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REVIEW

Association between urinary incontinence and frailty: a systematic review and meta-analysis

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Abstract

Purpose Urinary incontinence (UI) and frailty are common geriatric syndromes. Although literature increasingly supports a relationship between these two conditions, no systematic review and meta-analysis has been performed on this topic. Therefore, we aimed to investigate the potential association between UI and frailty, through a meta-analytic approach.
Methods A systematic search in major databases was undertaken until 15th March 2018 for studies reporting the association between UI and frailty. The prevalence of UI in people with frailty (vs. those without) was pooled through an odds ratio (OR) and 95% confidence intervals (CIs), with a random-effects model. The other outcomes were summarized descriptively.
Results Among 828 papers, 11 articles were eligible, including 3784 participants (mean age 78.2 years; 55.1% women). The prevalence of UI was 39.1% in people with frailty and 19.4% in those without. A meta-analysis with five studies (1540 participants) demonstrated that UI was over twice as likely in frail people versus those without (OR 2.28; 95% CI 1.35–3.86; $I^2 = 61\%$). One cross-sectional study, adjusting for potential confounders and one longitudinal study confirmed that UI is significantly associated with frailty. In two cross-sectional studies, using adjusted analyses, frailty was more common in people with UI.
Conclusion Urinary incontinence is twice as common in older people with frailty compared to older people without frailty. Screening and the development of interventions for UI and frailty could prove useful for this common comorbidity.

Keywords Frailty · Urinary incontinence · Meta-analysis · Aged

Introduction

Urinary incontinence (UI), one of the Geriatric Giants, introduced by Sir Bernard Isaacs in 1992, and later included in the list of Geriatric Syndromes, is a very common problem in the older person [1]. UI causes numerous negative effects on quality of life and has been shown to be associated with a twofold increased risk of impairment in both basic and instrumental activities of daily living, suggesting that it might represent an early marker of frailty [2].

Frailty is defined as a clinical state in which there is an increase in an individual's vulnerability to developing negative health-related events (such as disability, hospitalization, institutionalization, and death) when exposed to endogenous or exogenous stressors [3, 4]. Moreover, frailty is a non-specific state of vulnerability, which reflects multisystem physiological changes. However, these changes do not always represent a disease status, so some very old people, are frail without a specific life threatening illness [5].

Currently, frailty can be considered as a complex phenomenon, with multiple links and interactions between clinical, functional, mental and social components. It is reported

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that frailty can affect about 10% of older people and that exponentially increases with advancing age [6], reaching the maximum in very old persons in which the highest known prevalence of UI is expected (around 50–70%) [5]. Increasing research supports the fact that UI in frail older people constitutes a syndromic model with multiple interacting risk factors (such as age-related physiological changes, comorbidity, and common pathways between them), in which the accumulated effects of multiple impairments increase vulnerability to situational changes [7].

It is noteworthy that UI in frail older subjects is due mainly to functional impairments, concurrent medical diseases, and other different causal mechanisms. Consequently, these factors are shared by other geriatric syndromes, being potential targets for a multidisciplinary intervention [8]. Currently, it is accepted that the complex pathophysiological interaction of different factors might lead not only to UI, but also to other conditions typical of older people, such as instability, immobility, falls, impaired memory and consequently frailty [9, 10].

Given this background, we aimed at analysing the potential association between UI and frailty throughout a meta-analytic approach investigating the prevalence of UI in frail people (and vice versa), also taking in account potential confounders.

Methods

This systematic review was conducted in agreement to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) criteria [10] and the recommendations in the preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement [11] (Supplementary material 1). We followed a planned, but unpublished protocol that is available upon request.

Search strategy

The published literature was searched using keywords for the concepts of UI and frailty, until 15th March 2018. The search strategy was established using a combination of standardized terms (i.e. terms commonly used for identifying frailty and UI and terms recorded in MeSh) in PubMed and key words as follows: "(UI OR Continent OR continence OR incontinent OR incontinence) AND (frailty OR frail)". A similar search was run in Embase and Scopus. Two investigators (NV, PS) independently conducted an electronic literature search. Inconsistencies were resolved by consensus with a third author (BS).

