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REVIEW ARTICLE

Prevalence of female urinary incontinence in the developing world: A systematic review and meta-analysis—A Report from the Developing World Committee of the International Continence Society and Iranian Research Center for Evidence Based Medicine

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Abstract

Aims: The prevalence of urinary incontinence (UI) in the developing world varies widely. Factors influencing prevalence rates are a key area of interest, and knowledge of these would provide appropriate planning for preventive primary and secondary health care programs. The objective of this report was to synthesize the best available evidence to determine UI prevalence rates in adult women in a population setting.

Methods: A comprehensive search strategy was employed to find published and unpublished studies. Databases searched included PubMed, Embase, Scopus, Web of Science, and Google Scholar. We used the standardized Joanna Briggs Institute Meta-Analysis of Statistics, Assessment, and Review Instrument to appraise the included studies.

Results: In total, 54 studies with 138,722 women aged 10 to 90 years were included in this meta-analysis. Prevalence of UI ranged from 2.8% in Nigeria to 57.7% in Iran. The total prevalence of UI was 25.7% (95% CI: 22.3-29.5) and the prevalence rates for stress, urgency, and mixed UI were 12.6% (95% CI: 10.3-15.4), 5.3% (95% CI: 3.4-8.3), and 9.1% (95% CI: 7.0-11.8), respectively. When we excluded the elderly population, UI prevalence only slightly changed (26.2%; 95% CI: 22.6-30.2). Prevalence rates varied considerably during different recall periods, ranging from 15.6% for UI during the last 12 months to 41.2% for UI during the last 3 months. However, the study quality and use of validated vs nonvalidated questionnaires only had a minor impact on the prevalence rates.

Conclusions: The prevalence, methodology, and definition of UI vary widely. A large-scale multinational study with a homogeneous methodology is

necessary to correctly calculate and compare the prevalence rates to improve health policies in the developing world.

KEYWORDS
developing countries, prevalence, urinary incontinence

1 | INTRODUCTION

Urinary incontinence (UI) is a global medical problem observed in all age groups in different countries, cultures, and ethnicities.[1-3] The International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction defined UI as a "complaint of loss of urine."[4] UI is a clinical condition[5] and not a disease itself.[6] UI is often underestimated and underdiagnosed in both the developed and developing world.[7] UI is more common in older women[2] and can affect up to 58% to 84% of the elderly population.[5] However, its general prevalence is reported to be approximately 34% in elderly women and 22% in elderly men.[8] A British survey showed that the prevalence of female UI may only be approximately 14%.[9] The prevalence rates vary in different countries because of the utilization of various definitions of UI, target populations, study characteristics, assessment tools, response rates, age groups, gender, availability of health care, and other factors.[10,11]

There are many definitions and assessment tools for the diagnosis of UI. This variety limits the establishment of UI prevalence rates and definition of the problem. Many women consider UI as an inevitable part of their life which can delay or even prevent the diagnosis.[12] Milsom et al[13] stated that (a) most of the people with UI do not seek help, (b) only a small portion of this population receive medication or surgery, and (c) the worldwide estimation of UI is limited due to the lack of epidemiological data from the underrepresented research populations. These statements apply especially for women living in developing countries. Parameters with an influence on the (change of) symptomatology are a key area of interest, and knowledge of these factors can be useful for primary prevention or prevention of deterioration of the condition. The association of UI with other diseases, socioeconomic status, ethnicity, and lifestyle has only been examined in a few studies.[6,14]

UI is associated with a number of psychological issues such as anxiety, embarrassment, fear, loss of self-esteem, worry, vulnerability, shame, depression, paranoia, and uncleanliness.[15] UI has been declared as a global medical problem with a considerable impact on health care systems.[15,16] Several studies have been conducted to determine the effect of UI on quality of life.[17,18]

Recent studies demonstrated that UI is also a predictor of death.[19-22] When compared to continent patients, UI is associated with increased mortality with a pooled nonadjusted hazard ratio of 2.22 (95% CI: 1.77-2.78). The mortality risk increases with UI severity: 1.24 (95% CI: 0.79-1.97) for light, 1.71 (95%CI: 1.26-2.31) for moderate, and 2.72 (95% CI: 1.90-3.87) for severe UI.[23] Therefore, health systems should be able to predict the burden and mortality of the condition in different populations to improve continence programs.

1.1 | Aim of the review

Based on our initial literature search, no systematic review or meta-analysis on UI in the developing world has been published so far. Our review aims to identify studies on UI in the developing world, calculate the total prevalence, the prevalence rates of SUI, UUI, and MUI, and define parameters that could influence UI prevalence rates (eg, study quality, recall periods, different questionnaires, and geographical regions).

2 | MATERIAL AND METHODS

The title of our analysis has been registered in http://joannabriggs.org/research/registered titles.aspx

2.1 | Review questions

Primary outcome measure was the UI prevalence rate in adult women living in developing countries, as published in population-based studies. The definition of developing countries followed the recommendations of the World Bank for low- or middle-income countries.[24] Secondary outcome measures were the establishment of prevalence rates of UI subtypes and determination of their associated risk factors.

2.2 | Inclusion criteria

- Participants: the quantitative component of this review only considered studies that included adult women

who live in developing countries. Only population-based studies were included.
- Outcomes: this review considered all related studies that included the following outcome measures: pooled prevalence and prevalence rates for different types of UI (including SUI, UUI, and MUI).
- Types of studies: the quantitative component of the review considered epidemiological study designs including prospective and retrospective cohort studies, case-control studies and analytical cross-sectional studies. The quantitative component of the review also considered descriptive epidemiological study designs, including descriptive cross-sectional studies.

2.3 | Search strategy

The search strategy aimed to identify both published and unpublished studies. A three-step search strategy was utilized in this review. Initially, a limited search of the PubMed/Medline and CINAHL databases was undertaken, followed by the analysis of the text identifying words used in the title and abstract, and of the index terms used to describe the article. A second search using all identified keywords and index terms was then undertaken across all included databases (see list below). Afterwards, the reference list of all identified reports and articles was searched for additional studies. Studies published in any language were considered suitable for this systematic review.

2.4 | Databases

- Stage 1: PubMed/Medline, CINAHL, Virginia Henderson Library.
- Stage 2: Medline, CINAHL, Academic Search Premiere, Web of Science, DARE, PsyINFO, and ERIC.
- Grey Literature: Virginia Henderson Library, MEDNAR (which includes Google Scholar), New York Academy of Medicine Grey Literature Report, scirus.com, and Proquest Dissertations. Others resources were professional organizations relevant to the review objective to search for reports, guidelines, or unpublished research.

Initial keywords were "urinary incontinence" and "prevalence" (Supporting Information **Appendix 1**).

2.5 | Assessment of methodological quality

Publications with quantitative data were selected by two independent reviewers (HM and SH) for assessment of the methodological validity before inclusion in the review using the Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI)[25] (Supporting Information **Appendix 2**). Disagreements between the reviewers were resolved by discussion or a third reviewer (HSP). Selected studies were categorized into three quality groups based on the score of each study. A total score of greater than 80% was defined as high quality, a score between 60% and 80% as medium quality and a score less than 60% as low quality.

2.6 | Data collection

Quantitative data extracted from papers used the standardized data extraction tool from JBI-MAStARI (Supporting Information **Appendix 3**). Extracted data included specific details about the study populations, methods, and outcomes of interest for the review question and other specific objectives.

2.7 | Data synthesis

Quantitative papers, whenever possible, were pooled in the statistical meta-analysis by using the JBI-MAStARI and Comprehensive Meta-Analysis (CMA) software (version 2.2; Biostat, Englewood, NJ). All results were subject to double data entry. Weighted mean differences (for continuous data) and their 95% confidence intervals (95% CI) were calculated for the analyses. Heterogeneity was assessed statistically by using the standard χ^2 test and also explored by using subgroup analysis based on the different quantitative study designs included in this review. Where statistical pooling was not possible, findings were presented in a narrative form, including tables and figures.

2.8 | Assessment of heterogeneity

Both fixed method and random effects models were used. Statistical heterogeneity was assessed by using the I^2 value and the result of the χ^2 test. Results of the appropriate model are presented as forest plots.

3 | RESULTS

3.1 | Selection of studies

We initially identified a total of 3225 studies. We then removed duplicate articles (n = 38) and screened the title as well as abstract of the remaining studies (n = 3187). Articles

unrelated to UI were excluded, for example fecal incontinence. Studies related to other urinary problems, for example overactive bladder, urinary tract infections or male incontinence, and studies in developed countries were also excluded. Of the initially selected titles and abstracts, 2982 had to be excluded and, finally, 205 articles were retrieved for the detailed full-text review. Of these, 151 articles were excluded because they did not meet the inclusion criteria, for example prevalence studies in pregnant women. Finally, a total of 54 studies were included in the systematic review.[2,6,8,9,23,26-71] All studies underwent methodological quality assessment. The summary of search results and study selection is shown in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) diagram (Figure 1). Although all studies were included in the meta-analysis, five studies only reported about the prevalence rates for UI subtypes but not about the total prevalence rate.[8,54,63,66,67] Therefore, not all of the 54 selected studies appeared in the forest plots for all subgroup analyses.

