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## Occupation and lower urinary tract symptoms in women: A rapid review and meta-analysis from the PLUS research consortium

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### SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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## Abstract

**Aims:** Chronic, infrequent voiding may be a risk factor for lower urinary tract symptoms (LUTS) in women. To inform this hypothesis, we conducted a rapid literature review and meta-analysis of LUTS by occupation as an indirect measure of infrequent voiding behaviors.

**Methods:** Two independent medical librarians searched [Pubmed.gov](https://pubmed.ncbi.nlm.nih.gov/) studies (1990–2017) on adult women for occupations, industries, and workplace environment and LUTS outcomes: overactive bladder (OAB), urinary incontinence (UI), urinary tract infections (UTIs), and individual voiding and storage LUTS. Two authors reviewed full text articles meeting content criteria. Among studies with similar UI definitions, we estimated the prevalence of monthly UI using a random effects meta-analysis model.

**Results:** Of 1078 unique citations identified, 113 underwent full article review and 33 met inclusion criteria. Twenty-six of these studies examined specific occupation groups, including nurses/midwives ( $n = 6$  studies), healthcare workers/support staff ( $n = 6$ ), military personnel ( $n = 3$ ), teachers ( $n = 3$ ), and other groups ( $n = 7$ ), whereas eight compared findings across broad occupation groups. UI was reported in 30 studies (23% using validated measures), OAB in 6 (50% validated), and UTIs in 2 (non-validated). In pooled models, the degree of heterogeneity was too high ( $I^2 = 96.9\text{--}99.2\%$ ) among the studies to perform valid prevalence estimates for LUTS.

**Conclusions:** Current literature limits the ability to evaluate LUTS by occupation types. Future studies should characterize voiding frequency and toilet access in a consistent manner by occupation and explore its relation to LUTS development.

## Keywords

LUTS; occupation; productivity; risk factors; urinary incontinence; women; workforce

## 1 | BACKGROUND

Given the substantial growth of women in the US workforce—47% of US workers are women—more data are needed to understand the possible influence of occupation type and the workplace environment on lower urinary tract symptoms (LUTS).<sup>1,2</sup> LUTS include symptoms of urinary frequency, urgency, nocturia and urinary incontinence (UI), and affect the lives of millions of women.<sup>3–6</sup> LUTS occur in 40–60% of women, with rates of urgency type UI (UUI) and overactive bladder (OAB) (defined as urgency with increased daytime frequency and nocturia) increasing greatly with age.<sup>3,6–8</sup> Thus, recent emphasis is shifting to early recognition of specific modifiable factors to prevent the development and worsening of bladder symptoms over time.<sup>9</sup>

A possible, but under-studied, risk factor is chronic, infrequent voiding. Chronic, infrequent voiding may be a behavioral risk factor learned over time due to environmental influences

and social norms. Infrequent voiding may also occur in the work environment due to limitations with toilet access and availability, having the autonomy to toilet when needed, and adaptive behaviors to avoid urine production, such as fluid restriction. These differences could also arise due to occupational activities that affect urinary-holding behaviors in adult women, such as heavy lifting, stressful job demands, working in hot/cold environments, and having to wear specific clothing that could limit the ability to toilet when needed. For this study, we focused on how occupations differ in the prevalence of LUTS, using the type of occupation as a surrogate for the many reasons infrequent voiding may occur in the workplace.

Most research to date on this topic has examined LUTS prevalence in single occupation types hypothesized to have low voiding frequency and potentially limited toilet access, although previous studies did not evaluate toilet access directly. In a prior review of this research, nurses, one of the most commonly studied groups, were cited as having a higher prevalence of LUTS, specifically UI.<sup>10</sup> Other occupation groups also hypothesized to have low voiding frequency include retail workers, factory workers, other healthcare workers, and women in active military duty. Many women in specific occupations also engage in adaptive behaviors to manage voiding needs that include decreasing fluid and caffeine intake, wearing absorptive products for protection, and avoiding toileting.<sup>11,12</sup> Since these reviews, a few recent studies comparing OAB or UI across broad occupation types, such as women in service/sales occupations, non-manual (managers/professionals) versus manual labor occupations, and unemployed women or women who choose to stay at home, have been published.<sup>13–15</sup>

We hypothesize that occupation types have variations in the prevalence of LUTS. These variations could arise because of urinary-holding behaviors, including infrequent voiding with prolonged holding, due to various environmental factors related to toilet access. Therefore, our research aimed (i) to compare existing evidence that occupation type has an impact on the prevalence of LUTS; (ii) to evaluate the impact of having LUTS in the workplace; and (iii) to describe evidence related to toilet access in the workplace among women.

