Prevalence and factors related to urinary incontinence in older adults women worldwide: a comprehensive systematic review and meta-analysis of observational studies

Sedighe Batmani¹, Rostam Jalali¹, Masoud Mohammadi¹* and Shadi Bokaee²

Abstract

**Background:** Urinary incontinence is a common condition in the general population and, in particular, the older adults population, which reduces the quality of life of these people, so this study aims to systematically examine and meta-analyse the overall prevalence of urinary incontinence in older women around the world and the related and influential factors.

**Methods:** This report is a comprehensive systematic review and meta-analysis of the findings of research on urinary incontinence in older adults people across the world through looking for MEDLINE, Cochrane Library Sciencedirect, Embase, Scopus, ProQuest and Persian databases, namely iranmedex, magiran, and SID from January 2000 to April 2020, the heterogeneity of the experiments was measured using the I² index and the data processing was done in the Systematic Meta-Analysis programme.

**Results:** In 29 studies and the sample size of 518,465 people in the age range of 55–106 years, urinary incontinence in older adults women in the world based on a meta-analysis of 37.1% (95% CI: 29.6–45.4%) was obtained. The highest prevalence of urinary incontinence was reported in older adults women in Asia with 45.1% (95% CI: 36.9–53.5%). Meta-regression also showed that with increasing the sample size and year of the study, the overall prevalence of urinary incontinence in the older adults women of the world decreased and increased, respectively, which were statistically significant differences (P < 0.05). According to studies, the most important factors influencing the incidence of urinary incontinence in older women are women’s age (p < 0.001), obesity (p < 0.001), diabetes (p < 0.001), women’s education (p < 0.001), delivery rank (p < 0.001), hypertension (p < 0.001), smoking (p < 0.001). They also have urinary tract infections (p < 0.001).

**Conclusion:** Given the high prevalence of urinary incontinence in older women around the world, health policy makers must consider control and diagnostic measures in older women and prioritize treatment and rehabilitation activities.

**Keywords:** Prevalence, Urinary incontinence, Women, Older adults, Meta-analysis

* Correspondence: masoud.mohammadi1989@yahoo.com
1Department of Nursing, School of Nursing and Midwifery, Kermanshah University of Medical Sciences, Kermanshah, Iran

Full list of author information is available at the end of the article.
**Background**

The World Health Organization (WHO) finds citizens 65 years of age to be older adults and the United Nations deems people with 60 years or above to be older adults [1, 2]. The world’s population is aging rapidly, with 703 million people now over the age of 65, and this number is projected to reach 1.5 billion by 2050 [3]. Urinary incontinence is a common condition in the general population, especially the older adults, which reduces the quality of life so that ten to 20 % of all women and 77% of women living in nursing homes have urinary incontinence [4]. According to the International Association of Urinary Incontinence (ICS), any involuntary leakage of urine is called urinary incontinence (UI) [5].

Urinary incontinence is divided into three categories: stress, urgency and combination. Stress urinary incontinence (SUI) refers to the leakage of urine due to increased intra-abdominal pressure such as exercise and cough, which is due to the poor functional urethra. In connection with the reduction of anatomical support due to trauma, vaginal delivery, obesity and increased intra-abdominal pressure due to chronic constipation, lifting heavy objects and exercise is called urinary excretion with or above the distance after the sensation of excretion, urgent urinary incontinence (UUI) Called; If both urgency and stress are present together, it is called a hybrid type (MUI) [6, 7].

Urinary incontinence has been identified as a World Health Organization health priority [8]. Urinary incontinence has many physical, mental and social effects on women’s lives [9, 10], common mental problems in these people include anxiety and depression [11, 12]. Physical consequences include pressure sores [12], sleep disturbances and decreased sleep quality [13], urinary tract infections [14], falls and fractures, which are the leading causes of death in people over 65 [15].

Urinary incontinence has a great impact on daily and social activities such as work, travel, physical exercise and sexual function [16, 17] and thus reduces the quality of life [18]. Urgent incontinence is more common in nervous system disorders such as Parkinson’s, multiple sclerosis, and spinal and pelvic nerve damage [19, 20]. Age-related changes in the lower urinary tract include decreased bladder capacity and a feeling of fullness, decreased detrusor muscle contraction rate, decreased pelvic floor muscle strength, and increased residual urine volume [21].

The prevalence of urinary incontinence among older women has been reported in different studies, with an overall prevalence of 14% in US studies [22, 23]. In studies conducted in European countries, the prevalence of urinary incontinence has been estimated at 37% [24, 25]. In studies conducted in different regions of Asia, the prevalence of urinary incontinence in older adults was estimated at 13% [26, 27] and in Africa 45.3% [28]. In the study conducted in Middle Eastern countries, the prevalence of urinary incontinence was reported to be 52% [29–31].

In a study conducted in Iran, in a study in northern Iran (2016), one-third of older adults’ women in the city of Babol had urinary incontinence [32], in a study conducted in Yazd (2015) among women over 60 years, the prevalence of urinary incontinence was 62.2% [31]. Given the different prevalence reported and the need for consistent doses for intervention measures, and given that women cannot avoid aging and childbirth, awareness of the risk factors for urinary incontinence should be promoted.

On the other hand, studies in this field provide opaque and different information and the effective factors affecting urinary incontinence in older adults women in different studies report different reporting amounts and heterogeneity. Therefore, this study aims to answer the questions of the prevalence of urinary incontinence in older women in the world and what are the factors affecting this incontinence?

