

## The Definition, Prevalence, and Risk Factors for Stress Urinary Incontinence

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*Stress urinary incontinence (SUI) has an observed prevalence of between 4% and 35%. Whereas the clinical definition of SUI has been established by the International Continence Society, the epidemiologic definition has not been established, leading to a broad disparity in reported prevalence rates. Numerous risk factors for SUI have been identified. Aging, obesity, and smoking appear to have consistent causal relationships with the condition, whereas the roles of pregnancy and childbirth remain controversial. The prevalence of many of these risk factors is increasing in the adult female population of the United States. These population changes, combined with increasing physician awareness and the availability of nonsurgical therapy, will likely increase the number of women receiving care for SUI over the next 3 decades.*

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**S**tress urinary incontinence (SUI) is variably estimated to affect between 4% and 35% of adult women.<sup>1-3</sup> Because there is not a standard established definition of SUI for epidemiologic research, the reported variation in prevalence rates reflects differences in populations studied, as well as differences in the definition of SUI used by the investigators. The establishment of a reasonable and consistent definition of SUI has implications for clinical outcomes as well as for

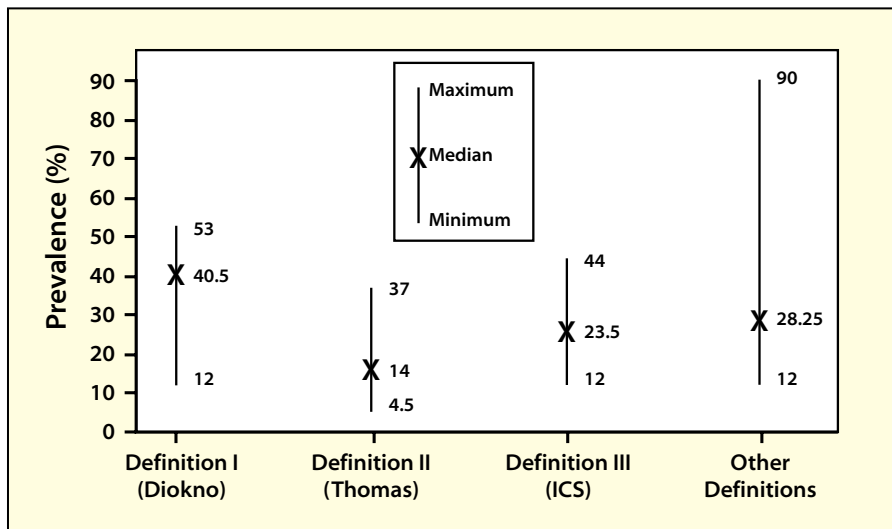


Figure 1. Reported prevalence of incontinence in women according to definitions of incontinence. ICS, International Continence Society. Reprinted from Hampel C et al. *Urology*. 1997;50(suppl 6A):4-14,<sup>2</sup> with permission from Elsevier.

epidemiologic research. The International Continence Society's standardization of terminology of lower urinary tract dysfunction provides a clinical definition of SUI.<sup>4</sup> Unfortunately, no such standardized definition has been established for epidemiologic research. This has resulted in a broad variation of definitions, making it difficult to compare or combine prevalence studies (Figure 1).<sup>2</sup> This variation in definitions creates obstacles to more sophisticated epidemiologic analyses, including identification of risk factors and development of prevention programs.

### Clinical Definitions

A clear and logical clinical definition of SUI is essential to both delivering patient care and effectively performing outcomes research. In 2001, the International Continence Society committee on terminology put forth a well-considered set of definitions for lower urinary tract symptoms (LUTS), including SUI.<sup>4</sup> The sequence of symptoms, signs, urodynamic observations, and conditions corresponds well to the ascending levels of patient evaluation. These terms encompass the heteroge-

neous character of female urinary incontinence, as well as the underlying pathophysiology of the condition.

The International Continence Society's terminology committee has organized lower urinary tract dysfunction into the logical sequence of symptoms, signs, and urodynamic diagnosis. In doing so, the committee has acknowledged that SUI can be

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evaluated and treated at many levels. Women with less bothersome symptoms may elect conservative therapy and therefore require less stringent diagnostic criteria before initiating care. For women with more bothersome symptoms, for which surgical intervention is considered, more explicit diagnostic criteria need to be met. Ascending levels of therapeutic invasiveness demand increasing levels of diagnostic accuracy.

The symptom, or "subjective indicator of disease," of SUI is described as "the complaint of involuntary

leakage on effort or exertion, or on sneezing or coughing." Table 1 contrasts this description with the symptom of urge urinary incontinence—"the complaint of involuntary leakage accompanied by or immediately preceded by urgency."<sup>4</sup>

The sign observed by the physician to verify or quantify the symptom of SUI is described as "the observation of involuntary leakage from the urethra, synchronous with exertion/effort, or on sneezing or coughing."<sup>4</sup> There is no analogous finding on physical examination for urge urinary incontinence, although the observation of increased voiding frequency recorded on a bladder diary, micturition time chart, or frequency volume chart may be considered a sign.