## 2 | METHODOLOGY

Rapid reviews are employed to streamline systematic review methods to synthesize evidence in a short timeframe. Similar to a systematic review, it consists of a structured methodology to search literature, extract and synthesize data, and assess risk of bias, but the degree of comprehensiveness for each step can vary. Our approach was comprehensive and only differs from a systematic review in not having each step conducted by two independent reviewers in order to expedite the timeframe. Our review protocol was registered on PROSPERO (CRD42017059817), an international registry of systematic and other types of reviews prior to search.<sup>16</sup> All English language research reports (clinical trials, cohort studies, case control studies, cross-sectional surveys, and case reports) focused on occupation types and bladder symptoms among women were included in this rapid review.

## 2.1 | Literature search strategy

Two independent medical librarians searched for articles published in Pubmed from January 1990 to July 2017 (see supplemental material). A combination of database-specific subject headings and keywords were used in the search strategies, covering the concepts of occupation or workforce AND bladder or LUTS or urination disorders.

## 2.2 | Inclusion and exclusion criteria

Inclusion criteria consisted of human studies, with populations limited to females (aged 18 years of age and older) or populations that included both females and males if a sub-analysis existed by sex. Included studies were also required to provide information on both occupation type and LUTS. We excluded studies based on the follow criteria: guidelines (ie, not original research); non-English language studies; those that included males or institutionalized adults exclusively; and those focused on renal diseases (without mention of LUTS), bladder cancer, kidney stones, catheter usage, renal transplant, pelvic organ prolapse, congenital urinary tract abnormalities, neurologic disorders, and surgical interventions.

## 2.3 | Decision process, study selection, and study quality

Seven reviewers performed the initial review of titles and abstracts for relevance using the inclusion and exclusion criteria. Two reviewers then applied these criteria to all selected full text manuscripts and came to consensus about inclusion. Authors extracted data independently using a standardized, pre-piloted form for assessment of study quality, and evidence synthesis.

We used the RTI International (formerly Research Triangle Institute, a non-profit organization) item bank, an existing tool for judging bias and the quality of the evidence.<sup>17</sup> After using the tool to rate the manuscripts, we reported our confidence about how close the true effect was to the observed effect (poor, fair, or strong) by considering study limitations, indirectness, imprecision, inconsistency, and publication/reporting bias.

## 2.4 | Prevalence estimates and meta-analysis

Data cleaning and extraction were carried out in Microsoft Excel 2016 (Redmond, WA). Statistical analysis and modeling were performed using R 3.2.4 (Vienna, Austria). In order to conduct a meta-analysis of prevalence estimates by occupational groups, we limited the prevalence estimates to studies that used similar definitions. UI prevalence, defined as at least monthly or more, was the only LUTS used in three studies of nurses compared to four studies including broad occupation groups, defined as non-manual labor, manual labor, unemployed, and paid versus non-paid groups. Using these studies that assessed UI by similar definitions, we conducted prevalence estimates using a random effects model<sup>18</sup> to incorporate heterogeneity, as measured by the  $I^2$  statistics.<sup>19</sup>

### 3 | RESULTS

We identified 1150 articles using our search strategy, of which 72 were duplicates. From the remaining 1078 citations, we selected 113 for full text screening, and identified 33 for inclusion in our review (Figure 1).