**Methods**

**Registration number**

This study has been registered with the code (IR.KUMS.REC.1399.455), in the deputy of research and technology of Kermanshah University of Medical Sciences.

**Search method and time domain**

This study is a systematic review and meta-analysis and is the result of extracting the findings of studies conducted in this field. First, articles published in domestic and foreign journals were retrieved by searching in databases, MEDLINE, Cochrane Library, Sciedirect, Embase, Scopus, ProQuest, and Persian databases including iranmedex, magiran and SID in the period January 2000 to April 2020.

The researcher uses the keywords urinary incontinence, women, the older adults, urinary disorders, or similar words in Persian sources and examines English-language databases using the words: Incontinence, women, older adults, urinary disorders, Prevalence, risk factor Urinary.

Also in the google scholar search engine, both words will be done in Persian and English, and the AND, OR and NOT operators will be used in combination for more comprehensive access to all articles, so the OR pragmatist will be used to check common letters about a disorder such as (Urinary incontinence OR Urinary disorders OR Urinary Reflex Incontinence OR Urinary Urge Incontinence), (Older adults OR Aging).
As well as the word AND among the keywords: (Urinary incontinence AND older adults AND Women) will be used through word matching in the MeSH Browser.

Each article was read by two browsers independently and if the article was rejected, the reason for its rejection was mentioned and in case of disagreement between the two browsers, the article was judged by the third browser and the third referee was considered. Prevalence of study disorder based on PRISMA diagram for entering meta-analysis and to manage articles and remove duplicate articles the EndNote software has been used (version X7, for Windows, Thomson Reuters).

Selection criteria and entry and exit criteria
Articles in Persian and English are taken from cross-sectional studies as well as case-control articles, all in the group to select the factors affecting urinary incontinence in older adults’ women had the selection criteria to enter the study. And review articles, articles that do not have access to full text despite the relationship with the author of the article and lack of proper response, as well as articles that are of low quality in the evaluation of quality evaluation were removed from the review list.

Quality assessment and evaluation of the risk of bias
The Newcastle-Ottawa Scale (NOS) is a quality assessment tool for observational studies that are recommended by the Cochrane Collaboration [21]. The NOS assigns up to a maximum of nine points for the least risk of bias in three domains: 1) selection of study groups (four points); 2) comparability of groups (two points); and 3) ascertainment of exposure and outcomes (three points) for case-control and cohort studies, respectively [21], and 11 scores possible. Eventually, articles were classified as high quality (scoring ≥5 points) or low quality (scoring<5 points). In this meta-analysis, all the articles that obtained five or more points were included.

Statistical analysis
Data were analysed using Comprehensive Meta-analysis software (Biostat, Englewood, NJ, USA version 3). To evaluate the heterogeneity of selected studies, the I² index test was used. If high heterogeneity is obtained in studies (75% < I²), random effects model will be used for meta-analysis of studies, and if low heterogeneity is obtained (I² < 25%), the fixed effects model will be used for the analysis of studies [21]. also, to investigate the publication bias and regarding the high volume of samples included in the study, The Begg and Mazumdar test and its corresponding Funnel plot were used at a significance level of 0.1. the meta-regression test was used to investigate the effects of potential factors influencing the heterogeneity of the studies.

Results
Search output
Based on studies on the prevalence and factors related to urinary incontinence in older women and including articles published in domestic and foreign journals and search in Cochrane Library Sciencedirect, Embase, Scopus, ProQuest and Persian databases including iranmedex, magiran and SID and in total searches: 2791 items were found. Then, the articles that had the initial conditions for inclusion in the study, based on the initial reviews by deleting 2522 duplicate articles and deleting 235 articles unrelated to the subject of study and deleting 5 articles during the secondary reviews due to lack of access to abstracts and main articles and low quality of articles (This number of deleted items from articles due to lack of access to the full text of articles and their abstracts due to being old or removed from the site of some journals and also their low quality in quality evaluation, of course, the deleted items due to low quality in the study is very limited.). The article entered the meta-analysis process (Fig. 1) (Table 1).

Review of publication bias and meta-analysis
The heterogeneity of the studies was investigated using the I² test and based on this test, the amount of heterogeneity (I² = 99.9%) was obtained and shows high heterogeneity in the included studies, so the random-effects model was used to combine the results of the studies. Also, the results of the study of publication bias in the studies were evaluated due to the high sample size entered in the studies with Begg and Manzumdar test and with a significance level of 0.1, which indicates that the diffusion bias was not significant in the present study (P = 0.252) (Fig. 2).

A review of 29 studies and the sample size of 518,465 people in the age range of 55~106 years, urinary incontinence in the older adults’ women of the world based on a meta-analysis of 37.1% (95% CI: 29.6~45.4%) was obtained. The highest prevalence of urinary incontinence in older adults’ women in Egypt with 80% (95% CI:72.2~86%) in 2020 [50] and the lowest prevalence of urinary incontinence in older adults’ women in Mexico with 9.5% (95% CI:8~11.2%) was achieved in 2017 [33] (Fig. 3).

In this figure, the prevalence of urinary incontinence is shown based on the random-effects model, in which the black square, the colour of the prevalence, and the length of the line segment on which the square is placed are 95% confidence intervals in each study.