3.2 | Assessment of the methodological quality

All articles were selected for quality synthesis (Table 1). The JBI checklist for critical appraisal of systematic reviews was used for this purpose.[25] No article had to be excluded because of the acceptable overall quality of the included studies. The numbers of high-, medium-, and low-quality articles were 23 (42.6%), 25 (46.3%), and 6 (11.1%), respectively (Figure 2).

3.3 | Assessment of heterogeneity

To evaluate the level of heterogeneity, I^2 statistic was calculated in the whole study and the subgroups. The I^2 across all studies and considering the random effect model was 48.84. In the subgroups based of the quality of the studies, I^2 was "0", 45.17, and 55.42 for low-, medium- and high-quality studies, respectively. In the

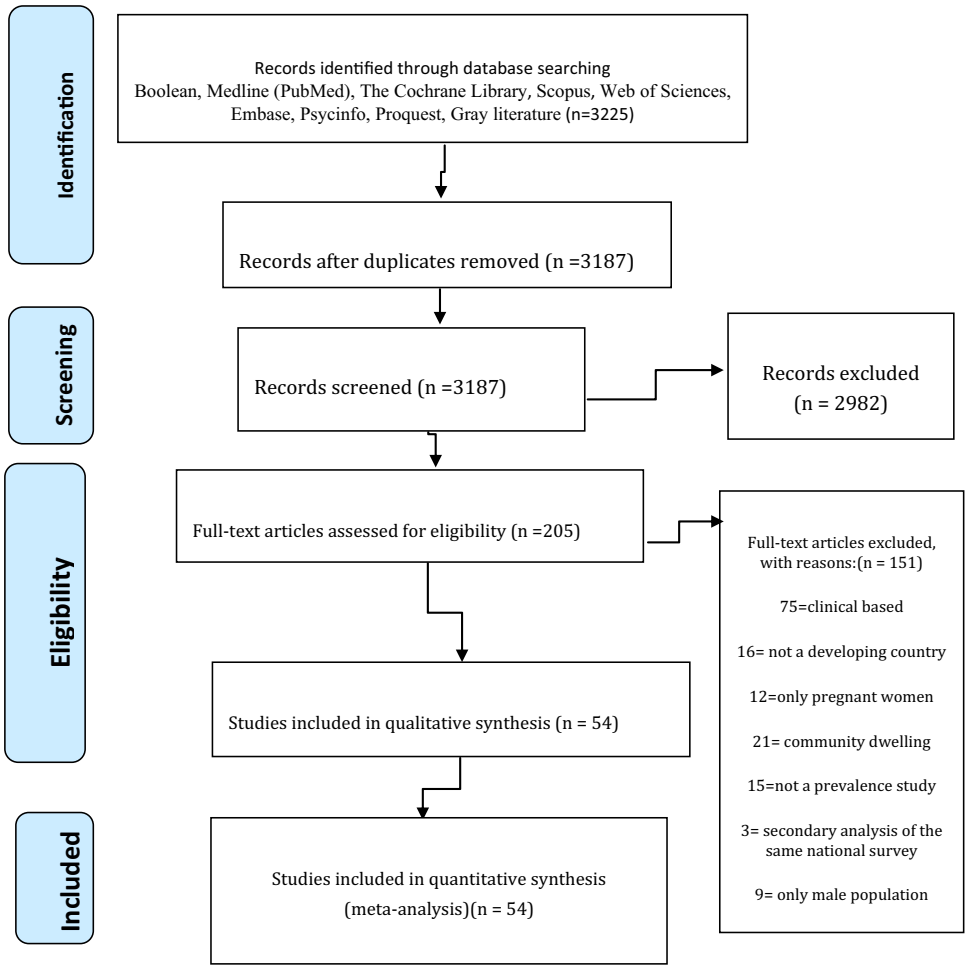

FIGURE 1 PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) chart to demonstrate the selection of studies for analysis of the prevalence of urinary incontinence in the developing world

TABLE 1 Characteristics of the included studies and probability of urinary incontinence (UI) and incontinence types, listed in alphabetical order by first author

Reference	Study method	country	Prevalence of UI (%)	Age (y)	Sample size (n)	Definition of incontinence	Questionnaire
Ahmadi[2]	cross-sectional	Iran	38.4	>40	800/800	not ICS	
Amaro[6]		Brazil	27	>20	685/685	not ICS	
Bodhare[9]	cross-sectional/ descriptive	India	10	>35	552	ICS	self-administered
Brieger[8]		Hong Kong		10- 90	819/3248	not ICS	Kings College Urodynamics (Chinese version)
Castro[53]	cross-sectional	Colombia	48		40–59	609/609	not ICS
Cayan[28]		Turkey	14.6	>18	1217		ICIQ-sf
Chen[29]		Taiwan	53.7	>20	1584	ICS	Bristol(Chinese version)
Choi[30]	cross-sectional/ telephone survey	Korea	23.8	>30	500/500	ICS	
Choo[12]	telephone survey	Korea	40.8	30–79	1303/1500	ICS	
El-Azab[31]	cross-sectional	Egypt	54.8	>20	1652/1652	ICS	UDI-6(Arabic version)
Eshkoor[26]		Malaysia	3.8	>60	2322/2322	not ICS	
Garcia-Perez[33]	population-based cross-sectional	Mexico	18.4	25–54	1307/1307	not ICS	self-administered
Ge[72]		China	22.1	>20	3100	ICS	ICIQ-FLUT
Hajebrahimi[27]	cross-sectional	Iran	23.6	15–53	400	not ICS	
Hemachandra[54]		Sri Lanka		15–49	1800	ICS	
Hornge[32]	national health interview system	Taiwan	22	35–64	4661	ICS	self-administered
Hsieh[42]	national survey	Taiwan	29.8	>60	2410	not ICS	
Islam[33]		Bangladesh	23.7	30–59	1590/1590	not ICS	QUID
Javadifar[34]	cross-sectional	Iran	57.7	15–49	2000/2000	not ICS	ICIQ-sf
Jiang[68]		China	27.7	>18	2750	not ICS	ICIQ-SF
Jokhio[35]	cross-sectional	Pakistan	11.5	>15	5064/5284	not ICS	self-administered

(Continues)

TABLE 1 (Continued)

Reference	Study method	country	Prevalence of UI (%)	Age (y)	Sample size (n)	Definition of incontinence	Questionnaire
Juliato[56]	cross-sectional	Brazil	23.6	45–60	749	ICS	ICIQ-SF (Portuguese version)
Lee[36]		Korea	24.4	>19	13,484/13,484	ICS	questionnaire used in 4 European studies
Li[69]	cross-sectional	China	30.9	>20	19024	ICS	ICIQ-FLUT
Liu[58]		China	23.3	>20	5433/5467	ICS	adapted from ICIQ-FLUT
Kim[73]	cross-sectional	Korea	7.5	19–65	5,928	not ICS	
Kwon[57]	national survey	Korea	7.9	>20	9873	not ICS	
Ma[55]		Hong Kong	34	>18	1018	not ICS	not defined
Manonai[37]	cross-sectional	Thailand	36.5	15–95	1126/1500	ICS	
Marques[38]	cross-sectional	Brazil	29.4	>60	1700/1705	ICS	
Megabiaw[39]	cross-sectional	Ethiopia	7.8	16–80	395/395	ICS	adapted from EPINCONT
Menezes[55]	population-based/ cross-sectional/ epidemiological	Brazil	10.7	>40	657	ICS	
Mikou[40]		Morocco	27.1	>18	1000	ICS	
Mohd Sidik[43]	cross-sectional	Malaysia	9.9	>60	223/223	not ICS	Malay version of the Barthel's Index (BI)
Mourad[71]	cross-sectional survey (EPIC)	Egypt	27	≥18	3600	ICS	
Nobrega[60]	observational cross-sectional analytical	Brazil	17.5	19–59	194	ICS	self-administered
Ojengbede[61]	prospective cohort	Nigeria	2.8	>18	5001/5001	not ICS	
Ozerdogan[44]	cross-sectional	Turkey	25.8	>20	625/625	ICS	Thomas et al.
Onur[62]	cross-sectional	Turkey	46.3	17–80	2275/2275	ICS	UDI-6
Pang[63]	telephone survey	Hong Kong		10–90	749	not ICS	UDI-6
Pathiraja[64]	cross-sectional	Sri Lanka	55.5	>18	2354	not ICS	

TABLE 1 (Continued)