#### 3.1 | Distribution of occupation and LUTS types across studies

Table 1 describes the 33 studies included in the review and meta-analysis. Of these studies, all were cross-sectional in design with one exception that evaluated the influence of UI on workforce disability and exit.<sup>20</sup> Twenty-six reported LUTS within a specific occupation group without comparison to other groups. The remaining eight studies examined broader occupation groups with comparisons across groups. Of the 26 studies within a specific occupation group, 6 studies examined nurses and midwives, 6 examined other health care workers or employees in a healthcare or academic setting,<sup>21–31</sup> 3 examined US military forces,<sup>32–34</sup> 3 primary and secondary school teachers,<sup>12,35,36</sup> and 7 various other single occupation groups.<sup>37–43</sup> Of the eight studies that compared women across broad occupation groups, the authors reported specific occupation types as employed versus non-employed, paid versus non-paid, and manual versus non-manual.<sup>13–15,20,44–46</sup> One of the eight examined occupation type as manual, non-manual, sales/service versus unemployed.<sup>13</sup>

Studies also varied in the type of bladder symptoms reported, the frequency of the symptom recorded, and the use of validated measures to ascertain symptoms (Table 1). UI was the most common bladder symptom reported in 30 publications,<sup>11–15,20–39,42–46</sup> 7 of which used validated UI measures.<sup>21,26,28,37,38,42</sup> Six publications focused on OAB,<sup>15,22,31,33,44,47</sup> including three that used validated OAB measures.<sup>15,22,44</sup> Five publications reported general LUTS, and all five used validated LUTS measures.<sup>14,23,24,30,36</sup> Other publications focused on daytime frequency,<sup>12,41</sup> UTIs,<sup>12,35</sup> and one on nocturia.<sup>40</sup> Only one manuscript reported data using frequency volume charts.<sup>40</sup>

#### 3.2 | Comparison of LUTS prevalence by occupation type

Despite the seeming overlap in occupation and LUTS types across studies, we were unable to combine estimates among the specific workforce groups because of the high degree of heterogeneity across estimates. For instance, even though 26 studies reported UI, the  $I^2$  value for a pooled estimate of UI across studies (27.1%, 95% confidence interval [CI]: 22.6–31.5%) was high (99.3%), with variations in the definitions of UI reported from each study. Further grouping of studies by similar occupation and period of UI assessment did not reduce heterogeneity. For example, we pooled the data and estimated the prevalence of monthly UI in nurses ( $n = 3$  studies) compared to studies of broad occupation groups ( $n = 4$  studies). Given the high degree of heterogeneity for these pooled estimates ( $I^2$  96.9% for nursing studies vs 99.2% for broad occupational group studies, we were not able to report prevalence estimates. Studies also reported a wide age range among nurses (19–74 years) and for broad occupation groups (18–80 years).

Of the eight publications that evaluated broader occupational groups, three studies reported prevalence rates (two reported UI and one OAB) across occupational groups.<sup>13–15</sup> In

multivariable analyses from two of the three studies, women working in manual labor jobs had an increased odds of UI (OR 6.9, 95%CI 5.7–8.5) and OAB (OR 1.7, 95%CI 1.6–1.8) compared to women in non-manual occupations or unemployed women.<sup>14,15</sup> In one of the three studies, women in sales/service workforce groups (OR 1.6, 95%CI 1.2–2.2) had a higher odds of UI than unemployed women, whereas no difference was observed for women in manual occupation groups (OR 1.2, 95%CI 0.8–1.7) versus employed women.<sup>13</sup>

### 3.3 | Impact of LUTS on workforce productivity, toileting behaviors, and toilet access

Three of the eight publications surveyed women across occupational groups and evaluated the impact of UI and OAB on workplace productivity and workplace activities, but did not directly compare the impact of LUTS on productivity or toileting behaviors across occupation groups.<sup>44,45,47</sup> In these three studies, women experiencing UI and OAB reported that their symptoms had a negative impact on work productivity (concentration and task completion) and workplace activities (performance on physical tasks and general interference) compared to women without LUTS. Women with more severe UI were also more likely to reduce their number of hours worked or change their type of work.<sup>45</sup> In a study among a single occupation group, nurses and midwives with more severe UI were more likely to report an intention to leave work at 12 months compared to women with less severe UI in adjusted models.<sup>28</sup> In another longitudinal study that evaluated women aged 55–65, the authors found that UI led to increased disability but not workforce exit.<sup>20</sup>

Nine studies reported that women with LUTS modified toileting behaviors in the workplace due to their symptoms.<sup>12,24–26,30,32,35,39,45</sup> In a study that compared UI across occupation groups, women with UI were more likely to wear pads and take frequent bathroom breaks than women without UI.<sup>45</sup> In other studies among women in the nursing workforce, nurses reported delaying voiding while at work, avoiding public toilets, voiding with little or no need (“just in case”), reducing fluid consumption due to work demands, and restricting fluid to reduce UI episodes.<sup>24–26,30</sup> Other workforce groups, such as teachers, military personnel, and factory workers, also reported similar behavior changes at work, especially related to restricting fluids.<sup>12,32,39</sup> Other studies reported higher rates of UTIs among women who restricted their fluid intake due to LUTS.<sup>12,35</sup>