Sensitivity analysis
A sensitivity analysis was performed to ensure the stability results, after removing each study results did not change (Fig. 4).
Meta-regression test

To investigate the effects of potential factors influencing the heterogeneity of the overall prevalence of urinary incontinence in older women around the world, meta-regression was used for two factors: sample size and year of study (Figs. 5 and 6). According to Fig. 5, with increasing sample size, the overall prevalence of urinary incontinence in the older adults women of the world decreases \( (P < 0.05) \). It was also reported in Fig. 6 that with increasing the year of the study, the overall prevalence of urinary incontinence in the older adults women of the world increases \( (P < 0.05) \).

Subgroup analysis by continent

Based on the results of Table 2, the highest prevalence of urinary incontinence in older adults women was reported in Asia with 45.1% (95% CI: 36.9–53.5%). The results of this table also report that no diffuse bias was observed in the study by continent, and the study of metallic mercury was also reported in each continent.

Effective and related factors in urinary incontinence in older adults' women

According to a systematic review of studies, various factors affect the incidence of urinary incontinence in older women, the most important of which are the age of women [25, 26, 38, 49, 50, 58–64], obesity based on BMI index [25, 37, 48, 49, 52, 58, 59, 62, 63, 65–67], diabetes [25, 26, 37, 49, 52, 58, 62, 66–68], women’s education [26, 30, 36, 48, 52, 58, 61], delivery rate [23, 37, 59, 60, 62, 67], hypertension [26, 66, 67], smoking...
as well as urinary tract infections [23, 49, 52]. Based on the results reported in Table 3, all these factors have a significant difference in the incidence of urinary incontinence in older adults' women (p < 0.05).

**Discussion**

Urinary incontinence is a very common condition that usually increases with age in women. Having general information about the prevalence of this disorder and identifying risk factors is useful and even necessary that can play an effective role in improving the quality of life and general health of society [4, 57]. This meta-analysis study was performed on 518,465 older adults women and the prevalence of urinary incontinence in older adults women was 37.1%. However, in the study of the prevalence of incontinence in older adults women by continents, the highest prevalence of urinary incontinence was reported in older adults women in Asia with 45.1%.

In a study conducted in Egypt (2020), the prevalence of incontinence among older women was 80% [50]. In the study of Summer Khan et al. in India (2018) the overall prevalence of urinary incontinence was 46.3% [30], in a study in Russia (2018) the prevalence of incontinence in older adults women was 40.2 [57].

In a study conducted in Iran (2017), it was reported that one-third of older women (33%) have urinary incontinence [34]. In another study conducted in Iran as a systematic review and meta-analysis (2018), the overall prevalence of urinary incontinence in women was estimated at 46% [64].

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**Table 1 Specifications of studies entered the study**

| Row | Author [References] | Publication year | Area | Participants' Age | Sample size | Prevalence | Quality assessment |
|-----|---------------------|------------------|------|-------------------|-------------|------------|------------------|
| 1   | Mağfiret Kasıçka [29] | 2015             | Turkey | ≥65               | 1094        | 51.6       | Moderate          |
| 2   | Mary K. Townsend [33] | 2017             | Mexico | ≥60               | 1289        | 9.5        | Moderate          |
| 3   | Samreen Khan [30] | 2017             | India  | ≥60               | 149         | 46.3       | Moderate          |
| 4   | Larissa Pruner Marques [23] | 2015 | Brazil | ≥60               | 1089        | 36.3       | High             |
| 5   | E. Moudi [34] | 2017             | Iran   | ≥60               | 590         | 32.9       | High             |
| 6   | Khanighaleejojh R [35] | 2011             | Iran   | 68–84             | 114         | 54.2       | Moderate          |
| 7   | David V. Espino [36] | 2003             | USA    | ≥65               | 1589        | 15         | Moderate          |
| 8   | Stefania Maggi [37] | 2001             | Italy  | ≥65               | 1531        | 21.6       | Moderate          |
| 9   | Yu Ko [38] | 2005             | USA    | ≥65               | 58,255      | 27.5       | Moderate          |
| 10  | Jing Ge [39] | 2015             | China  | ≥60               | 627         | 22.1       | High             |
| 11  | Juliana Schulze Burti [40] | 2012 | Brazil | ≥65               | 246         | 50         | Moderate          |
| 12  | Rochani Surardi [41] | 2014             | Indonesia | ≥60             | 273         | 24.2       | Moderate          |
| 13  | Gileard G. Masenga [42] | 2019 | Tanzania | 55–90             | 274         | 48.5       | Moderate          |
| 14  | Jennifer M. Wu [43] | 2015             | USA    | ≥60               | 2423        | 20.6       | Moderate          |
| 15  | Mary K. Townsend [33] | 2017             | Mexico | ≥60               | 1168        | 10.3       | Moderate          |
| 16  | Lei Zhang [44] | 2014             | China  | ≥60               | 3753        | 51.6       | Moderate          |
| 17  | Jaroslaw Pinkas [45] | 2016             | Poland | 90–106            | 870         | 60         | High             |
| 18  | Javier Jerez-Roig [46] | 2016             | Brazil | ≥60               | 240         | 40.8       | Moderate          |
| 19  | Renata B. Reigota [47] | 2016             | Brazil | ≥60               | 379         | 53.6       | Moderate          |
| 20  | Nazli Sensoy [48] | 2013             | Turkey | ≥60               | 203         | 29.3       | High             |
| 21  | J. Marleen Linde [49] | 2017             | Netherlands | ≥60             | 189         | 56.6       | Moderate          |
| 22  | Waaq A. Aly [50] | 2020             | Egypt  | ≥60               | 130         | 80         | Moderate          |
| 23  | Prabhu, Shrutikutal Atul [51] | 2013 | India  | ≥60               | 58          | 41.1       | High             |
| 24  | Bo Liu [52] | 2014             | China  | ≥60               | 1417        | 54.2       | Moderate          |
| 25  | Pamela L. [53] | 2013             | Canada | ≥65               | 331,000     | 14         | High             |
| 26  | Rui Luo [54] | 2017             | Singapore | ≥60             | 22          | 59.09      | High             |
| 27  | Catherine A. Matthews [55] | 2013 | America | 62–87            | 64,396      | 38         | Moderate          |
| 28  | Lea F. Schumpf [56] | 2017             | Switzerland | ≥65         | 44,811      | 54.7       | Moderate          |
| 29  | Olga NTkacheva [57] | 2018             | Russia | ≥65               | 286         | 40.2       | High             |
Based on the results, the highest prevalence of urinary incontinence in older adults’ women was reported in Asia with 45.1% and the lowest prevalence of urinary incontinence in older adults’ women was reported in America with 25.8%. By observing the prevalence in different regions, it can be concluded that the prevalence of urinary incontinence in different populations is completely different, which can be due to differences in culture or tools and methods of study.

