

# Worldwide prevalence estimates of lower urinary tract symptoms, overactive bladder, urinary incontinence and bladder outlet obstruction

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(prospective cohort)  
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## What's known on the subject? and What does the study add?

Few prevalence studies used current ICS LUTS symptom definitions and to our knowledge no studies exist that estimate total worldwide prevalence of reported LUTS symptoms. One of the primary goals of this analysis was to estimate current and future worldwide prevalence of LUTS among adults. Our estimation model suggests that LUTS are highly prevalent worldwide, with an increasing burden predicted over time.

## OBJECTIVE

- To estimate and predict worldwide and regional prevalence of lower urinary tract symptoms (LUTS), overactive bladder (OAB), urinary incontinence (UI) and LUTS suggestive of bladder outlet obstruction (LUTS/BOO) in 2008, 2013 and 2018 based on current International Continence Society symptom definitions in adults aged  $\geq 20$  years.

## PATIENTS AND METHODS

- Numbers and prevalence of individuals affected by each condition were calculated with an estimation model using gender- and age-stratified prevalence data from the EPIC study along with gender- and age-stratified worldwide and regional population estimates from the US Census Bureau International Data Base.

## RESULTS

- An estimated 45.2%, 10.7%, 8.2% and 21.5% of the 2008 worldwide population (4.3 billion) was affected by at least one LUTS, OAB, UI and LUTS/BOO, respectively. By 2018, an estimated 2.3 billion individuals will be affected by at least one LUTS (18.4% increase), 546 million by OAB (20.1%), 423 million by UI (21.6%) and 1.1 billion by LUTS/BOO (18.5%).
- The regional burden of these conditions is estimated to be greatest in Asia, with numbers of affected individuals expected to increase most in the developing regions of Africa (30.1–31.1% increase across conditions, 2008–2018), South America (20.5–24.7%) and Asia (19.7–24.4%).

## CONCLUSIONS

- This model suggests that LUTS, OAB, UI and LUTS/BOO are highly prevalent conditions worldwide. Numbers of affected individuals are projected to increase with time, with the greatest increase in burden anticipated in developing regions.
- There are important worldwide public-health and clinical management implications to be considered over the next decade to effectively prevent and manage these conditions.

## KEYWORDS

prevalence, lower urinary tract symptoms, overactive bladder, urinary incontinence, bladder outlet obstruction

## INTRODUCTION

Lower urinary tract symptoms (LUTS), overactive bladder (OAB), urinary incontinence (UI) and LUTS suggestive of bladder outlet obstruction (LUTS/BOO) are prevalent conditions [1,2] and many individuals experience bothersome symptoms that impair their health-related quality of life [3–5]. These conditions are also highly stigmatized [6] and are associated with a substantial economic and human burden [7–9]. According to current (2002)

International Continence Society (ICS) definitions, LUTS can be divided into storage (increased daytime frequency, nocturia of at least one episode/night, urgency and UI), voiding (slow or intermittent stream during micturition, splitting or spraying of the urine stream, straining, hesitation, terminal dribble) and postmicturition symptoms (feeling of incomplete emptying and postmicturition dribble) [10].

The prevalence of LUTS, OAB, UI and LUTS/BOO increases with advancing age [1,11–13],

and worldwide prevalence is expected to increase, based on the predicted aging of the worldwide population [14]. There are, however, notable inconsistencies across epidemiological studies in reported prevalence rates; for example, reported prevalence rates for male and female populations range from 13% [15] to 67% [16] for LUTS; 7% [17] to 26% [18] for OAB and 4% [19] to 50% [20] for UI. These inconsistencies have been attributed to differences between studies in the questions used for symptom assessment, mode of questionnaire

administration, study population and symptom definitions [1,21,22]. Few prevalence studies have used current ICS symptom definitions for LUTS, OAB, UI and LUTS/BOO [23]. Moreover, to our knowledge, no studies have used these definitions to estimate total numbers or overall prevalence of individuals affected by these conditions worldwide.