Reference	Study method	country	Prevalence of UI (%)	Age (y)	Sample size (n)	Definition of incontinence	Questionnaire
Prabhu Shruti[65]	cross-sectional/ descriptive	India	25.5	>20	353	ICS	
Santos[41]	cross-sectional/ epidemiological	Brazil	20.1	>18	519	ICS	reference to other article
Stones[45]		China	6.2	15–34	3150/3150	not ICS	
Tamanini[46]	cohort	Brazil	28.2	>60	1413	not ICS	not defined
Tseng[48]		Taiwan	21.6	>65	504/504	not ICS	
Tozun[47]		Turkey	49.5	>20	1585/1585	ICS	ICIQ-sf
Velazquez Magna[49]	observational transverse and descriptive	Mexico	46.5	20–80	80/80	ICS	ICIQ-UI-sf
Wong[66]	telephone survey	China		17–77	540/540	not ICS	UDI-6
Wu[50]		China	35.2	>20	2448/2500	ICS	ICIQ-FLUT
Yu[70]	cross-sectional	China	33.4	>60	743/743	not ICS	ICIQ-FLUT
Zhang[67]		China		>20	6066	not ICS	Bristol
Lei Zhang[51]	cross-sectional	China	31.9	>20	20,000	ICS	Bristol + ICIQ-FLUTS
Zhu[52]	cross-sectional	China	38.5	>20	5300	ICS	ICIQ-FLUT

						Incontinence type (%)		
Reference	Time of UI diagnosis	Validation status	country/region	year	Sex	SUI	UUI	MUI
Ahmadi[2]	daily leak/activity/ using pads	no	region	2007	F			
Amaro[6]	any involuntary loss of urine	no	region	2009	F			
Bodhare[9]	any involuntary loss of urine	yes	region	2010	F	5.7	2.3	2
Brieger[8]	unacceptable involuntary loss of urine	yes	telephone survey	1996	F	7	15	14
Castro[53]	any involuntary loss of urine	no	region (Amazon tribes)	2010	F			
Cayan[28]	UI in the past 4 weeks	yes	country	2016	F	4.7		1.8

(Continues)

TABLE 1 (Continued)

Reference	Time of UI diagnosis	Validation status	country/region	year	Sex	Incontinence type (%)		
						SUI	UUI	MUI
Chen[29]	UI in the past 4 weeks	yes	region	2003	F	18	18.6 (overflow]	17.1
Choi[30]	involuntary loss in the last 6 months	no	Country(3 cities)	2012	F			
Choo[12]	UI in the past 4 weeks	yes	telephone survey	2003	F	22.9	3.1	14.9
El-Azab[31]	any involuntary loss of urine	yes	region	2007	F	14.8	15	25
Eshkoor[26]		no	country		M/F			
Garcia-Perez[33]	involuntary loss in the last year	yes	region (northern Mexico)	2005	F	10.4	1.8	57.2
Ge[72]	UI in the past 4 weeks	yes	region	2009	F	12.9	1.7	7.5
Hajebrahimi[27]	any involuntary loss of urine	no	region	1998–1999	F			
Hema-chandra[54]		no	country	2006–2007	F	9.8		
Hornge[32]	Involuntary loss in the last year	no	national survey	2005	F			
Hsieh[42]	any involuntary loss of urine	no	country	1999	F			
Islam[33]	UI in the past 4 weeks	yes	country	2013–2014	F			
Javadifar[34]	UI in the past 4 weeks	yes	region	2018	F			
Jiang[68]	UI in the past 4 weeks	yes	region	2016	F	23.1	1.6	3.0
Jokhio[35]		no	region	2012	F	4.7	3.2	2.8
Juliato[56]	any involuntary loss of urine	yes	region	2012–2013	F	6.4	7.8	9.5
Lee[36]	any involuntary loss of urine	no	national survey	2005	F	11.9	1.9	10.2
Li[69]	UI in the past 4 weeks	yes	country	2006	F		2.6	9.4
Liu[58]	UI in the past 4 weeks	yes	region	2010–2012	F	14	3	6.3

TABLE 1 (Continued)

Reference	Time of UI diagnosis	Validation status	country/region	year	Sex	Incontinence type (%)		
						SUI	UUI	MUI
Kim[73]	any involuntary loss of urine	no	4th Korean National Health & Nutrition Examination Survey	2008–2009	F	OR (95%CI) for working women with a daytime work schedule was 2.14 (1.18–3.87)evening work schedules, it was 1.35 (1.05–1.74)		
Kwon[57]	do you have UI?	no	national survey	2007–2009	F			
Ma[55]	any involuntary loss of urine	yes	region	1994	F			
Manonai[37]	UI in the past 4 weeks	yes	region	2003–2004	F	33.6		
Marques[38]	any involuntary loss of urine	yes	region	2009–2010	M/F			
Megabiaw[39]	involuntary loss in the last year	no	region	2012	F	1.2		
Menezes[55]	any involuntary loss of urine	no	region	2003	M/F			
Mikou[40]	UI in the past 4 weeks	no		1998	F			
Mohd Sidik[43]	any involuntary loss of urine	yes	region	2002	M/F			
Mourad[71]		no	country	2018	F	6	6	12
Nobrega[60]	any involuntary loss of urine	no	region	2013	F			
Ojengbede[61]	any involuntary loss of urine	no	country	2009	F	2.3	1	0.6
Ozerdogan[44]	UI in the past 4 weeks	no	region	2003	F	11.1	7.04	7.7
Onur[62]	any involuntary loss of urine	yes	region	2009	F	46	43	
Pang[63]	any involuntary loss of urine	yes	telephone survey	2001–2002	F	13	15.5	30.9
Pathiraja[64]	UI in the past 3 months	no	country	2015–2016	F	10	15.6	29.9

(Continues)

TABLE 1 (Continued)

Reference	Time of UI diagnosis	Validation status	country/region	year	Sex	Incontinence type (%)		
						SUI	UUI	MUI
Prabhu Shruti[65]	definition of ICS was used	yes	region	2010–2011	F	14.3	8.2	3
Santos[41]		no	region	2007–2008	M/F			
Stones[45]	not defined	no	country(3 regions)	2003	F			
Tamanini[46]	UI in the past 3 months	yes	region	2010	F			
Tseng[48]	any involuntary loss of urine	no	region	1997	M/F	10.9	6.6	6.3
Tozun[47]	UI in the past 4 weeks	yes	region	2007	F	16.1	8.5	24.9
Velazquez Magna[49]	UI in the past 4 weeks	yes	region	2006	F			
Wong[66]	UI in the past 3 months	yes	country	2005	F	40.8	20.4	15.9
Wu[50]	UI in the past 4 weeks	yes	region	2009	F	26.4	1.9	6.9
Yu[70]	UI in the past 4 weeks	yes	region	2007	F			
Zhang[67]	UI in the past 4 weeks	yes	region	2005	F	16.6	10	
Lei Zhang[51]	UI in the past 4 weeks	yes	country	2006	F	18.9	2.6	9.4
Zhu[52]	UI in the past 4 weeks	yes	region	2005	F	22.9	2.8	12.4

Blank cells indicate missing data.

Abbreviations: F, females; M, males; MUI, mixed urinary incontinence; SUI, stress urinary incontinence; UUI, urgency urinary incontinence.

No	Authors	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
1	Ahmadi [2]	☺	☺	☺	☺	☺	☹	☺	☺	😐
2	Amaro [6]	☺	☺	☺	☺	☺	😐	☺	☺	😐
3	Bodhare [9]	☺	☺	☺	☺	☺	☺	☺	☺	☺
4	Brieger [8]	☺	☺	☺	☺	☺	☺	☺	☺	😐
5	Castro [53]	☺	☺	☺	☺	☺	☹	☺	☺	☺
6	Cayan [28]	☺	☺	☺	☺	☺	☺	☺	☺	😐
7	Chen [29]	☺	☺	☺	☺	☺	☺	☺	☺	☺
8	Choi [30]	☺	☺	☺	☺	☺	☹	😐	☹	😐
9	Choo [12]	☺	☺	☺	☹	☺	☺	☺	☺	☺
10	El-Azab [31]	☺	☺	☺	☺	☺	☺	☺	☺	☺
11	Eshkoor [26]	☺	☺	☺	☺	☺	☹	☺	☺	☺
12	Garcia-Perez [33]	☺	☺	☺	☺	☺	☺	☺	☺	☺
13	Ge [72]	☺	☺	☺	☺	☺	☺	☺	☺	☺
14	Hajebrahimi [27]	☺	☺	☺	☺	☺	☹	☺	☺	☺
15	Hemachandra [54]	😐	☺	😐	☺	☺	😐	☺	☺	☺
16	Horngе [32]	☺	☺	☺	☺	☺	😐	☺	☺	😐
17	Hsieh [42]	☹	☺	☺	☺	☺	😐	☺	☺	☺
18	Islam [33]	☺	☺	☺	☺	☺	☺	☺	☺	☺
19	Javadifar [34]	☺	☺	☹	☹	☺	☺	☺	😐	☺
20	Jiang [68]	☺	☺	☺	☺	☺	😐	😐	☺	☺
21	Jokhio [35]	☺	☺	☺	☺	☺	☹	☺	☺	☺
22	Juliato [56]	☺	☺	☺	☺	☺	☺	☺	☺	☺
23	Lee [36]	☺	☺	☺	☺	☺	☹	☺	☺	😐
24	Li [69]	☺	☺	☺	☺	☺	☺	😐	☺	☺
25	Liu [58]	☺	☺	☺	☺	☺	☺	☺	☺	☺
26	Kim [73]	☺	☺	☺	☺	☺	☹	☺	☺	😐
27	Kwon [57]	☺	☺	☺	☺	☺	☺	☹	☺	😐
28	Ma [55]	☺	☺	☹	☺	☺	☺	☺	☺	😐
29	Manonai [37]	☺	☺	☺	☺	☺	☹	☺	☺	☺