It can also show the effect of ethnoreligious factor on the insignificance of urinary incontinence in older adults’ women in Asian countries, this issue has been stated and reported in the study of Touhidi Nezhad and et al. this study is about rectovaginal fistula and explains the importance and says that The rectovaginal fistula is a complex and multifaceted problem with social, individual, familial, religious, and ethnic-environmental dimensions [69], this can embarrass Asian women and hide and increase the prevalence of urinary incontinence in older women.

The high prevalence obtained in this study shows the need to investigate and follow up this condition, due to the significant impact of this disorder on depression and quality of life of older adults’ women, requires special attention and screening for urinary incontinence in treatment and care programs in the country. Various studies have mentioned various factors in the incidence of urinary incontinence in women, such as age, menopause, delivery and number of deliveries, obesity, and diabetes are among the most important of these factors [25, 70].

Age is one of the important factors in the prevalence of urinary incontinence. Changes related to aging in the lower urinary system include: decreased bladder capacity and feeling of fullness, decreased rate of detrusor muscle contraction, decreased pelvic floor muscle resistance and increased residual urine volume [21].

In a study by Marland Lind et al. in the Netherlands and a study by Nazli et al. in Turkey, aging was one of the most influential factors in urinary incontinence [48, 49], while in a study in Brazil [46] In Iranian older adults women, no relationship was observed between urinary incontinence and aging [34]. Menopause, with a decrease in estrogen and a decrease in collagen, reduces the elasticity of the detrusor muscle of the ductus arteriosus and atrophic changes in the pelvic floor muscles and increases urinary incontinence in women [71].

In the study conducted in Turkey, menopause is one of the most important factors influencing female
incontinence [48], while in the study of Aquarius et al. in Brazil, no significant relationship was reported between menopause and the increased prevalence of urinary incontinence [72]. Urinary incontinence is higher in women with more deliveries and vaginal deliveries. These two factors seem to be one of the most important risk factors for urinary incontinence in women [73]. In the study conducted among Chinese women, there is a type of delivery and the possibility of urinary incontinence [52], also in the study of Marland Lind et al. there was a significant relationship between delivery history, number and type of delivery with increased urinary incontinence [49]. However, in a study in India, no association was found between childbirth and urinary incontinence [30].

Obesity is an exacerbating condition of urinary incontinence, which can be caused by the accumulation of excess weight on the urinary tract during life [22]. Many studies have shown an association between obesity and increased urinary incontinence. In a study by Ninomia et al. in Japan [59] and a study by Hong et al. in the United States [74], a significant relationship was found between weight gain and increased incidence of urinary incontinence.

Also, the level of education is considered as one of the components of individual and social development and its role in personal health and also a factor in increasing the quality of life [9]. In his study by Espanyo et al. in Mexico and the United States [36] and in the study by Marcos et al. in Brazil [23], increasing the level of education was reported to be an important factor in reducing the incidence of urinary incontinence. No urinary incontinence was reported between education levels [66].

Diabetes can cause UI by several mechanisms, hyperglycaemia causes increased urine volume and increased
### Meta Analysis