References of articles included in the analysis and of others relevant to the topic were hand-searched to identify additional, potentially relevant publications. Conference abstracts were also considered contacting the authors up to four times over a month period to enable inclusion and acquire the variables of interest. No language restriction was applied.

Study selection

We only considered studies that: (a) reported information regarding UI (through self-report information, structured interview or when assessing activities of daily living, e.g. Katz's index [12]); (b) reported data regarding frailty, assessed through a validated diagnosis, e.g. Clinical Frailty Scale (Rockwood index) [13] or the criteria suggested by Fried et al. [14], but all the validated definitions of frailty were considered as eligible.

Studies were excluded if they: (a) did not report data regarding UI or frailty; (b) the mean age of the population included was less than 65 years.

Data extraction

To be included in the quantitative synthesis, studies had to provide data on prevalence or incidence of UI in frail people (or vice versa). Two authors (NV, PS) independently recorded data extracted from the selected studies into a standardized Microsoft Excel spreadsheet. Any disagreement was resolved by consensus with a third author (BS).

The following information was extracted: (i) study characteristics; (ii) study setting (e.g. community); (iii) main condition; (iv) demographic characteristics (e.g. percentage of women and mean age); (v) criteria used for the assessment of frailty; (vi) criteria used for the assessment of UI. When two or more studies represented the same cohort, the largest study was included.

Outcomes

The primary outcome was the prevalence of UI in people with frailty vs. people without frailty (pre-frail and/or robust). When the prevalence of UI was reported for pre-frail and robust participants separately, the number of people with UI in these two groups was summed. We also considered studies reporting the prevalence of UI in pre-frail vs. robust, if this information was reported.

As secondary outcomes we considered the prevalence of frailty in people with UI (vs. continence) and the estimates adjusted for potential confounders (e.g. odds ratios, OR adjusted for covariates).

Assessment of study quality

The Newcastle–Ottawa Scale (NOS) [15–17] was used to assess study quality. The NOS assigns a maximum of 9 points based on three quality parameters: selection, comparability, and outcome, with a cut-off of ≤5 being indicative of high risk of bias [16].

Statistical analysis

Analyses were performed by one investigator (NV) using comprehensive meta-analysis (CMA) 2 (http://www.meta-analysis.com).

Only outcomes having at least four studies were meta-analyzed; the other findings were reported descriptively. Therefore, only the pooled prevalence of UI in people with frailty vs. no frailty was calculated and reported as OR. For other outcomes, where there was less than four studies, we summarized the data with a best evidence synthesis.

The random-effects model was used to account for anticipated between-study heterogeneity [17]. This was assessed using the Chi-squared and *I*-squared statistics, assuming that a $p < 0.10$ for the former and a value ≥ 50% for the latter were indications of significant heterogeneity [18]. We planned to run a meta-regression analysis for investigating the sources of this heterogeneity, but in agreement with the Cochrane's guidelines, the optimal number for running a meta-regression analysis is ten studies for an outcome [19].

Publication bias was assessed by visual inspection of funnel plots and using the Egger bias test [20]. When ≥ 3 studies were available, we used the Duval and Tweedie non-parametric trim-and-fill method to account for potential publication bias. Based on the assumption that the effect sizes of all the studies are normally distributed around the centre of a funnel plot, in the event of asymmetries, this procedure adjusts for the potential effect of unpublished (trimmed) studies [21].

Results

The search identified 828 non-duplicated, potentially eligible papers. After excluding 772 works based on their titles and abstracts, 56 full-text articles were examined, and 11 articles [9, 22–31] were finally included in systematic review (Fig. 1). Five studies gave sufficient data for a meta-analysis.

Study and patient characteristics

As shown in Table 1, the 11 studies [9, 22–31] included a total of 3784 older participants. These participants were, on average, 78.2 (SD 6.1) years old and mainly women (=55.1%). All the studies were cross-sectional, except one that was longitudinal and that investigated frailty as potential risk factor for UI [9].

The majority of the studies was conducted in Asia ($n = 6$) and among community dwellers ($n = 5$). Eight studies used the criteria proposed by Fried for assessing frailty, whilst the other three used the Clinical Frailty Scale. Finally, UI was assessed through self-reported information (like "do you have UI") in seven studies [9, 23–26, 29, 31] through the Katz's index in three studies [27, 28, 30] and through a structured questionnaire (Social Care Trust Continence Assessment) in another one [22].