Urodynamic observations represent a more precise and more invasive form of evaluation of incontinence and voiding dysfunction LUTS. Often, patients' symptoms and signs observed during basic examination allow the clinician to establish a working diagnosis and initiate conservative, nonsurgical care. Patients who respond satisfactorily to conser-

vative care have no need for urodynamic studies. However, women considering surgical intervention and those in whom a diagnosis is difficult to clarify based on basic evaluation benefit from the added precision afforded by urodynamic studies.

The International Continence Society's committee on terminology defines the urodynamic observation of SUI, classified as urodynamic SUI, as "the involuntary leakage of urine during increased abdominal pressure, in the absence of a detrusor contraction." In an analogous fashion, the

urodynamic observation that establishes the root cause of urge incontinence is defined as incontinence due to involuntary detrusor contractions; this condition is classified as detrusor overactivity incontinence (see Table 1).

It is often feasible to construct a working diagnosis of the cause of a patient's incontinence based on symptoms alone. In other cases, however, the symptoms related by the patient are inconsistent and/or confusing, so that further information is needed to establish a working diagnosis before initiating even conservative care. Both Weidner and colleagues<sup>5</sup> and FitzGerald and Brubaker<sup>6</sup> independently demonstrated that an evaluation based on symptoms alone can be misleading. Weidner and colleagues<sup>5</sup> evaluated 950 women and compared their presumptive diagnoses based on symptoms with subsequent diagnoses established through urodynamics. The investigators showed that, although only 30% of the women reported pure SUI by symptoms, 62% had pure SUI established by urodynamics. This corresponded to a positive predictive value of 73.7% and a negative predictive value of 58.2%. FitzGerald and Brubaker<sup>6</sup> showed a similar lack of specificity in a study comparing the commonly used Incontinence Impact Questionnaire (IIQ) and the Urogenital Distress Inventory (UDI) with urodynamic diagnosis in 293 women in a tertiary care center.

These results, however, are not entirely surprising. Women being evaluated for incontinence are asked to characterize their urine loss as "stress" versus "urge," and, although these terms may be second nature to clinicians, they are unfamiliar to patients and often are not well understood. Thus, women have difficulty communicating the character of their urinary incontinence in terms that the clinician understands,

Type of Incontinence	Symptom: Subjective Indicator of Disease	Sign: Observed by Physician to Verify/Quantify Symptoms	Urodynamic Observations
SUI	Involuntary leakage on effort or exertion, or on sneezing or coughing	Involuntary leakage from the urethra synchronous with exertion/effort or sneezing or coughing	USUI: involuntary leakage during increased abdominal pressure without detrusor contractions
UUI	Involuntary leakage accompanied by or immediately preceded by urgency	Small volume and daytime frequency on bladder diary	DOA: incontinence due to involuntary detrusor contraction
Mixed	Involuntary leakage associated with urgency and also exertion, sneezing, or coughing	Signs of both SUI and UUI	Both observations for SUI and UUI

SUI, stress urinary incontinence; UUI, urge urinary incontinence; USUI, urodynamic SUI; DOA, detrusor overactivity.  
Adapted from Abrams P et al. *Urology*. 2003;61:37-49.<sup>4</sup>

potentially leading to misdiagnosis. In addition, for many women, the occasional symptom of stress loss may not translate into a level of bother that qualifies as the disease of stress incontinence. Indeed, in the study by FitzGerald and Brubaker,<sup>6</sup> diagnostic accuracy of the UDI and IIQ increased to 90% when the calculation included women who indicated that they not only had the symptom of "leakage related to activity" but also were "greatly bothered" by it. Although it has been well established that urodynamics are not essential for routine evaluation of urinary incontinence, the difficulties in communication and diagnostic inaccuracies of questionnaires make urodynamics invaluable in assessing patients who present with challenging symptom profiles and are a reasonable prerequisite to surgical intervention.

### Epidemiologic Definition and Prevalence

Our ability to draw meaningful conclusions regarding the prevalence and risk factors for urinary incontinence has been hampered by the absence of a reasonable and broadly supported epidemiologic definition.<sup>2</sup> Despite this handicap, several authors have analyzed the broad variety of prevalence studies to create reasonable estimates of the prevalence of urinary incontinence and, in particular, SUI. Thom<sup>1</sup> analyzed 21 community-based studies and determined the rates of any urinary incontinence and daily incontinence in older women to be 35% and 14%, respectively. In younger women, the prevalence of any incontinence was lower at 28%; there were no data available regarding the prevalence of daily incontinence in this group. Among the women who report-

ed urinary incontinence, the cause of incontinence differed by age group. Specifically, older women were more likely to experience urge incontinence (70% among women >60 years vs 45% among women ≤60 years) and younger women were proportionately more likely to experience SUI.