The primary goal of this analysis was to estimate current and future worldwide prevalence of LUTS, OAB, UI and LUTS/BOO in adults aged  $\geq 20$  years using current ICS definitions. A second objective was to estimate the current and future overall prevalence in major geographic regions (i.e. Africa, Asia, Europe, North America and South America). The worldwide and regional numbers and prevalence of affected individuals were estimated for each condition using prevalence data from the EPIC study [1], a large population-based, cross-sectional telephone survey that assessed the prevalence of LUTS, OAB, UI and LUTS/BOO in 19 165 men and women in five countries, and worldwide and regional population estimates from the US Census Bureau International Data Base (IDB) [14].

## METHODS

Details of the EPIC survey study were reported previously [1]. Briefly, the EPIC study assessed the prevalence of LUTS, OAB, UI and LUTS/BOO in 19 165 men and women in Canada, Germany, Italy, Sweden and the UK between April and December 2005. Participants were  $\geq 18$  years of age and were randomly selected to ensure representation of the general population in their respective country. Prevalence of LUTS, OAB, UI and LUTS/BOO was determined via responses to a computer-assisted telephone interview.

In the present analysis, worldwide and regional numbers of individuals affected by LUTS, OAB, UI and LUTS/BOO were estimated for 2008 and predicted for 2013 and 2018 using gender- and age-specific prevalence data from the EPIC study [1] (including only data for respondents aged  $\geq 20$  years stratified into 5-year age groups; see Supplementary material, Table S1) and gender- and age-specific population estimates from the IDB [14] (also stratified into 5-year age groups; see Supplementary material, Table S2). Overall worldwide and regional numbers of

individuals affected by each condition were estimated via summation of male and female population estimates. Worldwide and regional prevalence rates were calculated for each condition by dividing the estimated number of affected individuals by the general population (IDB) estimate. Because the ICS definition for nocturia (at least one episode/night) is broad and may capture the normal clinical spectrum [1,24], a more conservative definition of nocturia (at least two episodes/night) was used in worldwide and regional estimates of individuals experiencing at least one LUTS and at least one storage LUTS; ICS guidelines were followed in defining all other LUTS. Worldwide and regional LUTS/BOO estimates were calculated based on the presence of ICS-defined voiding LUTS indicative of BOO. All calculations were made using non-rounded EPIC study and/or IDB source data but the results are presented as rounded figures. No formal statistical analysis was conducted to assess temporal or regional differences in estimates of prevalence rates and numbers of affected individuals.

Assumptions made in this estimation model were that the prevalence values determined in countries assessed in the original EPIC study are not, on average, different from prevalence in other locations or worldwide, and that the age- and gender-specific prevalence of these conditions will not change between 2008 and 2018.

## RESULTS

Assuming that the gender- and age-stratified prevalence of LUTS, OAB, UI and LUTS/BOO (as reported in the EPIC study [1]) remain stable over time, this estimation model predicts that worldwide numbers and prevalence of individuals affected by LUTS, OAB, UI and LUTS/BOO will increase between 2008 and 2018. This can be attributed to population growth and overall aging of the worldwide general population. The IDB population estimates forecast that the worldwide population  $\geq 20$  years of age will increase by 16.9% between 2008 (4.3 billion) and 2018 (5.0 billion), with an 11% increase between 2008 and 2018 in the proportion of individuals aged  $\geq 45$  years (40.4% to 44.9%).

The IDB estimates that in 2008, approximately 465 million individuals  $\geq 20$  years of age were residing in Africa, 2.6 billion in Asia, 572 million in Europe, 360 million in North America and 247 million in South America.

Similar to worldwide estimates, the numbers and prevalence of individuals affected by LUTS, OAB, UI and LUTS/BOO are expected to increase between 2008 and 2018 in each region because of population growth and overall aging of the general population. However, there is considerable variation between regions in the estimated increase of the general population. Africa is projected to have the greatest population increase (29.3%), followed by South America (18.6%), Asia (17.8%), North America (13.9%) and Europe, (0.8%). The growth of the aging population is also expected to differ across regions, with the greatest increase in Asia (16.1% increase between 2008 and 2018 in the proportion of individuals aged  $\geq 45$  years), followed by South America (13.5%), Europe (8.0%), North America (6.7%) and Africa (2.4%).