Only one study evaluated access to toilets and the toilet environment, along with other characteristics relevant to voiding in the workplace.<sup>13</sup> Women in this study responded to eight questions about toileting in the workplace: presence of a clean and comfortable workplace toilet, having a dangerous job and high probability of accidents, feeling pressed for time, having decision-making authority, maintaining trust and respect, being in awkward positions for long periods of time, carrying heavy weights, and hiding feelings at work.<sup>13</sup> UI rates were higher among women who reported having a dangerous job and a high probability of accidents ( $P = 0.012$ ), feeling pressed for time ( $P = 0.045$ ), being in awkward positions for long periods ( $P < 0.001$ ), and carrying heavy weights ( $P < 0.001$ ). This study did not report differences in these characteristics across broad occupational groups.

## 4 | DISCUSSION

This rapid review and meta-analysis found limited evidence to inform the hypothesis that infrequent voiding in the workplace contributes to LUTS. Few studies compared the prevalence of LUTS across occupation types, and single occupation studies were too variable to allow for informative comparisons across occupations. This high degree of heterogeneity prevented us from investigating claims that nurses and teachers have higher rates of UI than other groups. However, we did find suggestive evidence that LUTS prevalence varies across broad occupational groups. In the small number of studies conducted, women in manual occupations had increased rates of UI and OAB compared to unemployed women or women in non-manual occupations. Women with OAB and UI were also more likely to modify their behaviors in the workplace by decreasing voiding and fluid intake, have decreased work productivity, and were at increased risk for disability. To inform our hypothesis that infrequent voiding contributes to LUTS, higher quality studies are needed to compare LUTS across occupational groups, using validated LUTS questionnaires, especially those that measure changes in toileting access and adaptive behaviors over time, as well as longitudinal data to study the temporal relationship between occupation and LUTS.

In comparison to a 2016 review of 22 studies that evaluated pelvic floor dysfunction in workforce groups, Pierce et al reported that women in nursing occupations may experience higher rates of UI than other occupation groups, although they did not pool prevalence estimates or perform direct comparisons to other occupation groups.<sup>10</sup> In our analysis, which included an additional 11 studies, we were not able to make valid comparisons of UI prevalence across specific occupation groups due to the high degree of heterogeneity across prevalence estimates. This high degree of heterogeneity was likely due to the varying definitions and periods used to measure UI, as well as variations in the ages of women in the studies. Future studies should consider the ability to compare LUTS across specific high-risk occupation groups at increased risk for LUTS based on voiding frequency, toileting behaviors, and the workplace toilet environment.

Despite the limited number of studies and lack of direct comparisons across broad occupation groups, the data are supportive of a role for occupation group in the prevalence of LUTS. From the three studies that directly compared UI and OAB rates across workforce groups, those with higher manual labor demands and those in service/retail had an increased odds of UI compared to those in other workforce groups.<sup>13–15</sup> Women with manual occupations may have more physical demands at work (eg, heavy lifting or strenuous activity), which may precipitate stress UI, or have limited access to toilets in the workplace due to time or environmental constraints. Women in service and retail occupations may not have adequate time for toileting due to high-paced job demands. Further studies are needed to better understand the physical demands and toilet access of occupations represented by these broad occupational groups. Longitudinal data would also help inform temporal patterns of occupation as a risk factor over time to determine whether participants' occupations contributed to their LUTS or whether they chose their occupations to accommodate their pre-existing LUTS.

We limited our search to studies that included occupation groups as the primary risk factor of interest. Therefore, we did not include the largest study of US nurses, the Nurses' Health Study (NHS), to date that included cross-sectional and longitudinal data on UI among nurses.<sup>8,48,49</sup> However, in the NHS, prevalence, incidence, and remission rates are comparable to other data among US women.<sup>6,50,51</sup> And, low fluid intake was not related to high rates of incident UI or UI subtypes over a 4-year period.<sup>52</sup> To our knowledge, the NHS participants reported data on job strain and social support, but not on the specific type of nursing occupation, job activities or duty hours, which would help inform our hypothesis.<sup>53</sup> Given that the majority of studies in our review were cross-sectional, we were not able to investigate the possible role of fluid intake as a mediator in LUTS development among occupation groups.