FIGURE 2 Quality scoring results with the JBI Critical Appraisal Checklist for Studies Reporting Prevalence Data consisting of nine questions (Q1-Q9, see Supporting Information Appendix 2). The questions with answer "yes" are shown as , with answers "no" as , and answer "unclear" as \. A total score of greater than 80% was defined as high quality, a score between 60% and 80% as medium quality and a score less than 60% as low quality

30	Marques [38]	☺	☺	☺	☺	☺	☺	☺	☺	☺
31	Megabiaw [39]	☺	☺	☺	☺	☺	☹	☺	☺	☺
32	Menezes [55]	☺	☺	☺	☺	☺	☹	😐	☹	😐
33	Mikou [40]	😐	☺	😐	☺	😐	☹	😐	☺	😐
34	Mohd Sidik [43]	☹	☺	☺	☺	☺	☺	☺	☺	😐
35	Mourad [71]	😐	😐	☺	😐	☺	😐	☺	☺	☺
36	Nobrega [60]	☺	😐	😐	☺	☺	☹	😐	☺	😐
37	Ojengbede [61]	☺	☺	☺	☺	☺	☹	☺	☺	😐
38	Ozerdogan [44]	☺	☺	☺	☺	☺	☹	☺	☺	😐
39	Onur [62]	☺	☺	☺	☺	☺	☺	☺	☺	☺
40	Pang [63]	☺	☺	☺	☹	☺	☺	☺	☺	☺
41	Pathiraja [64]	☺	☺	☺	☺	☺	☺	☺	☺	😐
42	Prabhu Shruti [65]	☺	☺	☺	☺	☺	☺	☺	☺	☺
43	Santos [41]	☺	☺	☺	☺	☺	😐	😐	☺	😐
44	Stones [45]	☺	☺	☺	☺	☺	😐	☺	☺	😐
45	Tamanini [46]	☹	☺	☺	☺	☺	☺	☺	☺	☺
46	Tseng [48]	☹	☺	☺	☺	☺	☹	☺	☺	☺
47	Tozun [47]	☺	☺	☺	☺	☺	☺	☺	☺	😐
48	Velazquez Magna [49]	☺	☺	☺	☺	☺	☺	☺	☺	☺
49	Wong [66]	☺	☺	☺	☺	☺	☺	☺	☺	☺
50	Wu [50]	☺	☺	☺	☺	☺	☺	☺	☺	☺
51	Yu [70]	☺	☺	☺	☺	☺	☺	☺	☺	☺
52	Zhang [67]	☺	😐	☺	☺	☺	☺	☺	☺	☺
53	Lei Zhang [51]	☺	☺	☺	☺	☺	☺	☺	☺	☺
54	Zhu [52]	☺	☺	☺	☺	☺	☺	☺	☺	☺
	Total	**87.0%**	**94.4%**	**90.7%**	**92.6%**	**98.1%**	**55.6%**	**87.0%**	**94.4%**	**62.7%**

FIGURE 2 Continued

subgroups based on the definition of UI, I^2 was 17.26, 47.91, 4.44, 0, 65.28, and 46.90 for UI defined as "any involuntary loss of urine", "involuntary loss of urine in the last 4 weeks", "involuntary loss of urine in the last 3 months", "involuntary loss of urine in the last 6 months", "involuntary loss of urine in the last year", and "not identified", respectively. The I^2 was 60.55 in the studies that used a validated questionnaire and 19.48 for the studies that used nonvalidated questionnaires. Finally, the I^2 was calculated 64.70 in the "country" subgroup and 26.87 in "region" subgroup.

3.4 | Publication bias

To assess the publication bias of the selected studies, a funnel plot was drawn. It seems that the sample size of the included studies is appropriate for the purpose of

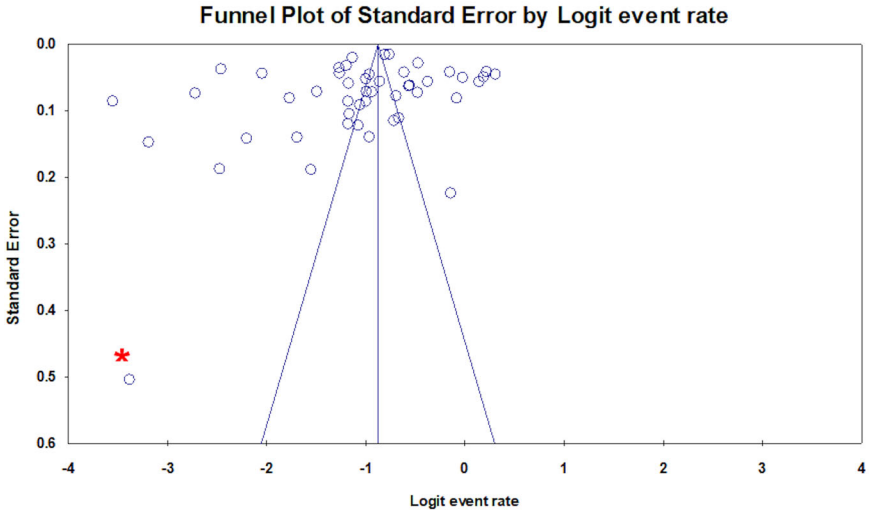

FIGURE 3 Funnel plot analysis of 54 studies. Only one study on the left side (*) below is totally out of distribution[50]

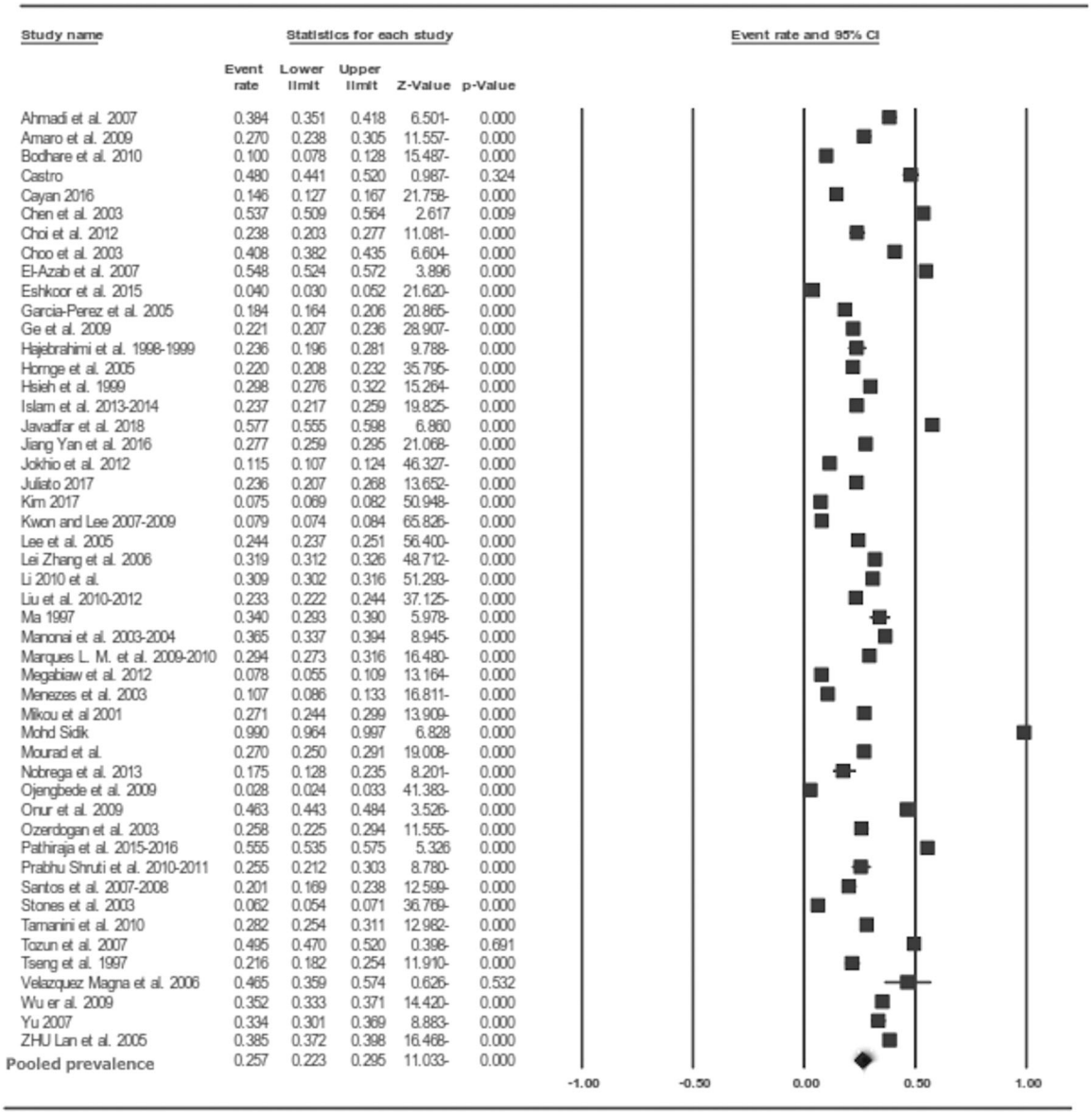

FIGURE 4 Prevalence of urinary incontinence in the individual studies of the selected literature resulting in a pooled prevalence rate of 25.7% (95% confidence interval: 22.3-29.5) using random-effects analysis