The quality of the studies was generally high, as shown by the median value of the NOS scale (median 8) (Table 1).

Prevalence of UI in frailty and frailty as risk factor for UI

Figure 2 shows the prevalence of UI in frail vs. no frail participants. UI was present in 39.1% of people with frailty vs. 19.4% in people without frailty. A comparative meta-analysis found a significantly higher presence of UI in people with frailty ($n = 5$ studies; 1540 participants; OR 2.28; 95% CI 1.35–3.86; $p = 0.002$; $I^2 = 61\%$). Publication bias was not present as indicated by the Egger's test (− 0.94 ± 2.53; $p = 0.74$) and according to the funnel plot inspection.

Two studies reported the association between UI and frailty, taking in account potential confounders and not reporting the prevalence of UI by frailty status. The first one [30], after adjusting for eight covariates, failed to report any significant association between these two conditions (OR 1.66; 95% CI 0.37–7.72), whilst the other one [28] reported that UI was four times higher in people with frailty compared to those without, after adjusting for four potential confounders (OR 4.27; 95% CI 1.75–10.25). In a study including only pre-frail and robust older participants, pre-frailty was associated with a significantly higher prevalence of UI, after taking in account 12 potential confounders (OR 1.90; 95% CI 1.33–2.73) [29].

Finally, a recent longitudinal study reported that frailty predicts incident UI in 210 hospitalized older people [9]. Frailty, in fact, predicted incident UI and/or death over time (12 months: OR 2.67; 95% CI 1.13–6.27; $p = 0.025$), considering age, sex, and severity of illness as confounders [9].

Prevalence of frailty in UI

Two studies reported the prevalence of UI in frail (vs. no frail people) [22, 23]. In the first study [22], after adjusting for seven confounders, UI was associated with a two times higher prevalence of frailty compared to control group without incontinence and (OR 2.1; 95% CI: 1.20–3.60). The second study [23] reported an adjusted OR for this association of 7.47 (95% CI 4.58–12.77).