**Fig. 4** Results of sensitivity analysis

| Study name          | Statistics with study removed | Event rate (95% CI) with study removed |
|---------------------|-------------------------------|----------------------------------------|
| Ma et al.           | 0.366 0.290 0.450 -3.094 0.002 |
| Mary K. Townsend    | 0.386 0.308 0.471 -2.619 0.009 |
| Samreen Khan        | 0.368 0.292 0.452 -3.048 0.002 |
| Larissa Pruner Marques | 0.372 0.295 0.456 -2.957 0.003 |
| E. Moudi            | 0.373 0.296 0.457 -2.931 0.003 |
| Kianighalejough     | 0.366 0.290 0.449 -3.112 0.002 |
| David V. Espino     | 0.382 0.304 0.466 -2.719 0.007 |
| Stefania Maggi      | 0.378 0.300 0.462 -2.806 0.005 |
| Yu Ko               | 0.376 0.288 0.473 -2.501 0.012 |
| Jing Ge             | 0.378 0.300 0.462 -2.819 0.005 |
| Juliana Schulze Burti | 0.367 0.291 0.451 -3.078 0.002 |
| Rochani Sumardil6,5 | 0.377 0.299 0.461 -2.846 0.004 |
| Gilead G. Masengal  | 0.367 0.291 0.451 -3.066 0.002 |
| Jennifer M. Wu      | 0.378 0.300 0.463 -2.790 0.005 |
| Mary K. Townsend1   | 0.385 0.307 0.470 -2.638 0.008 |
| Lei Zhang           | 0.366 0.290 0.450 -3.101 0.002 |
| Jaroslav Pinkas     | 0.366 0.290 0.449 -3.113 0.002 |
| Javier Jerez-Roig   | 0.370 0.293 0.454 -3.002 0.003 |
| Renata B. Reigola   | 0.366 0.290 0.449 -3.109 0.002 |
| Nazi Sensoy         | 0.374 0.297 0.459 -2.897 0.004 |
| J. Marleen Linde    | 0.365 0.289 0.448 -3.132 0.002 |
| Walaa W. Aly        | 0.356 0.281 0.439 -3.350 0.001 |
| Prabhu, Shruti Atul | 0.370 0.293 0.454 -3.008 0.003 |
| Bo Liu              | 0.365 0.289 0.449 -3.120 0.002 |
| Pamela L.           | 0.380 0.330 0.432 -4.393 0.000 |
| Rui Luo             | 0.365 0.289 0.448 -3.131 0.002 |
| Catherine A. Matthews | 0.372 0.287 0.465 -2.678 0.007 |
| Lea F. Schumpf      | 0.364 0.299 0.435 -3.683 0.000 |
| Olga NTkachev       | 0.370 0.294 0.454 -2.996 0.003 |

**Fig. 5** Meta-regression diagram of the overall prevalence of urinary incontinence in older adults' women worldwide by sample size
activity of the bladder muscle, and ultimately causes dysfunc-
tion of this muscle. Diabetic cytopathic and bladder nerve 
damage are other effective complications [75]. In a 
study by Absen et al. in Norway, it was reported that 
there was a significant association between diabetes and 
urinary incontinence [60], while a German study found no 
association between diabetes and urinary incontin-
ence [25].

Chronic respiratory diseases are associated with 
symptoms such as a cough that can cause urinary in-
continence [76]. In a study based on the population of 
Jinge Ge et al. in China, a significant relationship was 
reported between lung disease and incidence [39]. 
However, in the study of Ralph Souher et al. in 
Germany [4] and the study of Sohan et al. in Korea 
[26], no significant relationship was observed between 
urinary incontinence and respiratory disease.

Nervous system disorders are seen as an important 
factor in the prevalence of urgent incontinence [19, 20]. 
There were mental illnesses, cancer and conditions such 
as living alone [25]. A study by Kasik et al. in Turkey 
also reported obesity, smoking, a history of constipation, 
UTI, family history, chronic illness, chronic cough, a his-
tory of hormone therapy, genital prolapse, a history of 
urology, and a history of communication impairment. 
Have significance with incontinence [46].

In a promising study by colleagues in Iran, it was 
reported that urinary incontinence is directly and 
significantly related to factors such as marital status, 
constipation, and corticosteroid medications, while 
urinary incontinence is associated with factors such 
as age, obesity, education, number of children, dia-
abetes, hypertension, and Respiratory disorders were 
not associated [34].

In a 2016 study by Aquarius et al. in Brazil, the 
factors that increased urinary incontinence in women 
cluded: number of pregnancies, deliveries, genital 
prolapse, anxiety, depression, and obesity [72]. In a 
study by Marcos et al. in Brazil, there was a signifi-
cant relationship between age, education, physical 
activity, dependence, cognitive problems, symptoms 
of anoma, bronchitis, asthma, cardiovascular disease, 
diabetes, hypertension, stroke and ischemia, nutri-
tional status, polypharmacy, self-Urinary inconti-
ence was reported [23].

Given the above, it is necessary for physicians and 
specialists to consider adults’ women in the age 
group of 55 to 106 years according to the criteria

| continents | Number of articles | Sample Size | $I^2$ | Begg and Mazumdar Test | Prevalence % (95% CI) | Meta-regression | $p$ value |
|------------|-------------------|-------------|------|------------------------|-----------------------|-----------------| ---------|
| Asia       | 12                | 7419        | 97.1 | 0.394                  | 45.1 (95% CI: 36.9–53.5) | increase         | decrease  | < 0.05   |
| Europe     | 6                 | 48,698      | 99.1 | 0.247                  | 43.8 (95% CI: 32.2–56.1) | increase         | increase   | < 0.05   |
| America    | 11                | 462,074     | 99.9 | 0.535                  | 25.8 (95% CI: 18.2–35.3) | decrease         | decrease   | < 0.05   |