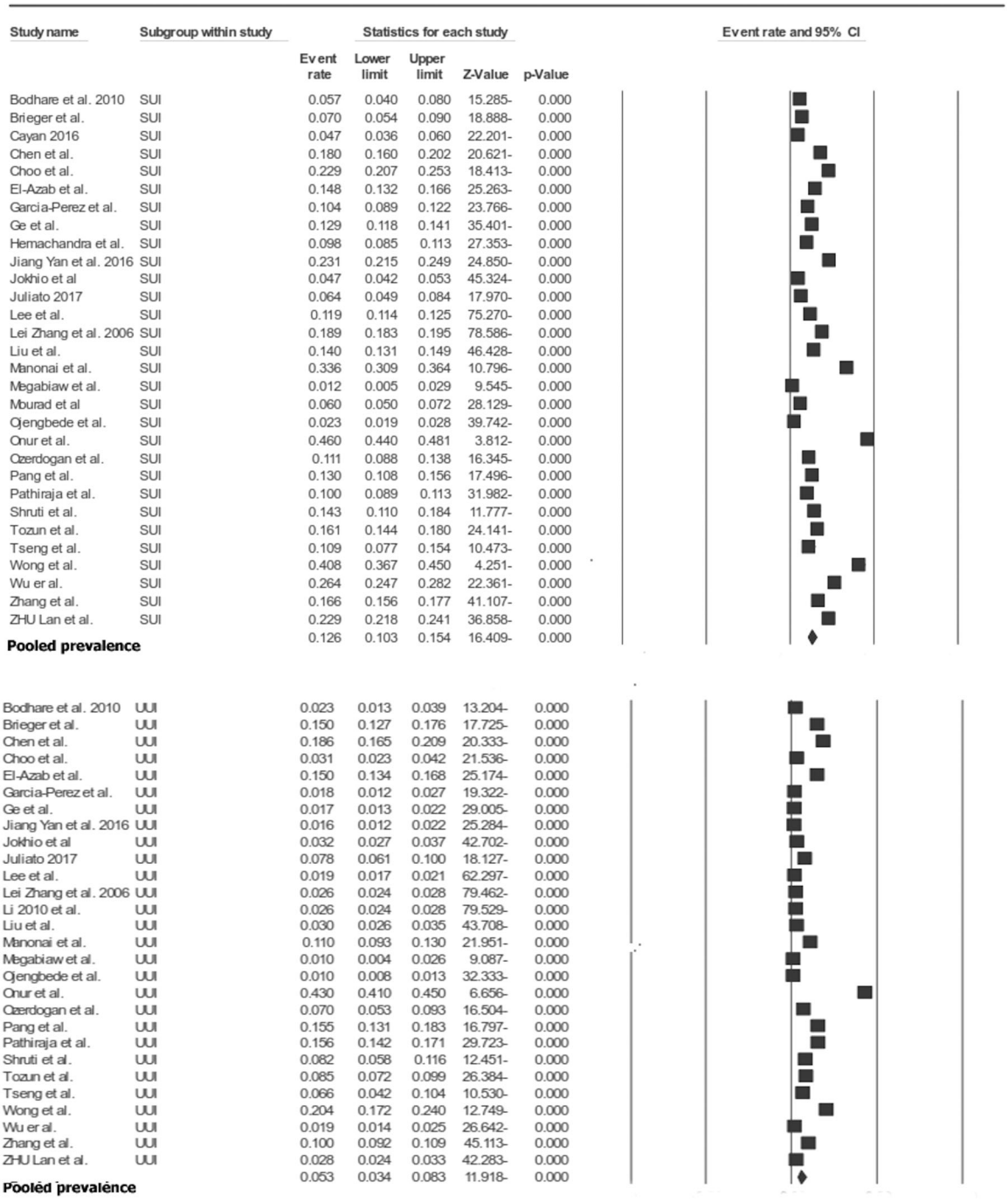

FIGURE 5 Prevalence rates for subtypes of urinary incontinence using random-effects analysis: stress urinary incontinence (SUI) 12.6% (95% confidence interval 10.3-15.4), urgency urinary incontinence (UUI) 5.3% (95% confidence interval 3.4-8.3) and mixed urinary incontinence (MUI) 9.1% (95% confidence interval 7.0-11.8)

our analysis but the pattern of distribution is not completely symmetric. This could have been caused by a publication bias or methodological flaw. We did not exclude any of these studies and performed subgroup analyses because only one study[43] was totally out of distribution (Figure 3).

3.5 | Prevalence of UI

The prevalence rates of the individual studies and the total prevalence of UI is shown in Figure 4. In the fixed method analysis, prevalence of UI was 29.4% (95% CI: 29.1-29.6) but I^2 was more than 50% which demonstrates

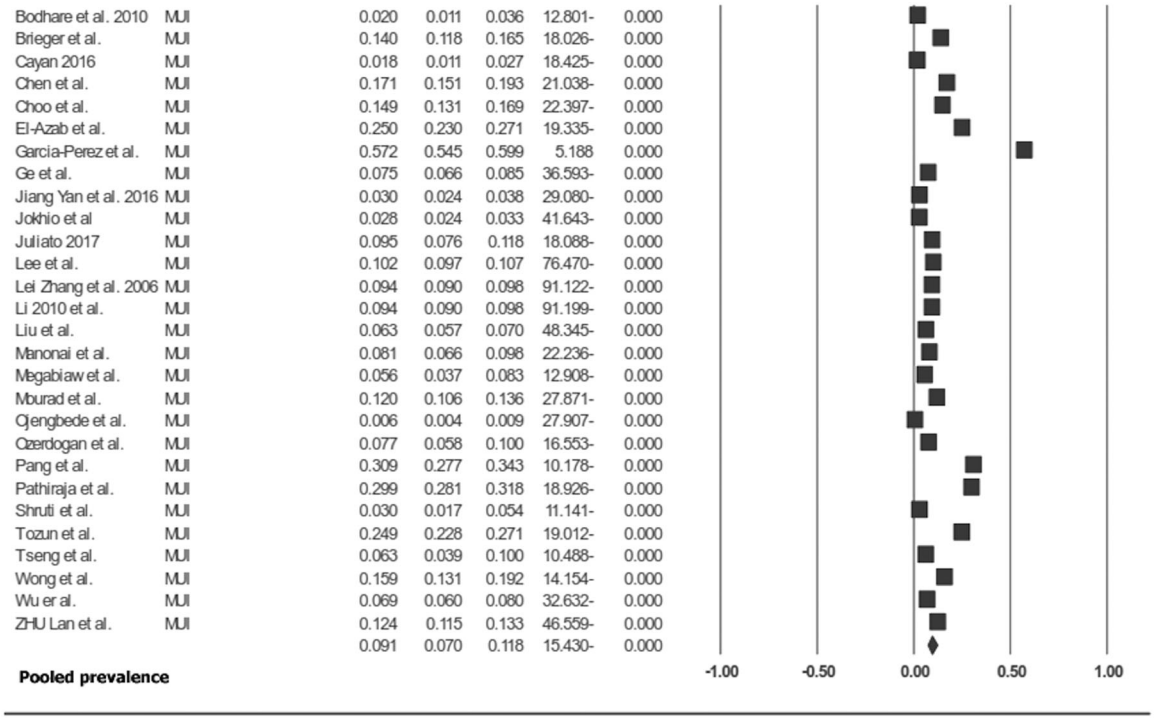

FIGURE 5 Continued

high heterogeneity of the studies. We therefore used the random effect model here and for all additional analyses that showed an overall UI prevalence of 25.7% (95% CI: 22.3-29.5). The prevalence of different UI types was 12.6% (95% CI: 10.3-15.4), 5.3% (95% CI: 3.4-8.3), and 9.1% (95% CI: 7.0-11.8) for SUI, UUI, and MUI, respectively (Figure 5).