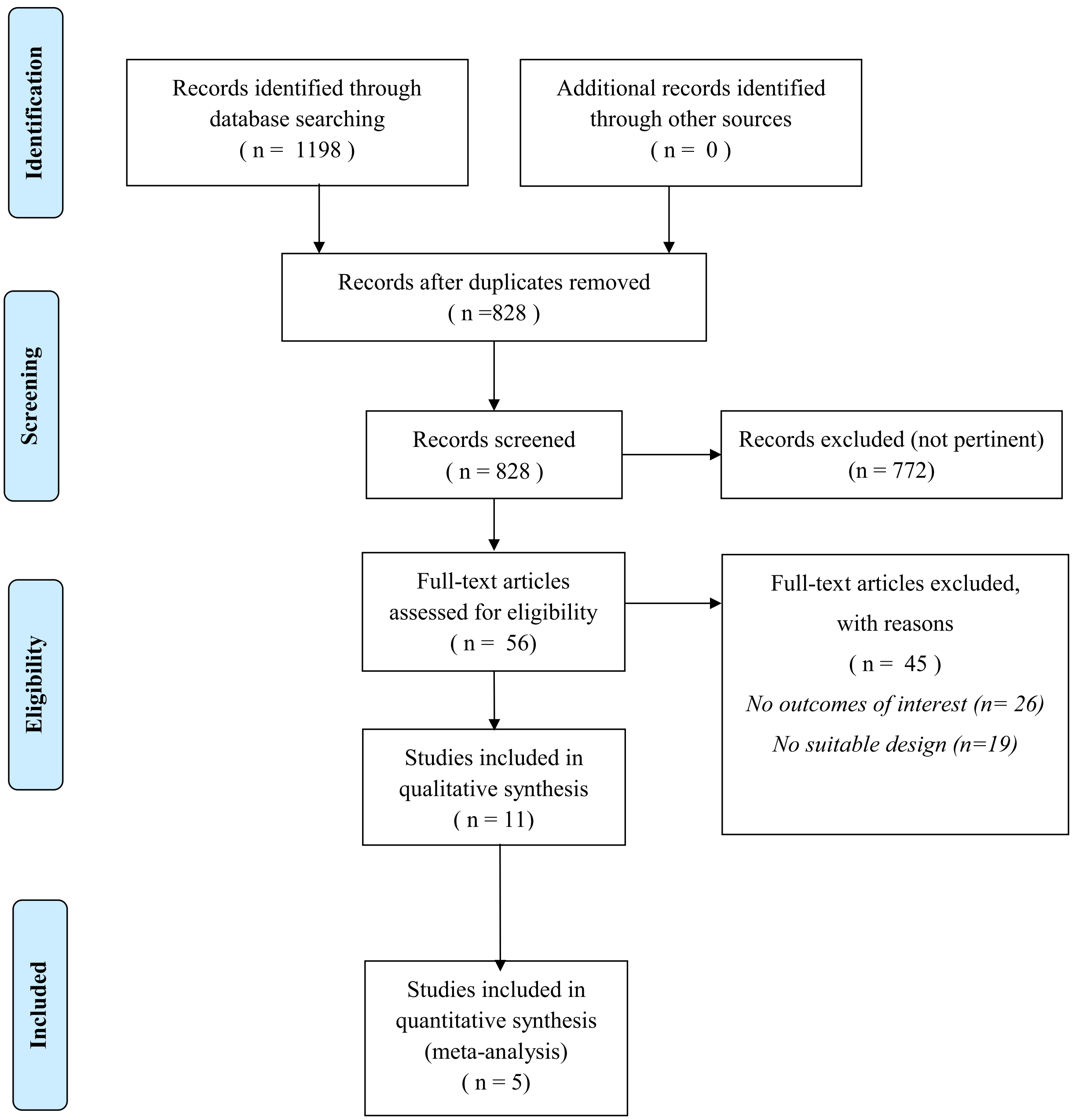

Fig. 1 PRISMA flow chart

Discussion

In this systematic review and meta-analysis, which included 11 independent studies and 3784 participants, we found that UI affects 39.1% of frail people, twice as common compared to a control group of no frail subjects. These findings were confirmed in a cross-sectional study adjusting for potential confounders and in a recent longitudinal study which showed that frailty can predict the onset of UI.

UI has been shown to cause a wide range of negative outcomes in older people, including falls, urinary tract infections, skin complications, functional decline, psychosocial limitations, decreased quality of life, and poor health perception [1]. These complications resulting from UI might lead to an accumulation of deficits, well known and sufficient to create the state of frailty. Conversely, individuals with frailty frequently experience homeostatic dysregulations leading to impairments in physical functioning, mobility, gait and balance, and cognition, which might result in UI [9].

A key distinction in the aetiology of UI between robust and frail older people is the presence of conditions and

Table 1 Descriptive characteristics of the studies included

Author, year	Continent	Population	Sample size	Mean age (SD)	Females (%)	Frailty criteria	Urinary incontinence criteria	Newcastle–Ottawa scale
Barradas Calado, 2016	South America	Community dwelling	385	73.9 (6.5)	64.7	Fried	Self-reported	6
Berardelli, 2013	Europe	Community dwelling	570	≥ 65 years	56.7	Fried	Self-reported	8
Bilotta, 2010	Europe	Outpatients	302	81.9 (6.7)	71	Fried	Katz's index	9
Chang, 2011	Asia	Community dwelling	275	≥ 65 years	53.8	Fried	Self-reported	8
Chong, 2018 (longitudinal)	Asia	Inpatients	210	89.4 (4.6)	69.5	Fried	Self-reported	9
Erekson, 2015	North America	Outpatients (pelvic surgery)	150	76.2 (7.2)	100	Fried	Katz's index	5
Goeteyn, 2017	Europe	Inpatients (surgery)	98	74 (8.7)	36	Clinical Frailty Scale	Self-reported	5
Jung, 2016	Asia	Community dwelling	382	74.4 (6.5)	56.3	Fried	Kat's index	8
Kang, 2015	Asia	Inpatients	352	≥ 65 years	42.3	Clinical Frailty Scale	Self-reported	6
Matsushita, 2017	Asia	Healthy, community dwelling	620	69.3 (4.4)	56.8	Fried	Self-reported	9
Wang, 2017	Asia	Nursing home	440	86.6 (4.1)	0	Clinical Frailty Scale	Social care trust continence assessment form	9
Total	Asia: six studies; Europe: three; North America: one; South America: one	Community dwelling: five studies; inpatients: three; outpatients: two; nursing home: one	3784	78.2 (6.1)	55.1	Fried scale: eight studies; Clinical Frailty Scale: three	Self-reported: seven studies; Katz's index: three; structured questionnaire: one	Median 8 (range 5–9)