**Table 2** Evaluation of urinary incontinence in older adults’ women by different continents
| Author [References] | Place of study        | type of study       | Risk factors examined                           | p-value |
|---------------------|-----------------------|--------------------|------------------------------------------------|---------|
| S.A. Eshkoor 2017 [27] | Malaysia              | Case-control       | Blood Triglycerides                             | 0.015   |
|                     |                       |                    | Albumin                                         | 0.026   |
|                     |                       |                    | HDL                                             | 0.029   |
|                     |                       |                    | Monounsaturated fat                             | 0.009   |
|                     |                       |                    | Cataract-glaucoma                               | 0.051   |
|                     |                       |                    | Tiredness                                       | 0.039   |
|                     |                       |                    | Constipation                                     | < 0.001 |
|                     |                       |                    | Gastric-Ulcer Problem                           | < 0.001 |
|                     |                       |                    | Vision-hearing loss                             | 0.010   |
|                     |                       |                    | Joint pain                                       | 0.002   |
| Shi LU et al. 2016 [65] | China                | Cross-sectional    | Age                                             | 0.041   |
|                     |                       |                    | BMI                                             | 0.027   |
|                     |                       |                    | Menstrual status                                 | 0.036   |
|                     |                       |                    | Mode of delivery                                 | 0.007   |
|                     |                       |                    | Heart disease                                    | 0.02    |
|                     |                       |                    | Dyslipidemia                                     | 0.038   |
|                     |                       |                    | Arthritis                                       | 0.003   |
|                     |                       |                    | Gynecological disease                            | < 0.001 |
|                     |                       |                    | Chronic pelvic pain                              | < 0.001 |
|                     |                       |                    | Atrophic vaginitis                              | < 0.001 |
|                     |                       |                    | Constipation                                     | < 0.001 |
|                     |                       |                    | Fecal incontinence                               | < 0.001 |
| Ralf Suhr et al. 2017 [25] | Germany             | Cross-sectional    | Musculoskeletal disease                         | 0.002   |
|                     |                       |                    | Stroke                                          | 0.035   |
|                     |                       |                    | Cancer                                          | 0.003   |
|                     |                       |                    | Dementia                                         | < 0.001 |
|                     |                       |                    | Live with barriers                               | 0.129   |
|                     |                       |                    | Living alone                                     | 0.143   |
|                     |                       |                    | BMI                                             | 0.01    |
|                     |                       |                    | Age                                             | 0.06    |
|                     |                       |                    | Female sex                                       | 0.007   |
|                     |                       |                    | Respiratory                                      | 0.158   |
|                     |                       |                    | Diabetes                                         | 0.798   |
|                     |                       |                    | Cardiovascular                                   | 0.002   |
|                     |                       |                    | Psychiatric                                      | 0.927   |
| Pedersen et al. 2017 [58] | Germany and Denmark | Analytical descriptive | Age                                             | < 0.001 |
|                     |                       |                    | BMI                                             | 0.001   |
|                     |                       |                    | Diabetes                                         | 0.007   |
|                     |                       |                    | Chronic obstructive pulmonary disease            | 0.002   |
|                     |                       |                    | Vaginal deliveries                               | < 0.001 |
| Maşfiret Kaşkçı et al. 2015 [36] | Turkey     | Cross-sectional    | BMI                                             | < 0.001 |
|                     |                       |                    | Smoking                                         | 0.047   |
|                     |                       |                    | Constipation                                     | < 0.001 |
| Author [References] | Place of study | type of study | Risk factors examined | p-value |
|---------------------|----------------|--------------|-----------------------|---------|
| Kyungjin Sohn et al. 2018 [26] | Korea | Longitudinal Study | Urinary tract infection | < 0.001 |
|                     |                |              | Chronic diseases      | < 0.001 |
|                     |                |              | Familiar history      | < 0.001 |
|                     |                |              | Complaint of chronic coughing | 0.530 |
|                     |                |              | Hormone replacement   | < 0.001 |
|                     |                |              | Genital prolapse      | < 0.001 |
|                     |                |              | Cystocele             | < 0.001 |
|                     |                |              | Urogenital operation  | < 0.001 |
|                     |                |              | Nocturia              | < 0.001 |
|                     |                |              | Age                   | < 0.001 |
|                     |                |              | Education             | < 0.001 |
|                     |                |              | Marital status        | 0.043   |
|                     |                |              | Chronic lung disease  | 0.034   |
|                     |                |              | Cerebrovascular disease II | 0.002 |
|                     |                |              | Social activity       | 0.007   |
|                     |                |              | Arthritis             | < 0.001 |
|                     |                |              | Difficulty in daily living due to visual problems | < 0.001 |
|                     |                |              | Difficulty in daily living due to hearing problems | < 0.001 |
|                     |                |              | Experience of fall in the last 2 years | 0.017 |
|                     |                |              | Psychiatric disease   | 0.008   |
|                     |                |              | Fear of falling       | < 0.001 |
|                     |                |              | Psychiatric disease   | 0.008   |
| Samreen Khan et al. 2017 [30] | India | Cross-sectional | Years spent in menopause | 0.002 |
|                     |                |              | parity                | 0.001   |
|                     |                |              | Hysterectomy          | 0.006   |
|                     |                |              | UTI                   | < 0.001 |
|                     |                |              | Pelvic organ prolapse | 0.031   |
| Sanae Ninomiya et al. 2017 [59] | Japan | Cross-sectional | Age                   | < 0.001 |
|                     |                |              | BMI                   | < 0.001 |
|                     |                |              | parity                | 0.009   |
|                     |                |              | Mode of delivery      | < 0.001 |
|                     |                |              | Constipation          | 0.01    |
| Larissa Pruner Marques et al 2015 [23] | Brazil | Cross-sectional | Gender                | < 0.001 |
|                     |                |              | Age                   | < 0.001 |
|                     |                |              | Education             | < 0.001 |
|                     |                |              | Physical activity     | < 0.001 |
|                     |                |              | Dependence            | < 0.001 |
|                     |                |              | Cognitive deficiency  | < 0.001 |
|                     |                |              | Depressive symptoms   | < 0.001 |
|                     |                |              | Diabetes              | < 0.001 |
|                     |                |              | Bronchitis or asthma  | < 0.001 |
Table 3 A systematic review of the factors affecting older adults’ women with urinary incontinence (Continued)