3.6 | Prevalence of UI without elderly women

The prevalence of UI significantly increases with age.[2] However, we could not perform the age-based analysis for our patient groups because this data was unavailable in the literature. For this reason, we performed a subgroup analysis after excluding studies focussing on the elderly population in the title or text (n = 6). This analysis showed that the total UI prevalence only changed slightly to 26.2% (95%CI: 22.6–30.2; Figure 6).

3.7 | Prevalence of UI based on the definition of incontinence

There are several definitions for UI that may influence the prevalence. The prevalence of UI for any involuntary loss of urine independent on the time period was 25.5% (95% CI: 18.5-34.2; Figure 7). When UI was defined as involuntary loss of urine in the last 4 weeks, the prevalence rate was 33.4% (95% CI: 29.5-37.5). However, when UI was defined as involuntary loss of urine during the last 3 months, the prevalence rate was 41.2% (95% CI: 18.4-68.5), whereas the prevalence rate of any involuntary loss of urine during the last year was 15.6% (95% CI: 10.9-21.8).

3.8 | Prevalence of UI according to the study quality

To demonstrate the effects of the study quality on data pooling, we divided the retrieved studies according to their methodological quality. The UI prevalence was 28.2% (95% CI: 24.0-32.9), 19.4% (95% CI: 15.0-24.8), and 21.8% (95% CI: 11.1-38.3) for studies with high, medium, and low quality, respectively (Figure 8).

3.9 | Prevalence of UI according to the use of validated vs nonvalidated questionnaires

The methods to assess the prevalence of UI varied widely. Only approximately half of the studies (55.5%) utilized validated questionnaires (n = 30). For this reason, we analyzed the prevalence of UI according to the use of validated or

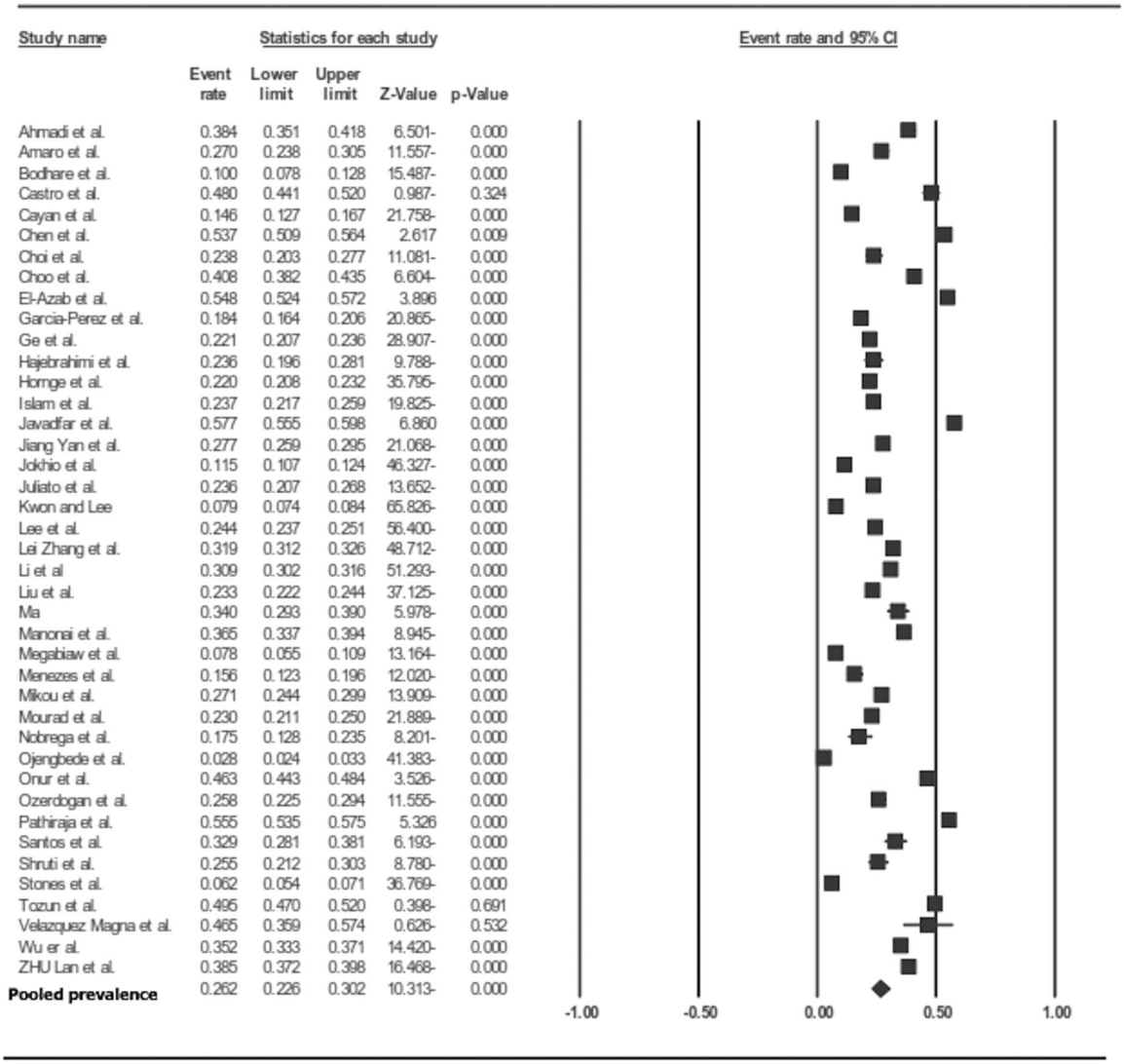

FIGURE 6 Prevalence of urinary incontinence excluding elderly women using random-effects analysis

nonvalidated questionnaires. In the studies with validated questionnaires, the prevalence rate of UI 23.5% (95% CI: 19.4-28.1). In contrast, the prevalence rate was 27.7% (95% CI: 22.6-33.4) in studies that used nonvalidated questionnaires.

3.10 | Prevalence of UI according to geographical region

Included studies were also analyzed according to their geographical origin (Figure 9):

- Eastern Asian and Pacific region: 25.6% (95% CI: 21.4-30.2)
- South Asia: 14.2% (95% CI: 6.1-29.8)
- Europe and Central Asia: 32.2% (95% CI: 18.9-49.15)
- Middle East and North Africa: 37.3% (95% CI: 25.8-50.5)
- Sub-Saharan region: 4.6% (95% CI: 1.7-12.3)
- Latin America: 28.8% (95% CI: 22.2-36.4).

In large population studies in individual regions or countries, the prevalence rate of UI was 18.9% (95% CI: 14.4-24.3). In contrast, the prevalence of UI was 28.8% (95% CI: 24.4-33.5) when only a small population sample was investigated. The results of all subgroup analyses are summarized in Table 2.

4 | DISCUSSION

Our systematic review and meta-analysis is the first comprehensive report of UI prevalence rates in the developing world. Our analysis demonstrates that approximately 26% of the adult female population in developing countries has UI. However, more accurate prevalence data is difficult to retrieve from the epidemiologic literature since striking differences exist among the studies in terms of methodology, definitions of UI and