Proportions of men and women in worldwide and regional populations are estimated to change  $\leq 0.5\%$  between 2008 and 2018.

Estimated worldwide numbers of individuals aged  $\geq 20$  years experiencing LUTS are shown by symptom category type, gender and year in Table 1. Approximately 1.9 billion individuals in the 2008 worldwide population were estimated as experiencing any LUTS, with numbers of affected individuals projected to increase by 9.3% to 2.1 billion in 2013 and by 18.4% to 2.3 billion in 2018. The worldwide prevalence of LUTS is anticipated to increase from 45.2% in 2008 to 45.8% by 2018. The prevalence of LUTS is estimated as being greater in women than men in 2008 (46.3% vs 44.1%, respectively), 2013 (46.5% vs 44.4%) and 2018 (46.8% vs 44.7%).

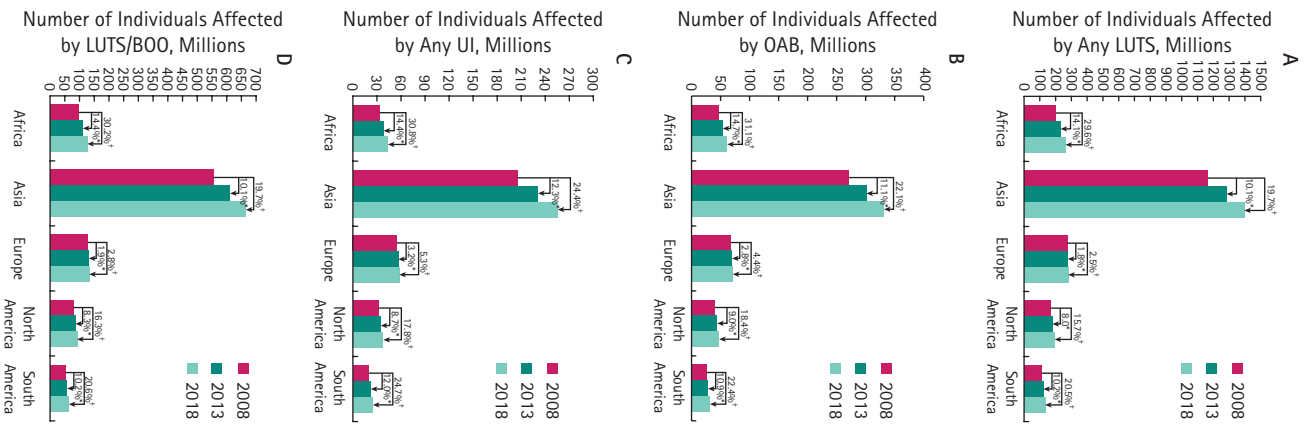
Storage symptoms, the most common LUTS subtype, are estimated to affect 1.4 billion individuals in 2008, 1.5 billion in 2013 (9.6% increase) and 1.6 billion in 2018 (19.2% increase from 2008); the prevalence of storage symptoms is estimated to increase from 31.8% in 2008 to 32.5% in 2018. Numbers of individuals experiencing voiding and postmicturition LUTS in 2008 (917 million and 630 million, respectively) are estimated to increase 9.3% and 9.4% by 2013 and by 18.5% and 18.8% by 2018, respectively. The prevalence of voiding LUTS is anticipated to increase from 21.5% in 2008 to 21.8% in 2018 and the prevalence of postmicturition LUTS is expected to increase from 14.7% in 2008 to 15.0% in 2018. Women are estimated to have a higher prevalence of at least one storage

TABLE 1 Estimated worldwide number of individuals with LUTS by type, gender and year