Although this manuscript did not meet published criteria for a systematic review, such as having two independent reviewers extract data from all full text manuscripts, our rapid review process remained rigorous.<sup>16</sup> Our methodology followed guidelines that included using two independent librarians to implement our search strategy, a large group of independent reviewers during the abstract screening process, two reviewers who approved manuscripts for inclusion/exclusion criteria, and validated methodology for the quality review.<sup>16</sup> However, limitations in our approach include only using one database to search for existing studies (Pubmed) and the lack of two independent reviewers during the screening process.

In conclusion, women in the workforce commonly experience UI and LUTS, and modify their behaviors to manage their symptoms. Current literature limits the ability to compare rates of LUTS by occupation among working women, especially in homogeneous high-risk groups, such as elementary school teachers and specific types of nurses. To better characterize the prevalence of LUTS by occupation group additional studies need to use validated LUTS assessments, well-defined occupational groups, and clear comparison groups. Additionally, it is critical that we understand how the work environment affects voiding frequency, access to toilets, autonomy to void when needed, adaptive behaviors to manage LUTS, as well as work productivity, especially over time. Given that the majority of US women work outside the home, this type of research could help inform toileting policies in the workplace environment.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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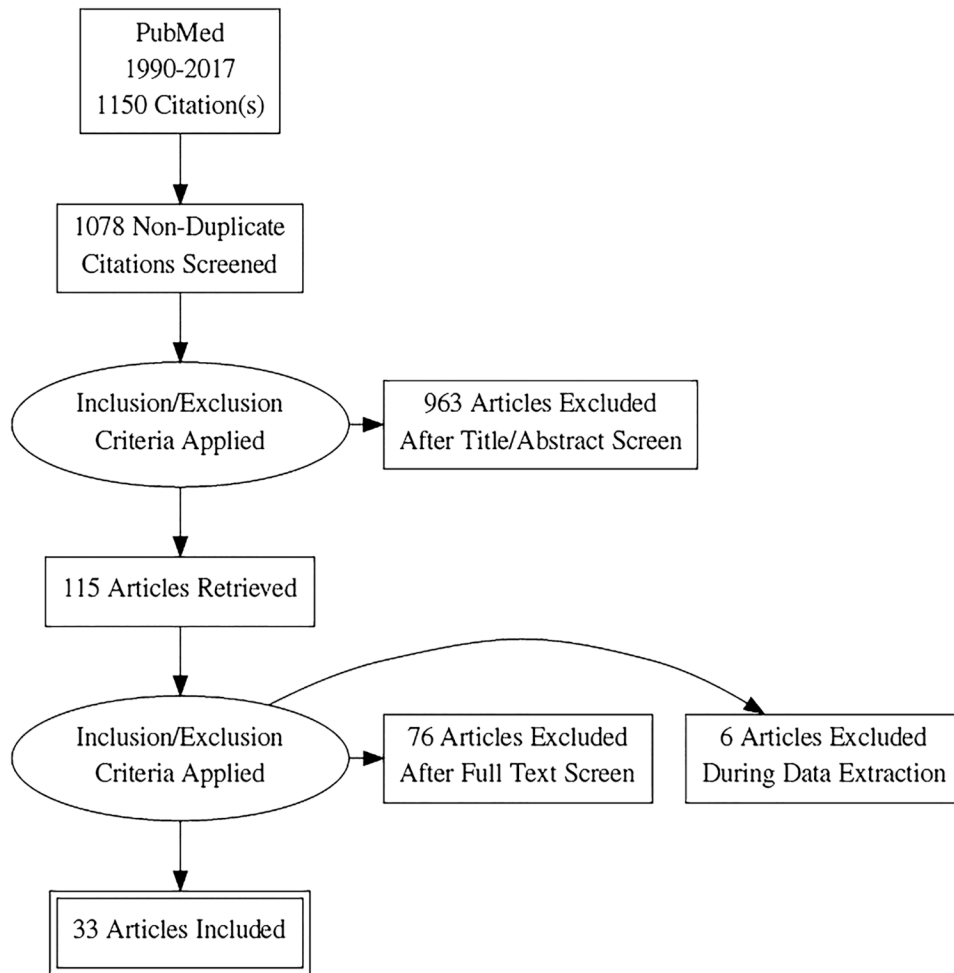
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**FIGURE 1.**  
Flow diagram for studies on occupation and lower urinary tract symptoms