SD standard deviation

Study name	Odds ratio	Lower limit	Upper limit	p-Value	UI / Total: Frail	UI / Total: No frail
Barradas Calado, 2016	1.774	0.874	3.600	0.112	15 / 35	104 / 350
Chang, 2011	1.847	0.737	4.628	0.190	7 / 31	33 / 242
Erekson, 2015	0.952	0.326	2.778	0.928	5 / 25	26 / 125
Jung, 2016	6.379	2.967	13.713	0.000	16 / 66	15 / 314
Kang, 2015	2.346	1.516	3.632	0.000	78 / 152	62 / 200
	2.281	1.349	3.858	0.002	121 / 309	240 / 1231

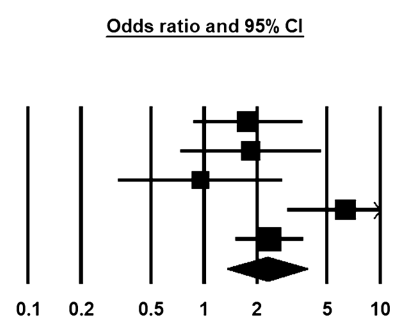

Fig. 2 Meta-analysis of pooled odds ratio of urinary incontinence in frail and no frail people

factors outside the lower urinary tract—such as cognitive impairment, poor mobility and polypharmacy—in precipitating loss of continence and/or aggravating the main urinary symptoms [32]. Moreover, this finding justifies the need of a multidimensional approach and clinical evaluation of UI in older people to assess the main risk factors and the aetiology of UI, with the incorporation of new components to detect frailty, and then, to establish the integral and patient tailored plan of treatment [1].

A recent study in—community-dwelling older adults found that patients with UI were 6.5 times more likely to be frail and 2.3 times more likely to fall in the pre-frail group, when compared to subjects without UI. In addition, the same study reported that patients who are "very frail" with UI were 7.8 times more likely to sustain a fall compared to their counterparts without UI [23].

A cross-sectional study from Taiwan of men aged 80 years and older found that the overall prevalence of UI was 19.1% and that prevalent UI was independently associated with frailty, stool incontinence, and depressive symptoms [22].

Based on the results of this systematic review and meta-analysis, we propose accepting a close relationship between these two, as well as with other geriatric syndromes (such as falls, malnutrition, and immobility). Moreover, we propose to systematically incorporate new tools for the evaluation of frailty in older people with UI, because the treatment should be different. The frailest older people have a multifactorial aetiology of UI, with higher prevalence of comorbidity, polypharmacy and disability than the robust older people. Consequently, the plan of treatment in this patient population should also be different due to the higher prevalence of drug interactions and side-effects of the pharmacological treatment, especially antimuscarinic drugs, and in whom the conservative (non-pharmacological) treatment appears more safe and useful. Moreover, the detection of UI in older people and its integral approach could prevent frailty with a positive effect on older people's quality of life and clinical and functional outcomes.

However, the findings of this work should be interpreted with caution, thereby considering certain limitations. First, there is a paucity of data on the association between incident UI and frailty, especially among older adults following an unplanned hospital admission. Second, most studies are cross-sectional in design and provide data only on risk factors for prevalent UI. Finally, it is also unclear whether the association between UI and mortality is applicable to hospitalized older adults [9].

In conclusion, our meta-analysis supports the hypothesis that UI is very common in older subjects with frailty, whilst more research is needed about the prevalence of frailty in people with UI. Altogether, our findings suggest that UI should be early recognized in older people with frailty. However, future longitudinal studies are needed to confirm our preliminary findings.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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