

subgroup analysis revealed that constipation was significantly associated with UI risk. There was little evidence of heterogeneity, indicating that the results of the case-control studies were homogeneous. We then conducted subgroup analyses to ascertain the impact of differences in study design, geographic location, and sample size. However, the results did not materially change. In addition, several potential confounding factors such as parity, BMI, chronic disease, smoking, and water intake might influence the association between constipation and UI. Although multivariate logistic regression analysis was used to control for numerous confounding factors in individual studies, adjusted confounding factors varied among different studies. We were not able to analyze the effect of each confounding factor on the conclusion because of the absence of sufficient information.

Several clinical studies supported the association between a history of constipation and the development of UI symptoms. Barbosa et al. reported that constipated pregnant adolescents were 1.7-fold more likely to have UI than those not constipated [25]. A prospective cohort study by Charach et al. showed that medical relief of constipation significantly improved lower urinary tract symptoms and urinary residue in the elderly [33]. Maeda et al. found that functional constipation was related to overactive bladder with UI in female patients [7]. According to EAU guidelines, adults with UI who also suffer from constipation are strongly recommended for bowel management in line with good medical practice [34]. This meta-analysis provides evidence that constipation was significantly associated with risk of UI, which reminds urologists that they should realize this association and provide appropriate treatments to improve constipation symptoms when treating women with UI.

The potential biological mechanism of the association between constipation and UI remains to be clarified. However, several proposed explanations were reasonable. The rectum and bladder are in anatomical proximity, and they share a common embryological origin in the cloaca. A dysfunction in either organ may influence the function of the other one [35, 36]. Furthermore, the motor neurons responsible for their innervation both arise from the existing pelvic parasympathetic nerve endings in S2 and S4 [9]. External anal sphincters and external urethral sphincters also have common signal crosstalk through overlapping pudendal neural pathways [37]. Constipation may lead to contraction of the urethral sphincter and reflexively restricts spontaneous bladder distention, which worsens irritative bladder symptoms [38–40]. In addition, chronic constipation may increase the force on the pelvic support structures, which increases the risk of having pelvic organ prolapse and UI [41, 42].

The present meta-analysis had some limitations. First, substantial heterogeneity existed across the studies, even though we conducted a random effect model to alleviate them to some extent. Second, most of the included studies had an

observational design, which could lead to biased results. Third, most studies were based on self-reported symptoms of UI and constipation, which could distort the findings. Finally, we were not able to analyze the effect of constipation on each type and the severity of UI in the absence of sufficient information.

Conclusions

Our analysis suggests constipation is significantly associated with UI risk in women. The approach to improving constipation symptoms should be considered when treating women with UI. However, further well-designed, large-scale prospective studies are needed to clarify the causality. The mechanisms responsible for this association also need to be elucidated.

Compliance with ethical standards

Conflicts of interest None.

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