Condition	Male population			Female population			Total population		
	2008	2013	2018	2008	2013	2018	2008	2013	2018
Any LUTS*	1 259 424 877	1 377 756 239	1 494 129 431	1 382 747 558	1 508 619 102	1 632 626 678	2 642 172 435	2 886 375 341	3 126 756 109
Any LUTS†	932 947 020	1 020 763 257	1 107 206 981	995 968 819	1 086 969 434	1 176 252 502	1 928 915 839	2 107 732 691	2 283 459 483
Storage LUTS									
Any storage LUTS*	1 049 604 905	1 151 554 080	1 253 722 107	1 252 107 326	1 367 719 650	1 482 792 290	2 301 712 231	2 519 273 729	2 736 514 397
Any storage LUTS†	597 219 718	655 873 843	715 093 706	761 920 081	833 875 985	905 668 568	1 359 139 799	1 489 749 828	1 620 762 275
Nocturia ≥1 time/night	942 162 943	1 035 519 516	1 130 404 416	1 100 002 339	1 203 619 777	1 307 753 336	2 042 165 282	2 239 139 293	2 438 157 752
Nocturia ≥2 times/night	387 875 072	427 555 413	468 789 610	464 940 904	510 905 415	558 338 637	852 815 976	938 460 828	1 027 128 247
Urgency	204 975 873	226 043 985	247 478 322	249 837 613	274 366 611	298 569 985	454 813 487	500 410 596	546 048 307
Frequency	126 696 352	139 367 165	152 325 169	160 947 117	174 399 799	186 877 992	287 643 469	313 766 964	339 203 161
Any UI‡	97 926 056	109 245 296	120 578 611	250 205 314	276 439 685	302 919 365	348 131 370	385 684 981	423 497 976
Mixed UI‡	11 008 015	12 307 137	13 655 245	42 645 806	47 578 010	52 682 706	53 653 821	59 885 146	66 337 951
Stress UI	10 378 899	11 658 466	13 064 025	127 568 529	140 670 362	153 534 055	137 947 428	152 328 829	166 598 080
Urgency UI	22 008 077	24 673 121	27 442 749	27 268 012	30 096 699	32 937 466	49 276 090	54 769 820	60 380 215
Other UI‡	54 722 571	60 811 314	66 632 889	53 006 915	58 405 026	64 128 218	107 729 486	119 216 340	130 761 108
Voiding LUTS									
Any voiding LUTS§	514 768 768	563 516 317	612 034 508	402 617 124	439 325 111	475 263 932	917 385 892	1 002 841 428	1 087 298 441
Intermittency	164 269 137	180 990 603	198 176 329	148 382 880	162 253 590	175 999 877	312 652 017	343 244 193	374 176 206
Slow stream	156 320 309	173 766 759	193 589 613	122 766 573	134 771 536	146 998 916	279 086 882	308 538 296	340 588 530
Straining	132 186 270	145 246 389	158 023 197	83 353 097	90 734 402	98 184 808	215 539 367	235 980 791	256 208 005
Terminal dribble	288 892 001	315 397 622	341 268 312	210 911 393	229 398 652	246 978 098	499 803 393	544 796 274	588 246 410
Post-micturition LUTS									
Any post-micturition LUTS	332 189 247	364 739 378	397 357 370	297 620 365	324 360 340	350 599 698	629 809 613	689 099 717	747 957 069
Incomplete emptying	262 522 471	288 484 165	314 632 596	257 979 864	280 958 427	303 568 531	520 502 335	569 442 592	618 201 127
Other post-micturition incontinence	107 544 267	118 200 573	128 976 031	64 037 018	70 068 486	76 044 295	171 581 285	188 269 059	205 020 326
OAB syndrome	204 975 873	226 043 985	247 478 322	249 837 613	274 366 611	298 569 985	454 813 486	500 410 597	546 048 307

\*Nocturia defined as at least one episode/night. †Nocturia defined as at least two episodes/night. ‡Participants reporting both urgency UI and stress UI symptoms were classified as having mixed UI. Those who reported UI without symptoms of urgency UI or stress UI were categorized as having other UI. §Indicator of LUTS suggestive of bladder outlet obstruction in the present analysis. LUTS, lower urinary tract symptoms; OAB, overactive bladder; UI, urinary incontinence.