| Author [References]                  | Place of study       | type of study                                      | Risk factors examined                          | p-value  |
|--------------------------------------|----------------------|---------------------------------------------------|------------------------------------------------|----------|
| E. Moudi et al. 2017 [34]            | Iran                 | Cross-sectional                                   | Hypertension                                   | < 0.001  |
|                                      |                      |                                                   | Cardiovascular                                 | < 0.001  |
|                                      |                      |                                                   | Stroke                                         | < 0.001  |
|                                      |                      |                                                   | Nutritional state                              | 0.017    |
|                                      |                      |                                                   | Polypharmacy                                   | < 0.001  |
|                                      |                      |                                                   | Self-rated health                              | < 0.001  |
| David V. Espino et al. 2003 [36]     | Mexico               | Cross-sectional                                   | Marital status                                 | 0.03     |
|                                      |                      |                                                   | Constipation                                   | 0.01     |
|                                      |                      |                                                   | Steroid drug                                   | 0.04     |
| Stefania Maggi et al. 2001 [37]      | Italy                | Cross-sectional                                   | Education                                      | 0.03     |
|                                      |                      |                                                   | BMI                                            | 0.03     |
|                                      |                      |                                                   | Diabetes                                       | 0.01     |
|                                      |                      |                                                   | Smoking                                        | < 0.001  |
|                                      |                      |                                                   | Impaired activities of daily living            | 0.03     |
|                                      |                      |                                                   | Age                                            | 0.02     |
| Marit Helen Ebbesen et al. 2013 [60] | Norway               | Cross-sectional                                   | Age                                            | < 0.001  |
|                                      |                      |                                                   | BMI                                            | < 0.001  |
|                                      |                      |                                                   | Self-perceived health status                    | < 0.001  |
|                                      |                      |                                                   | Smoking                                        | 0.009    |
|                                      |                      |                                                   | Alcohol                                        | 0.016    |
|                                      |                      |                                                   | Parity                                         | < 0.001  |
|                                      |                      |                                                   | Diabetes                                       | 0.029    |
|                                      |                      |                                                   | Angina                                         | 0.021    |
|                                      |                      |                                                   | Heart attack                                   | 0.047    |
|                                      |                      |                                                   | Stroke                                         | 0.032    |
| Clemens Wehrberger et al. 2012 [68]  | Austria              | Longitudinal, population-based study              | Alzheimer                                      | 0.073    |
| Jeongok Park et al. 2015 [66]        | Korea                | Analytical descriptive                             | Age                                            | < 0.001  |
|                                      |                      |                                                   | BMI                                            | 0.02     |
|                                      |                      |                                                   | Place of residence                             | 0.003    |
|                                      |                      |                                                   | Self-reported health status                     | < 0.001  |
|                                      |                      |                                                   | Hypertension                                   | < 0.001  |
|                                      |                      |                                                   | Stroke                                         | < 0.001  |
|                                      |                      |                                                   | Diabetes                                       | < 0.001  |
**Table 3** A systematic review of the factors affecting older adults’ women with urinary incontinence (Continued)

| Author [References] | Place of study | type of study       | Risk factors examined                                                                 | p-value   |
|---------------------|----------------|---------------------|---------------------------------------------------------------------------------------|-----------|
| Jing Ge et al. 2015 [39] | China          | Analytical descriptive | Asthma, Depot, Falls, Functional ability, Physical strength, Age, Job, Education, BMI, Income/month, Smoking, Physical exercise frequency, Menstrual status, Pregnancy history, Abortion times, Parity, Age at first delivery, Mode of delivery, Chronic pelvic pain, Respiratory disease, Digestive disease, Cardiovascular, Neurologic disease, Osteoarticular disease, Hyperlipemia, Diabetes, History of pelvic surgery, Gynecological disease, Constipation, Fecal incontinence | < 0.001   |
| Juliana Schulze Burti et 2012 [40] | Brazil         | Cross-sectional     | Diabetes, Hypertension                                                                | 0.022     |
| Joshua A. Cohn et al. 2018 [61] | USA            | Cohort              | Age, Education                                                                       | < 0.001   |
| Vatche A. Minassian et al. 2020 [62] | USA            | Cohort              | Age, BMI, Parity, Smoking, Physical activity, Diabetes, History of vascular disease, Postmenopausal hormone use, Baseline UI severity | < 0.001   |
Table 3 A systematic review of the factors affecting older adults’ women with urinary incontinence (Continued)