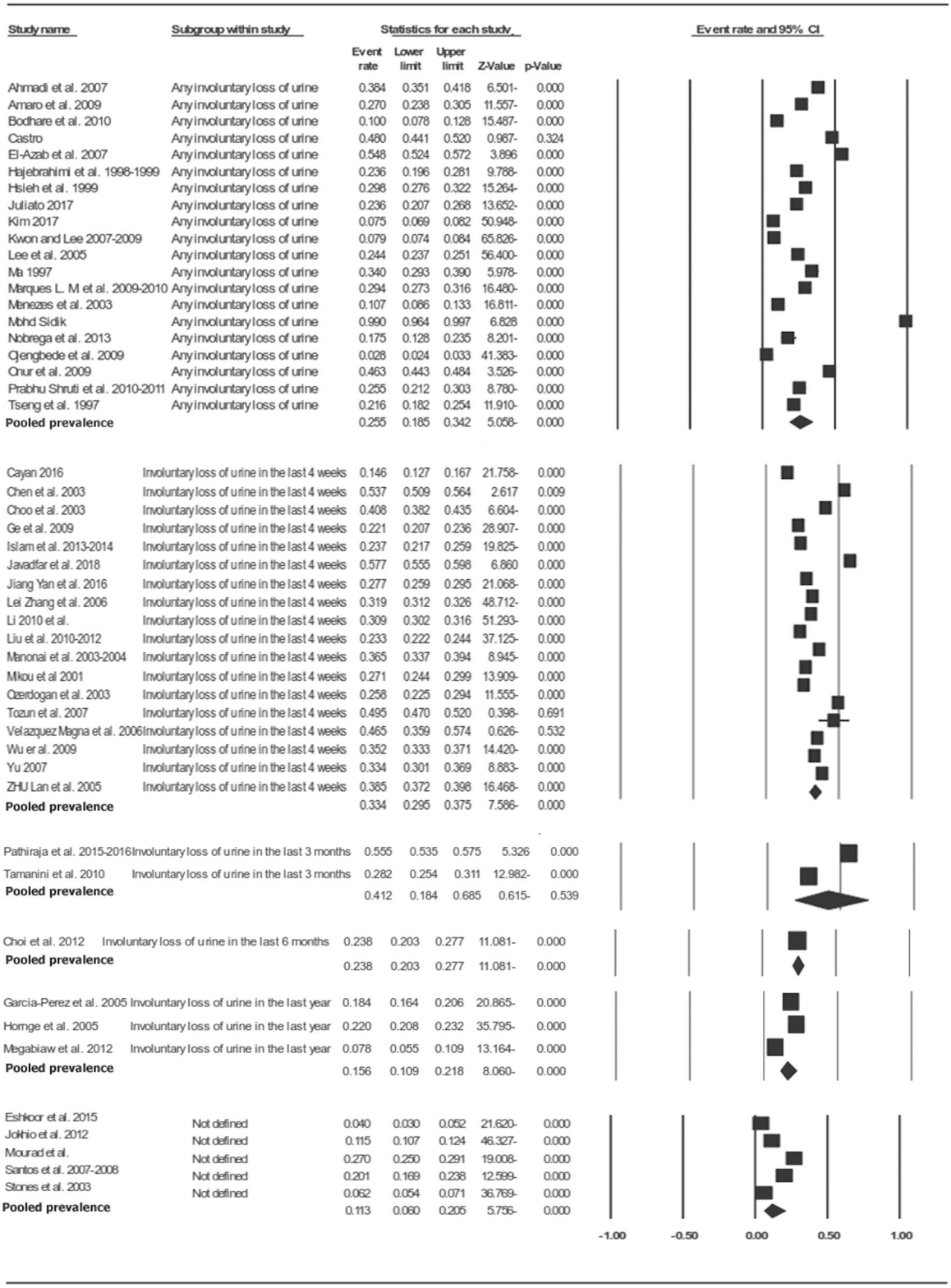

FIGURE 7 Prevalence of urinary incontinence (UI) based on its definition using random-effects analysis. Some studies defined UI as any involuntary loss of urine, whereas other studies defined incontinence as involuntary loss of urine during the last 4 weeks, 3 months, or 12 months. However, some studies did not define the recall period for UI

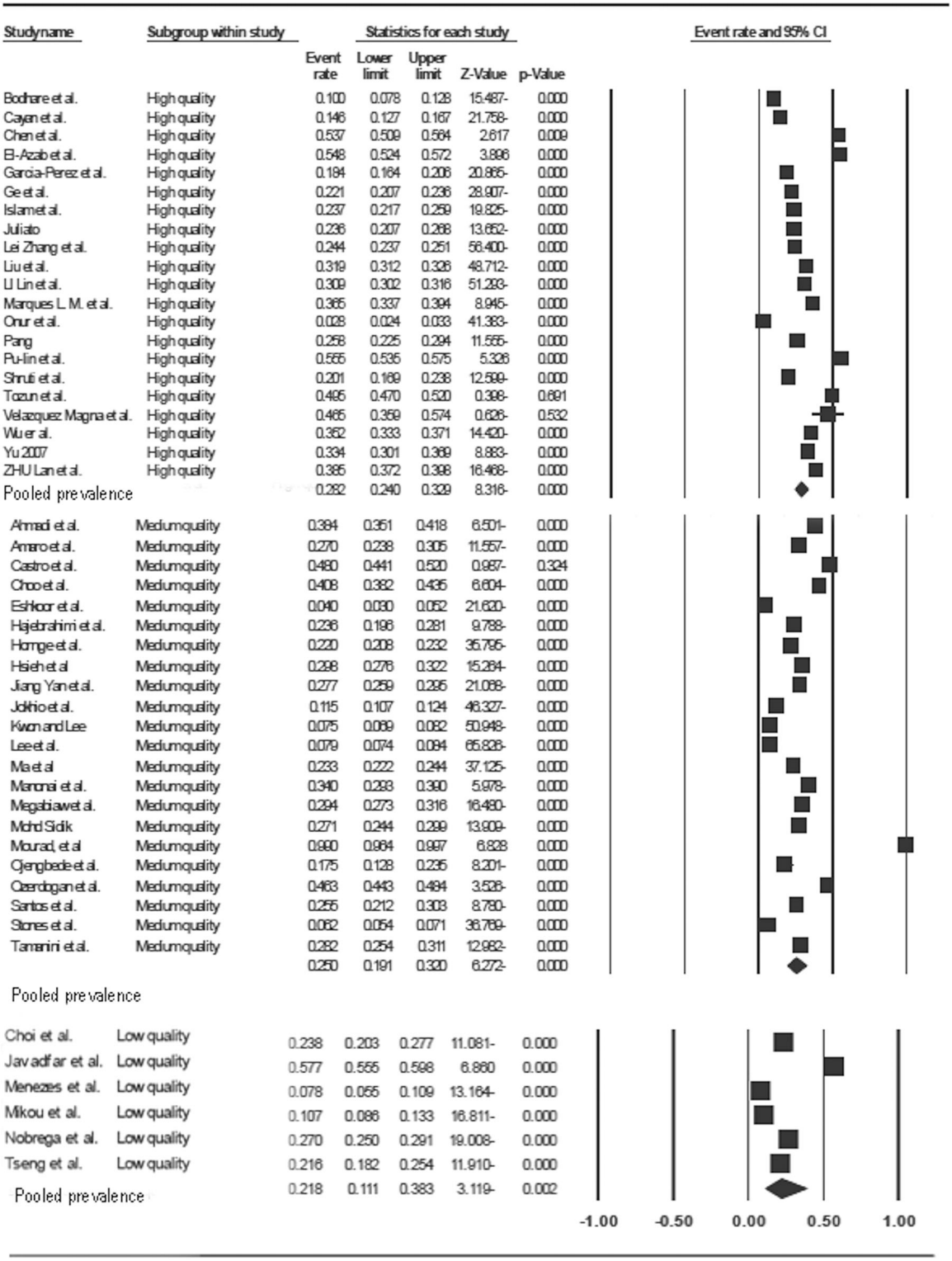

FIGURE 8 Prevalence of incontinence according to the study quality using random-effects analysis. Publications with quantitative data were selected for assessment of the methodological validity before inclusion in the review by using standardized critical appraisal instruments from the Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI) (Supporting Information Appendix 2). Selected studies were categorized into three groups based on the score of each study. A total score of less than 80% was defined as high quality, a score between 60% and 80% as medium quality and a score less than 60% as low quality

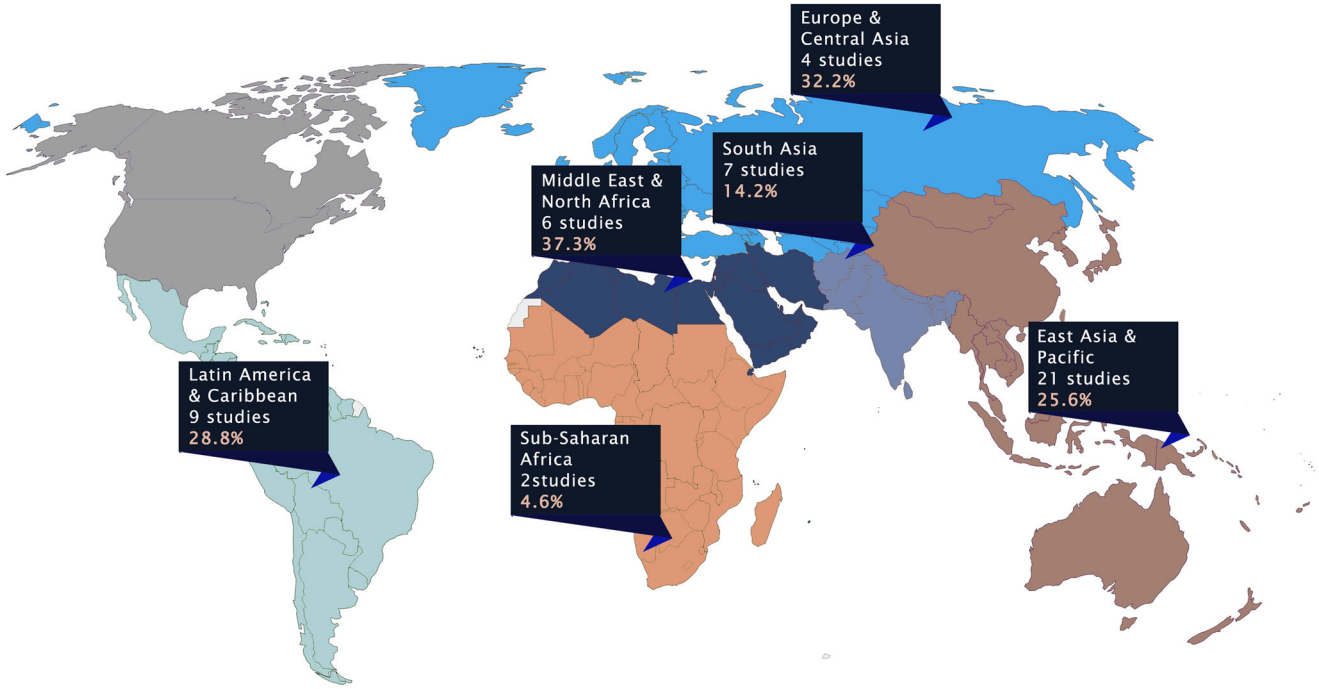

FIGURE 9 Urinary incontinence prevalence rates based on studies in different geographical locations

populations that together limit the calculation of more accurate estimates. The heterogeneity between the studies prevented additional calculations but our results still provide some important insights into the parameters that influence the UI prevalence in the developing world.