**FIG. 1.** Estimated numbers of individuals in major world regions affected by (A) any/lower urinary tract symptom (LUTS), nocturia defined as at least two episodes/night), (B) overactive bladder (OAB), (C) urinary incontinence (UI) and (D) LUTS suggestive of bladder outlet obstruction (LUTS/BOO) in 2008, 2013 and 2018. \*Percentage increase in the number of affected individuals from 2008 to 2013. †Percentage increase in the number of affected individuals from 2008 to 2018.



LUTS than men (35.4% vs 28.2% in 2008, 35.7% vs 28.5% in 2013, 36.0% vs 28.9% in 2018, respectively). Conversely, a lower prevalence is estimated in women versus men for at least one voiding LUTS (18.37% vs 24.3% in 2008, 18.8% vs 24.5% in 2013, 18.9% vs 24.7% in 2018, respectively) and at least one postmicturition LUTS (13.8% vs 15.7% in 2008, 13.9% vs 15.9% in 2013, 13.9% vs 16.1% in 2018).

Estimated numbers of individuals affected by LUTS in 2008, 2013 and 2018 are greatest in the region of Asia, followed by Europe, Africa, North America and South America (Fig. 1A). These values are expected to increase most rapidly between 2008 and 2018 in the developing regions of Africa (30.1%), South America (20.5%) and Asia (19.7%), with a relatively small predicted increase in Europe (2.5%). The 2008 and 2018 prevalence of LUTS is estimated as being similar across regions, with the highest values in Europe (47.6% and 48.4%), respectively; 1.8% increase over time), followed by North America (46.3% and 47.0%; 1.5% increase), Asia (44.8% and 45.5%; 1.6% increase), South America (44.8% and 45.5%; 1.6% increase) and Africa (43.9% and 44.2%; 0.7% increase).

Estimated worldwide numbers of individuals aged  $\geq 20$  years experiencing OAB are shown by gender and year in Table 1. An estimated 455 million individuals worldwide experienced OAB in 2008, with numbers of affected individuals anticipated to increase to 500 million by 2013 (10.0% increase) and to 546 million by 2018 (20.1% increase). Worldwide prevalence is anticipated to increase from 10.7% in 2008 to 10.9% by 2018. The prevalence of OAB worldwide is estimated as being greater in women versus men in 2008 (11.6% vs 9.7%, respectively), 2013 (11.7% vs 9.8%) and 2018 (11.9% vs 10.0%).

As with LUTS, both the 2008 and 2018 burden of OAB is estimated as being greatest in Asia, followed by Europe, Africa, North America and South America (Fig. 1B), with the greatest increases in numbers of affected individuals projected in the developing regions of Africa, South America and Asia (31.1%, 22.4% and 22.1% increase, respectively, from 2008 to 2018). The 2008 and 2018 prevalence of OAB is estimated as being similar across regions, with the highest values in Europe (11.9% in 2008 and 12.3% in 2018), followed by North America (11.2% and 11.6%), South America

(10.5% and 10.8%), Asia (10.5% and 10.8%) and Africa (9.9% at both time points).