**TABLE 1**

**Rapid review findings related to occupation groups and lower urinary tract symptoms (LUTS), 33 studies**

LUTS type, definition, & characteristics											
Study population: Location or survey name	Study 1st author (journal)	Pub year	Occupation group(s)	Diseased/Non-diseased	Age Mean ± SD, (range)	Type	Validated measure (Y/N)	Characteristics	Time frame	Findings & notes	Quality (poor, fair, good)
<b>Studies reporting LUTS among occupation groups or workplace, n = 25</b>											
<b>Nurses/Advance practice nurses/Midwives, n = 6</b>											
Japan	Araki (J Urol) <sup>30</sup>	2005	Nursing department in 52 hospitals	3734/7229	35.2 ± 10.8 (20–64)	UI	Y	Frequency; UI subtypes	Weekly or more	Validated questionnaire used, but only weekly UI rates reported; nurses with UI had greater impairments in quality of life	Fair
Taiwan: Taipei	Liao (Int J Nursing Studies) <sup>23</sup>	2009	Employed female nurses	907/1065	31.0 ± 6.3 (21–59)	LUTS and UI	Y	Presence or absence; severity; UI subtypes	Past year	Nurses (47%) likely to decrease fluid intake at work. Of the respondents, 50% reported inadequate bathroom breaks. Nurses with LUTS had greater impairments in quality of life.	Poor
China: Beijing	Zhang (Neurourol Urodyn) <sup>30</sup>	2013	Nurses at three tertiary hospitals	1070/1685	29.5 ± 7.9 (19–58)	OAB and UI	N	Frequency	Monthly	No direct comparison by group; occupational stress inventory given. Nurses with OAB had higher stress	Poor
USA: Pennsylvania	Palmer (Int J Clin Pract) <sup>25</sup>	2015	Advanced practice nursing providers	113/373	45.1 (26-68)	UI	Y	Frequency	Monthly	Validated toileting behavior questionnaire	Poor
China: Jinan	Wan (Int J Nursing Studies) <sup>29,53</sup>	2016	Nurses at three tertiary hospitals	636 (no response rate)	30.6 ± 7.9 (22–55)	LUTS and UI	Y	Frequency	Monthly	Validated toileting behavior questionnaire	Poor
Australia: NSW	Pierce (Neurourol Urodyn) <sup>27</sup>	2017	Nurses and midwives	2907/5041	47.4 ± 11.6, (19–74)	UI	Y	Frequency	Monthly	Intent to leave work based on UI reported —women more severe. UI had increased intent to leave current job	Fair
<b>Healthcare workers—Mixed occupations including clinicians, support staff, and administrative staff, n = 6</b>											
South Africa	Bailey (African J Primary Health Care Fam Med)	2010	Hospital workers	109/154	28.3 (18–51)	UI	Y	Frequency; UI subtypes	Monthly	Types of hospital workers not identified. Workers with UI had impaired quality of life.	Poor
China	Chen (Int Urol Nephrol) <sup>31</sup>	2015	Physicians	351/500	47.1 ± 5.4 (42–59)	OAB	Y	Frequency	Monthly	Evaluated impact of non-menopausal symptoms on OAB; OAB a secondary outcome.	Poor
USA: Baltimore	Palmer (Women Health J); <sup>34</sup> Fitzgerald (AAHON J); <sup>10</sup> Hart, K. J. (ClinNurs Res) <sup>54</sup>	2000	Urban Academic Center Employees (faculty, clinical, and administrative staff)	232/1113	40.3 (18–73)	UI	N	Frequency	Monthly	Discussed strategies to manage UI at work and healthcare seeking	Poor
Turkey: Eskisehir	Kaya Y (Low Urin Tract Symptoms) <sup>22</sup>	2016	Secretaries and Nurses	281 (218 nurses; 63 secretaries)	23.8 ± 3.7	LUTS and UI	Y	Frequency	Monthly	Nurses hypothesized to have more LUTS than secretaries, no differences in UI or LUTS found between the two occupation groups	Poor
France: Paris	Peyrat (B: J Urol Imp) <sup>36</sup>	2002	French academic hospital	1700	(20–62)	UI	N	Presence or absence; UI subtypes	NA	Evaluated the association of heavy lifting and UI in the workplace	Poor
India: Lucknow	Singh <sup>38</sup>	2013	Hospital healthcare providers and employees in Ob/Gyn department	3000 (no response rate)	Median 40 (18–70)	UI	N	Frequency; UI subtypes	Weekly	No direct comparison by group	poor
<b>Primary and Secondary School, n = 3</b>											
France	Kovess-Masfety, V. (BMC Public Health) <sup>34</sup>	2006	Male and female teachers compared to non-teachers	5496/10000 Women teachers = 2183; control = 942	(20–60)	UTI	N	Frequency	Past year	Focus on mental health and other medical diagnoses; Teachers experience higher UTI rates than non-teachers, but do not have higher rates of other health conditions	Poor
Taiwan: Taipei	Liao (Int Urogyn J) <sup>35</sup>	2007	Elementary school teachers at 26 schools	445/520	38.9	OAB and UI	Y	Severity; frequency; UI subtypes	Monthly	Pad usage and health seeking behavior reported	Poor
USA	Nygaard (Int Urogyn J) <sup>11</sup>	1997	Public school teachers	791/1492	43.1 (22–73)	Voiding frequency, UTI and UI	N	Frequency	UTI: past year; UI: weekly	Fluid intake limited by teachers due to urinary symptoms.	poor