| Author [References]          | Place of study | type of study       | Risk factors examined                  | p-value |
|------------------------------|----------------|--------------------|---------------------------------------|---------|
| Máyra Cecilia Dellú et al. 2016 [63] | Brazil          | Cross-sectional    | Pregnancy                             | < 0.001 |
|                              |                |                    | Post-partum                           | < 0.001 |
|                              |                |                    | Genital prolapse                      | < 0.001 |
|                              |                |                    | Stress                                | < 0.001 |
|                              |                |                    | Depression                            | < 0.001 |
|                              |                |                    | BMI                                   | < 0.001 |
| Javier Jerez-Roig et al. 2016 [46] | Brazil          | Cross-sectional    | Ethnicity                             | 0.005   |
|                              |                |                    | Stroke                                | 0.003   |
|                              |                |                    | Physical activity                     | 0.03    |
| Ramazan Altintas et al. 2013 [67] | Turkey          | Retrospective study | Age                                   | < 0.001 |
|                              |                |                    | BMI                                    | < 0.001 |
|                              |                |                    | Parity                                 | < 0.001 |
|                              |                |                    | Hypertension                           | 0.008   |
|                              |                |                    | Diabetes                               | < 0.001 |
|                              |                |                    | Birth trauma                           | < 0.001 |
|                              |                |                    | Gynecological surgery                  | < 0.001 |
| Nazli Sensoy et al. 2013 [48] | Turkey          | Cross-sectional    | Age                                   | < 0.001 |
|                              |                |                    | Marital status                         | < 0.001 |
|                              |                |                    | Education                              | < 0.001 |
|                              |                |                    | Job                                    | < 0.001 |
|                              |                |                    | BMI                                    | < 0.001 |
|                              |                |                    | Number of Deliveries                   | < 0.001 |
|                              |                |                    | Episiotomy                             | < 0.001 |
|                              |                |                    | Abortion                               | < 0.001 |
|                              |                |                    | Age at first delivery                   | < 0.001 |
|                              |                |                    | 4 kg baby delivered                    | < 0.001 |
| J. Marleen Linde et al. 2017 [49] | Netherlands    | Cross-sectional    | Age                                   | < 0.001 |
|                              |                |                    | BMI                                    | < 0.001 |
|                              |                |                    | UTI                                    | < 0.001 |
|                              |                |                    | Nocturia                               | 0.04    |
|                              |                |                    | Fecal incontinence                     | 0.004   |
|                              |                |                    | Constipation                           | < 0.001 |
|                              |                |                    | Diabetes                               | < 0.001 |
|                              |                |                    | Vaginal hysterectomy                    | < 0.001 |
|                              |                |                    | Childbirth history                      | < 0.001 |
|                              |                |                    | Number of deliveries                    | < 0.001 |
| Bo Liu et al. 2014 [52]      | China           | Cross-sectional    | BMI                                    | < 0.001 |
|                              |                |                    | Monthly Income                         | < 0.001 |
|                              |                |                    | Education                              | < 0.001 |
|                              |                |                    | Residence                              | < 0.001 |
|                              |                |                    | Physical activity                      | < 0.001 |
|                              |                |                    | Labor                                  | < 0.001 |
|                              |                |                    | Physical activity                      | < 0.001 |
|                              |                |                    | Hyperlipemia                            | < 0.001 |
recommended by the International Continence Society (ICS) and to standardize the criteria so that diagnostic and treatment strategies are more effective.

Limitations
The most important limitations of the present study are the high heterogeneity of studies, which can be due to sampling size, age groups, geographical areas, races, and other different factors in the studies, which can be controversial in the study.

Conclusion
Given the high prevalence of urinary incontinence in older women around the world, health policy makers must consider diagnostic measures in older women and prioritize treatment and rehabilitation activities.

Abbreviations
WHO: World Health Organization; ICS: International Association of Urinary Incontinence; UI: urinary incontinence; SUI: Stress urinary incontinence; UUI: Urgent urinary incontinence; NOS: The Newcastle-Ottawa Scale; SID: Scientific information database; PRISMA: Preferred reporting items for systematic reviews and meta-analysis; STROBE: Strengthening the reporting of observational studies in epidemiology for cross-sectional study

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Authors\' contributions
RJ and SB1 and MM contributed to the design, MM statistical analysis, participated in most of the study steps. SB1 and MM prepared the manuscript. SB1 and RJ and SB2 assisted in designing the study, and helped in the interpretation of the study. All authors have read and approved the content of the manuscript.

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Availability of data and materials
Datasets are available through the corresponding author upon reasonable request.

Declarations
Ethics approval and consent to participate
This study was recorded in the ethics committee of Kermanshah University of medical sciences with the ethics code of (IR.KUMS.REC.1399.455).

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no conflict of interest.

Author details
1Department of Nursing, School of Nursing and Midwifery, Kermanshah University of Medical Sciences, Kermanshah, Iran. 2Faculty of Health and Life Sciences, School of Life Sciences, Coventry University, Coventry, UK.

Table 3 A systematic review of the factors affecting older adults\' women with urinary incontinence (Continued)

| Author [References] | Place of study | Type of study | Risk factors examined | p-value |
|---------------------|----------------|---------------|-----------------------|---------|
| Walaa W. Aly et al. 2020 [50] | Egypt | Cross-sectional | Cardiovascular | < 0.001 |
|                      |               |               | Nervous System Disease | < 0.001 |
|                      |               |               | Diabetes | < 0.001 |
|                      |               |               | Nocturia | < 0.001 |
|                      |               |               | Constipation | < 0.001 |
|                      |               |               | Alcohol | < 0.001 |
|                      |               |               | Smoking | < 0.001 |
|                      |               |               | Prolonged Labor | < 0.001 |
|                      |               |               | Chronic pelvic pain | < 0.001 |
|                      |               |               | Marital status | < 0.001 |
|                      |               |               | Respiratory disease | < 0.001 |
|                      |               |               | Pregnancy | < 0.001 |
|                      |               |               | UTI | < 0.001 |
|                      |               |               | Mode of delivery | < 0.001 |
|                      |               |               | Praying | < 0.001 |
|                      |               |               | Social activities | < 0.001 |
|                      |               |               | Physical recreational activities | 0.002 |
|                      |               |               | Anxiety | < 0.001 |
|                      |               |               | Depression/hopelessness | < 0.001 |
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