Estimated worldwide numbers of individuals aged  $\geq 20$  years experiencing UI are shown by UI type, gender and year in Table 1. Approximately 348 million individuals worldwide in 2008 experienced any UI, with numbers of affected individuals projected to increase 10.8% to 386 million by 2013 and 21.6% to 423 million by 2018. The worldwide prevalence of UI is anticipated to increase from 8.2% in 2008 to 8.5% by 2018. Stress UI is predicted to be the most common UI type worldwide through 2018 because of its high prevalence in women (5.9% in women vs 0.49% in men in 2008, 6.0% vs 0.51% in 2013, 6.1% vs 0.53% in 2018). Worldwide numbers of stress UI are projected to increase by 10.4% to 152 million by 2013 and by 20.8% to 167 million by 2018, with the overall prevalence anticipated to increase from 3.2% to 3.3% between 2008 and 2018. Numbers of patients affected by urgency UI are expected to increase from 49 million in 2008 to 55 million in 2013 (11.1% increase) and to 60 million in 2018 (22.5% increase), which corresponds to an increase in prevalence from 1.15% to 1.21%. Numbers of individuals affected by urgency UI are estimated to be similar in men and women. Mixed UI affected an estimated 54 million individuals in 2008, which is expected to increase to 60 million in 2013 (11.6% increase) and to 66 million in 2018 (23.6% increase); the prevalence of mixed UI is anticipated to increase from 1.26% in 2008 to 1.33% in 2018. Mixed UI is predicted to affect more women than men (probably because of the greater occurrence of stress UI in women). Finally, an estimated 108 million individuals in the 2008 population were affected by an 'other' type of UI (i.e. UI without symptoms of urgency UI or stress UI). This value is expected to increase by 10.7% to 119 million by 2013 and by 21.4% to 131 million by 2018, corresponding to an increase in prevalence from 2.5% in 2008 to 2.6% in 2018, with similar numbers of men and women affected.

Similar to LUTS and OAB, the regional burden of UI is expected to be greatest in Asia, followed by Europe, Africa, North America and South America (Fig. 1C), with the developing regions of Africa, South America and Asia showing the greatest increase in affected individuals between 2008 and 2018 (30.8%, 24.7% and 24.4%, respectively). The prevalence of UI in both 2008 and 2018 is

estimated as being similar across regions, with the highest values in Europe (9.6% in 2008 and 10.0% in 2018), followed by North America (8.9% and 9.2%), South America (8.0% and 8.4%), Asia (7.9% and 8.3%) and Africa (7.2% and 7.3%).

Estimated worldwide numbers of individuals aged  $\geq 20$  years experiencing LUTS/BOO (defined as the presence of any voiding symptom) are shown by gender and year in Table 1. An estimated 917 million individuals worldwide experienced LUTS/BOO in 2008, with numbers of affected individuals projected to increase by 9.3% to 1.0 billion in 2013 and by 18.5% to 1.1 billion in 2018. The worldwide prevalence of LUTS/BOO is anticipated to increase from 21.5% in 2008 to 21.8% by 2018. The prevalence of LUTS/BOO is estimated as being greater in the men versus women population in 2008 (24.3% vs 18.7%, respectively), 2013 (24.5% vs 18.8%) and 2018 (24.7% vs 18.9%).

The 2008 and 2018 burden of LUTS/BOO is estimated as being greatest in Asia, followed by Europe, Africa, North America and South America (Fig. 1D), with the greatest increases between 2008 and 2018 in numbers of affected individuals projected in the developing regions of Africa (30.2%), South America (20.6%) and Asia (19.7%). The 2008 and 2018 prevalence of LUTS/BOO is estimated as being similar across regions, with the highest values in Europe (22.5% in 2008 and 23.0% in 2018), followed by North America (22.0% and 22.4%), Asia (21.3% and 21.7%), South America (21.2% and 21.6%) and Africa (20.9% and 21.0%).

## DISCUSSION

This is the first analysis to estimate current (2008) and future worldwide and regional prevalence of LUTS, OAB, UI and LUTS/BOO based on current ICS symptom definitions. Using gender- and age-specific prevalence data from the EPIC study and population estimates from the IDB, our model estimates that LUTS, OAB, UI and LUTS/BOO were highly prevalent in the 2008 worldwide population (45.2%, 10.7%, 8.2% and 21.5% respectively), and that the numbers of individuals affected by each of these conditions are expected to increase by approximately 20% by 2018. Individual LUTS, estimated as being the most common across all time points, included nocturia, postmicturition symptoms,

incomplete emptying, terminal dribble and urgency. Regional numbers of individuals affected by these conditions are also predicted to increase between 2008 and 2018, with the greatest increases expected in the developing regions of Africa (30.1–31.1% increase across conditions), South America (20.5–24.7%) and Asia (19.7–24.4%). Increases in worldwide and regional prevalence are also predicted for all conditions by 2018: although these increases appear to be small, they translate into a substantial number of affected individuals given the size of the worldwide and regional general populations.