LUTS type, definition, & characteristics

Study population: Location or survey name	Study 1st author (Journal)	Pub. year	Occupation group(s)	Diseased/Non-diseased	Age Mean ± SD, (range)	Type	Validated measure (Y/N)	Characteristics	Time frame	Findings & notes	Quality (poor, fair, good)
<b>Military, n = 3</b>											
USA: Iraq and Afghanistan Veterans	Bradley (J Urol) <sup>32</sup>	2014	Deployed military service members <2 yrs after return	1775/3538	31.1 ± 8.4	OAB and Urgency UI	Y	Presence or absence	NA	Returning women Veterans with OAB had greater odds of having non-manual health symptoms and history of sexual assault.	Fair
USA: Army	Davis (Military Med) <sup>31</sup>	1999	Military service—active duty	563/713	28.3 (18-51)	UI	N	Frequency; UI subtypes	Monthly or more	Evaluated interference of symptoms in work related duties	Poor
USA: Air force	Fischer (Obstet Gynecol) <sup>33</sup>	1999	Military service—Air Force Aircrew	274/426	NR	UI	N	Presence or absence of “ever” leaked; UI subtypes	NA	Place where UI occurs—home, on duty, flying	poor
<b>All other, n = 7</b>											
Japan	Azuma (Nurs Health Sc.) <sup>36</sup>	2008	Retail stores	975/2175	47.6 ± 9.8 (18-72)	UI	Y	Frequency; UI subtypes	Monthly or more	Knowledge and health seeking behaviors included	Poor
Norway	Bo (Neurolog Urodyn) <sup>37</sup>	2011	Fitness instructors	847/1473; 685	32.8 ± 8.3 (18-68)	UI	Y	Frequency	Monthly	Prevalence rate of UI similar across types of	Poor
USA	Fitzgerald (Women Health) <sup>35</sup>	2002	Factory workers—Manufacturing/ Distribution of pottery	269/500	40 (16-69)	UI	N	Frequency; UI subtypes	Monthly or more	Health seeking behaviors included	Poor
Taiwan	Lin (Appl Ergon) <sup>41</sup>	2009	Operators at telecommunication call centers	868 women/1100	(25-34)	Urinary frequency	N	Frequency	Daily	Primary aim to evaluate job stress and physical discomfort; frequent urination had higher odds for having increased job stress	Fair
Korea	Kim (Urology) <sup>40</sup>	2015	male and female nonshift and shift workers ages 40-70 seeking care in urology clinic	1376 nonshift workers (764 women); 365 shift workers—165 women	58.5 ± 13.9	Nocturia	Y	Frequency and volume charts	Daily	Retrospective study; nocturia higher in shift workers; not all participants had LUTS or were seeking care for LUTS	Poor
Taiwan	Su (Int Urogynecol) <sup>43</sup>	2009	Electronics industry workers	2062/2062	Non pregnant workers: <24, 24-27, 28-30, >30	UTI	N	Frequency	NA	Urinating 3 or more times was protective for UTI	Poor
France: GAZEL cohort	Saadoun (Neurolog Urodyn) <sup>42</sup>	2006	Utility company employees: blue collar, clerical, supervisors, management	556/2640	55 ± 3 (49-61)	UI	Y	Frequency; severity	Monthly or more	UI rates not reported by specific occupations	Fair
<b>Studies comparing LUTS across broad occupation groups, n = 8</b>											
USA: OAB POLL	Coyne (Urology) <sup>47</sup>	2012	Current employment status: working full-time, working part-time, and other work for pay	3210 women	No symptoms 40.7 ± 13.8 OAB symptoms 45.4 ± 14.2	OAB	Y	Frequency	Monthly or more	OAB rates not reported by occupation groups; Women with OAB less likely to work full time, increased negative impact in work productivity; men but not women with OAB more likely to be unemployed	Fair