The prevalence rate of SUI (12.6%) was higher than the prevalence rates of MUI (9.1%) or UUI (5.3%). Most strikingly, the prevalence of MUI in the developing world is almost two-fold higher than for UUI. Contradictory data appeared when comparing the prevalence rates for the recall periods of 3 months (41.2%) and 12 months (15.6%). Patients may have overestimated the frequency of UI during the shorter recall period or forgotten urinary leakage episodes during a longer recall period, especially in women with infrequent or less severe UI. In the present analysis, we did not have any time restriction of the published literature. Therefore, it is also possible that more recently published studies demonstrate a higher prevalence of UI due to greater awareness and reporting.

In our meta-analysis of 54 studies, heterogeneity in the fixed method model was high. Nevertheless, the heterogeneity in a meta-analysis of clinical trials should be small because all included studies estimate the same condition for a similar population in one region.[74] However, this heterogeneity is still possible due to differences in study populations, measurement methods, and possible cultural differences, especially when effects are measured by applying patient-reported outcomes.[75] Because of the high heterogeneity of the studies, we performed random-effect analyses for the main results and subgroups. It is arguable whether random-effect analyses are more suitable because different studies may measure different items in epidemiological studies.[76] The situation is different when results are pooled from several epidemiological studies. Here different studies definitely measure different things. There is no way of controlling for all possible confounders and, therefore, substantial heterogeneity can be expected.[74]

In the current meta-analysis, the funnel plot was not symmetric for the selected studies and, therefore, some kind of publication bias or methodological effect is likely. Inadequate response rate can also cause an asymmetric funnel plot. In other words, we cannot see a uniform methodology and assessment tool for screening and diagnosing UI across the studies.

The difficult task in the interpretation of the meta-analysis results, despite its purely statistical tool nature, is to draw general conclusions for the real world based on analyses in the theoretical world in which all models are correct and all prerequisites are fulfilled.[23] The majority of the included studies were conducted in Eastern Asia and the Pacific region and only a few studies were carried out in Sub-Saharan Africa. The high number of studies in a highly populated country like China[45,50-52,58,66-70,72] is plausible but the high number of studies in less populated countries like Turkey[28,44,47,62] may influence the overall outcome of the meta-analysis. This appears to be important because ethnicity can influence the prevalence

TABLE 2 Summary of subgroup analyses for urinary incontinence in the developing countries

Variables	Event rate: Random-effect analysis % (95% CI)	Event rate: Fixed method model % (95% CI)
Total UI prevalence	25.7% (22.3-29.5)	29.4% (29.1-29.6)
SUI	12.6% (10.3-15.4)	17.3% (17.0-17.6)
UUI	5.3% (3.4-8.3)	7.6% (7.4-7.8)
MUI	9.1% (7.0-11.8)	12.1% (11.8-12.3)
UI prevalence without elderly women	26.2% (22.6-30.2)	29.3% (29.1-29.6)
UI prevalence based on its definition		
Any involuntary loss of urine	25.5% (18.5-34.2)	23.4% (22.9-23.8)
Involuntary loss of urine in the last 4 wk	33.4% (29.5-37.5)	32.5% (32.2-32.9)
Involuntary loss of urine in the last 3 mo	41.2% (18.4-68.5)	48.3% (46.6-50.1)
Involuntary loss of urine in the last year	15.6% (10.9-21.8)	20.7% (19.7-21.7)
UI prevalence based on study quality		
High quality	28.2% (24.0-32.9)	31.5% (31.1-31.8)
Medium quality	25.0% (19.1-32.0)	21.6% (21.2-22.0)
Low quality	21.8% (11.1-38.3)	36.3% (34.9-37.7)
UI prevalence based on questionnaire type		
Validated	23.5% (19.4-28.1)	27.7% (27.4-28.0)
Nonvalidated	27.7% (22.6-33.4)	34.0% (33.5-34.6)
UI prevalence based on geographical location		
East Asia and Pacific	25.6% (21.4-30.2)	27.5% (27.3-27.8)
South Asia	14.2% (6.1-29.8)	26.3% (25.3-27.2)
Europe and Central Asia	32.2% (18.9-49.1)	40.3% (38.9-41.6)
Middle East and North Africa	37.3% (25.8-50.5)	42.8% (41.6-43.9)
Sub-Sahara	4.6% (1.7-12.3)	3.4% (2.9-3.9)
Latin America	28.8% (22.2-36.4)	29.8% (28.5-31.0)

Results of both the random-effect analysis, which were used throughout the articles, and the fixed method model are provided.
Abbreviations: MUI, mixed urinary incontinence; SUI, stress urinary incontinence; UI, urinary incontinence; UUI, urgency urinary incontinence; 95% CI, 95% confidence interval.

and type of UI.[34,52] The highest prevalence of UI, with more than 37% of population affected, was seen in Middle East and North Africa as well as in Europe and Central Asia, whereas the lowest prevalence rate was seen in Sub-Saharan countries. These variations in the prevalence rates of UI confirm that the region with different cultures and races influences results.[1-3,77] Other explanation for the geographical differences is its impact on social activities and responsibilities in different cultures and regions. Embarrassment, shame, lack of trust to the health system as well as the lack of knowledge and understanding of incontinence as a disease decrease the help seeking behavior in the patients. Thus, some patients rather hide their condition and others might consider it a natural process of aging.[78] Different definitions of UI complicate the calculations and produce heterogeneous data.[79,80] For example, the UI prevalence rate of UI ranged from 12% to 53% with a mean of 35.1% in the study of Diokno et al. In this study, the authors defined UI as urinary leakage at 6 or more days during the last 12 months.[81] When UI was defined as any uncontrolled loss of urine with frequency of at least twice per month, the prevalence rate ranged from 4.5% to 37%, with a mean of 18%.[82] These findings show that the accurate and reproducible prevalence of UI cannot be measured without using standardized definitions and validated questionnaires in well-designed high-quality studies.[79]

Several studies reported about the prevalence of different UI types, including SUI, UUI, and MUI. The most prevalent type of UI in the individual studies and in our meta-analysis was SUI. The prevalence ranged between 13% and 50% in younger and between 6.4% and 42.2% in older women. The number of participants included in the group with younger women ranged from 405 to 27 936 and the number of

participants included in the group with older women from 227 to 142 651.[40,55,62,64,68] It seems that the lower and upper limits of prevalence rates are different in first world countries where study participants were mainly evaluated by population-based or cross-sectional surveys. In contrast, data in the developing world was frequently collected by nonvalidated questionnaires for self-completion, postal surveys or face-to-face interviews.[29,31,33,34,41,43,47,49,50,56,58,62,63,66,69,70] This was the reason why we performed a subgroup analysis to distinguish the UI prevalence rates with validated or nonvalidated questionnaires. Our subanalysis showed that UI prevalence rates with nonvalidated questionnaires are almost identical to those obtained by validated questionnaires. Therefore, we are confident that the use of nonvalidated questionnaires in 45% of the studies did not have a relevant impact on the overall result.

4.1 | Recommendations for future research

There are still limited numbers of studies assessing the UI prevalence in developing countries. More studies are needed to draw a more accurate, valid, and homogenous picture of the problem. Furthermore, there is a need to use one internationally accepted method for assessing the prevalence of UI which includes, next to others, the same sampling strategy, definition of UI, questionnaires, and age groups. Since there is a high prevalence rate of UI in different regions of the world, additional studies can help estimating the true and accurate prevalence rates worldwide.

5 | CONCLUSIONS

Despite differences in the definition of UI, assessment tools, geographical regions, and ethnicities, we were able to calculate the overall prevalence of female UI in the developing world, which is approximately 26%. However, UI prevalence rates vary widely throughout the world and, therefore, prevalence rates of 2.8% or 57.7% can both be meaningful. Surprisingly, the prevalence of UI varied widely in smaller regions. We were unable to perform an age-based analysis of UI because of the lack of data in the included studies. A multinational study in the developing world with inclusion of different age groups and regions/ethnicities as well as use of identical validated questionnaires and study methodology are necessary for future research and health care policies. Our analysis may stimulate researchers and stakeholders in designing appropriate studies for determination of the exact prevalence of UI.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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