Reported increases in numbers of affected individuals are the result of IDB predictions of population growth and overall aging in worldwide and regional general populations. For Africa, these increases are primarily attributed to the substantial size growth (29.3%) that is predicted within its general population between 2008 and 2018, with little overall population aging expected. For Europe, these increases are largely driven by the overall aging of the general population (8.0% increase in the number of individuals aged  $\geq 45$  years between 2008 and 2018). For Asia and South America, increases in numbers and prevalence of affected individuals are similarly affected by the size growth (17.8% and 18.6%, respectively) and overall aging (16.1% and 13.5% increase in numbers of individuals  $\geq 45$  years of age, respectively). The use of gender- and age-specific prevalence values from the EPIC study is a major strength of this analysis. The EPIC study is a landmark epidemiological study because it is the first large, multinational, population-based study to simultaneously assess the prevalence of LUTS, OAB and UI based on current ICS symptom definitions [1]. Consistent with other epidemiological studies [2,11,25], the EPIC study showed that LUTS, OAB, UI and LUTS/BOO are highly prevalent, and that prevalence increases with age [1].

There are very few published studies on the prevalence of LUTS in some regions of the world, which requires an assumption to be made for the model to estimate numbers of individuals reporting LUTS. This model assumes that the prevalence rates reported in the EPIC study are representative of worldwide LUTS prevalence; the use of EPIC prevalence rates is a conservative estimation for several reasons. The gender- and age-

specific LUTS, OAB, UI and LUTS/BOO prevalence values from the EPIC study represent the 'average' prevalence across countries weighted by size [1]. These values reflect neither the highest nor lowest prevalence values reported in other population-based epidemiological studies. The prevalence of OAB and UI in EPIC was on the lower end of the range seen in the literature. The overall prevalence of LUTS in EPIC was on the higher side, which was primarily driven by the prevalence of nocturia when defined as at least episode/night [1]. However, our model uses a more stringent definition of nocturia (at least two episodes/night). Hence, the model prevalence of any LUTS (46.5% for men and 48.1% for women) is a more conservative estimate. Notably, many published studies did not use the current LUTS ICS definitions, which could account for some of the variability in the prevalence rates among countries.

Based on the less stringent ICS definition of nocturia, our model estimates that 2.6 billion individuals in the worldwide population (61.9%) experienced at least one LUTS in 2008, with a projected increase of 18.3% to 3.1 billion (62.7%) in 2018. The large difference in these estimates versus those derived from the more stringent at least two episodes/night nocturia definition – 1.9 billion (45.2%) in 2008 to 2.3 billion (45.8%) in 2018 – suggest that experiencing one micturition per night may be part of the normal clinical spectrum [26]. Possible exceptions to the 'underestimation' potential of our model are the estimates for worldwide number and prevalence of individuals affected by 'other' UI, which may be overestimated in comparison with urgency stress and mixed UI estimates. The EPIC study reported that 21% of women and 54% of men with UI could be classified as experiencing 'other' UI [1], whereas other epidemiological studies have classified only 2% to 10% of individuals with UI as experiencing 'other' UI [27–29].

The already high and increasing burden of LUTS, OAB, UI and LUTS/BOO predicted by our estimation model has significant implications for public health and clinical practice. These conditions are under-reported, underdiagnosed and undertreated [5,30,31]; and are associated with significant direct and indirect costs [7–9]. Using values from a recently published economic model evaluating the direct healthcare costs attributed to OAB [8] and estimated

worldwide numbers of individuals affected by OAB in the present analysis, we can extrapolate that the average worldwide annual direct cost of OAB was €1.2 trillion to €2.7 trillion in 2008 and can be expected to increase to €1.4 trillion to €3.2 trillion by 2018. Many individuals with LUTS, OAB, UI and LUTS/BOO experience symptom bother and reduced health-related quality of life [3–5]. In particular, urgency UI is reported as being bothersome by many patients with OAB [25]; urgency UI and mixed UI appear to have a greater impact on health-related quality of life compared with stress UI [32]. Notably, individuals experiencing LUTS may have one or multiple symptom types at any given time [2,8,13]; affected individuals are more likely to experience symptom bother as the number of LUTS increases [26]. However, not all individuals who report the presence of LUTS experience symptom bother or require treatment. For example, in the original EPIC study, only 54% of men and 53% of women with OAB considered their symptoms bothersome, although a greater percentages of men (77%) and women (67%) in this population reported symptom bother when UI was also present [5].