USA: National family opinion survey	Fulze (Occupational Med) <sup>45</sup>	2005	Working full-time, working part-time, volunteer work, retired, homemaker status	3364/5130	44 (18-60)	UI	Y	Frequency severity; UI subtypes	Monthly or more	UI rates not reported by occupation groups; data on UI management and impact on work productivity	Fair
USA: National health and retirement survey	Hung (Obstetrics Gynecology) <sup>49</sup>	2014	Working full-time, working part-time, unemployed, partly retired, retired, disabled, or not in the labor force	4511	59.4 (54-65)	UI	N	Frequency	Monthly or more	UI rates not reported by occupation groups; UI increased risk for work disability but not work force exit in adjusted analysis over time	Fair
Denmark: Aarhus	Lam (Dan Med Bull) <sup>46</sup>	1992	Employers, white collar, skilled workers, housewives, pensioners	2631 women	(30-59)	UI	N	Frequency; UI subtypes	Past year	Types of UI reported by occupation groups in age-adjusted analysis without direct comparison data on prevalence; data on social context, abstention, and perception	Fair
China: Shanghai	Liu (Int J ClinExp Med) <sup>13</sup>	2014	Manual (intensity) vs non-manual labor	5433/5467	median 46.8 (20-100)	LUTS and UI	Y	Frequency; severity; UI subtypes	Monthly or more	Manual labor versus non-manual increased odds of UI in adjusted analysis (OR 6.3, 95%CI 3.7-8.5)	Good
Korea: KHANES	Kim (Women & Health) <sup>13</sup>	2016	Korean Standard Classification of Occupations: non-manual, service/sales, manual workers, unemployed	5928 women	(19-64)	UI	N	Presence or absence of “current UI”	NA	Non-manual and service/sales occupation groups had increased prevalence of any UI than manual and unemployed groups in unadjusted analysis. In adjusted analysis, women in sales/service vs unemployed women had increased odds of having any UI (OR 1.6, 95%CI 1.2-2.2).	Fair

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LUTS type, definition, & characteristics

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USA: EpiLUTS	Sexton (Am J Managed Care) <sup>44</sup>	2009	Working full-time, working part-time, and other work for pay	2820 women	51 ± 6.5	LUTS and UI	N	Frequency; UI subtypes	Monthly or more	OAB and UI rates not reported by sex, age group. When OAB/UI less likely, men had higher and lower negative impact in work productivity; unadjusted analysis	Fair
China: Six geographic regions	Wang (NeuroUrol Urodyn) <sup>14</sup>	2011	Manual worker, "mental" worker, and unemployed/housewife	14844/21 513	47.5 (18-80)	OAB	Y	Frequency; severity; UI subtypes	Weekly or more	Manual workers versus other groups had increased odds of OAB in adjusted analysis (OR 1.7 95%CI 1.6-1.8)	Good

LUTS, lower urinary tract symptoms; NA, not applicable; NR, not reported; OAB, overactive bladder; UI, urinary incontinence; UTI, urinary tract infection.