Considering this information as a whole, we believe that there is a clear and urgent need to improve the awareness, prevention, diagnosis and management of these conditions. International and national programmes that increase public awareness, educate clinicians and at-risk or affected populations, and implement public campaigns designed to diminish or eliminate social stigma will be a significant step toward reaching this objective. Such public-health programmes will need to be adapted by region because countries often differ in their healthcare resources, treatment guidelines and social perceptions. Additional prevalence research can provide further support for these programmes and valuable information on how to best customize their objectives, methodologies and goals, especially in the developing regions of Africa and South America where there are a paucity of LUTS, OAB, UI and LUTS/BOO prevalence data to assist with public healthcare planning.

A potential limitation of our study is that the prevalence results are approximations and not true values. Also, the LUTS, OAB, UI and LUTS/BOO prevalence and population burden estimates do not reflect a homogeneous population of individuals bothered by and

seeking treatment because of their symptoms. Another potential limitation is the model assumption that the gender- and age-specific LUTS, OAB, UI and LUTS/BOO prevalence reported in the EPIC study are not, on average, different from the prevalence regionally or worldwide. As discussed, country-specific variation in LUTS prevalence was observed in the EPIC study [1]. Country-specific variability in UI prevalence (4.3–16.2%) was similarly observed in a population-based study evaluating male UI prevalence across four countries [33]. However, the impact of this limitation may be minimal given that the gender- and age-specific LUTS, OAB, UI and LUTS/BOO prevalence rates reported in EPIC are conservative compared with those from other epidemiological studies. Another potential limitation is the model assumption that the age- and gender-specific prevalence of LUTS, OAB, UI and LUTS/BOO will not change between 2008 and 2018. This is also most likely a conservative assumption because IDB population estimates forecast that the worldwide population  $\geq 20$  years of age will increase [14]. Finally, potential limitations of the original EPIC study also apply to this analysis, namely that self-reports were used to assess symptoms (i.e. the analysis does not reflect numbers of individuals diagnosed with or bothered by these conditions) and that the results of the self-report may have been influenced by the mode of questionnaire administration [1].

Our estimation model results suggest that LUTS, OAB, UI and LUTS/BOO are highly prevalent worldwide, with an increasing burden predicted over time. The burden is expected to increase to the greatest extent in the developing regions of Africa, South America and Asia. Although our results are only approximations, we hope that these data will provide support for the development of international and national education and intervention programmes to improve the awareness, social acceptance, prevention, diagnosis and management of these conditions.

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#### CONFLICT OF INTEREST

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**Abbreviations:** LUTS, lower urinary tract symptoms; OAB, overactive bladder; UI, urinary incontinence; LUTS/BOO, LUTS suggestive of bladder outlet obstruction; ICS, International Continence Society; IDB, US Census Bureau International Data Base.

## SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

**TABLE S1** Age- and Gender-Specific Prevalence Estimates of LUTS, OAB, UI, and LUTS/BOO From the EPIC Study.

**TABLE S2** Worldwide and Regional Population Estimates from the United States Census Bureau International Data Base.[14]

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## EDITORIAL COMMENT

### WORLDWIDE PREVALENCE ESTIMATES OF LOWER URINARY TRACT SYMPTOMS, OVERACTIVE BLADDER, URINARY INCONTINENCE, AND BLADDER OUTLET OBSTRUCTION

Voiding dysfunctions including overactive bladder, urinary incontinence, bladder outlet obstruction, and various lower urinary tract symptoms are highly prevalent conditions in