In a meta-analysis of 48 studies, Hampel and colleagues<sup>2</sup> reported similar results, estimating the prevalence of urinary incontinence to be 16% for women younger than 30 years and 29% for women aged 30 to 60 years. The investigators found SUI to be more common than urge urinary incontinence, with 78% of women having SUI versus 51% with urge urinary incontinence. In both studies, between 29% and 36% of women reported a combination of both stress and urge incontinence, or “mixed incontinence.”<sup>1,2</sup>

### Risk Factors

Currently, there is intense interest in identifying independent risk factors for SUI and other pelvic floor disorders, such as pelvic organ prolapse and anal incontinence. This effort is a result of the growing awareness of the enormous impact that these conditions have on quality of life and ability to function for an increasingly large segment of the US population.<sup>7,8</sup> The ability to alter risk factors and reduce the rates of SUI and other pelvic floor disorders has motivated researchers to examine the impact of factors such as aging, pregnancy, route of delivery, ethnic heritage, smoking, obesity, diabetes, and other conditions that may be comorbidities or may affect the development and/or progression of stress incontinence. Bump and Norton<sup>9</sup> have constructed an excellent model that places these risk factors in context: risk factors are divided into categories that predispose, incite, promote, decompensate, or intervene to

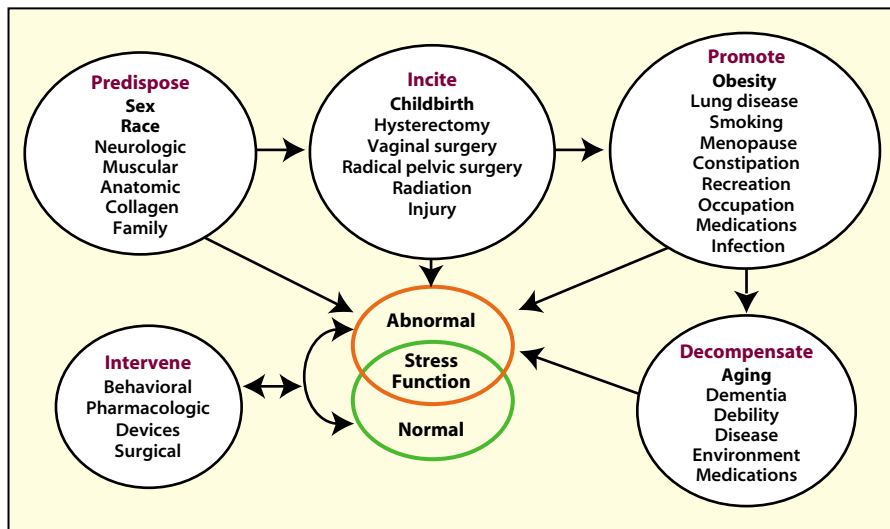


Figure 2. Risk factors for stress urinary incontinence. Adapted from Bump RC, Norton PA. *Obstet Gynecol Clin North Am.* 1998;25:723-746,<sup>9</sup> with permission from Elsevier.

effect change in pelvic floor disorders (Figure 2). Not all of these factors are completely understood in their causal relationship and magnitude; several, however, stand out as risk factors of which we are reasonably confident, including aging, obesity, smoking and, more controversially, pregnancy and route of delivery.

### Aging

Although it is evident that aging is associated with a higher risk of SUI, the specific changes associated with aging that cause this increase in prevalence are not clearly defined.<sup>3</sup> The association between aging and urge incontinence is relatively easily explained: ultrastructural changes in the bladder and distinct changes in receptor response provide a partial explanation for the rising prevalence of urge incontinence with increasing age.<sup>10</sup> This phenomenon is less understood for stress incontinence. In fact, several older studies suggested that the prevalence of stress incontinence may decrease with advancing age.<sup>11</sup> However, recent data from the Norwegian Epidemiology of Incontinence in the County of Nord-

Trøndelag (EPINCONT) group demonstrate a clear pattern of increasing prevalence of stress incontinence with advancing age.<sup>3</sup> This trend may reflect a general loss of muscle tone, long-term effects of denervation injuries experienced during parturition, and/or changes in hormonal stimulation, as well as not-yet-identified factors.

The US population is currently undergoing unprecedented demographic change. Within the next 30 years, the number of women older than 60 years will increase by approximately 82%, according to US Census Bureau middle series projections.<sup>7</sup> This aging of the population has profound implications for those providing health care to women with SUI.

### Obesity

Obesity has often been invoked as a risk factor for urinary incontinence. There are several mechanical and physiologic reasons why an increased body mass index (BMI) may be associated with, if not causative of, urinary incontinence. Evidence suggests that the prevalence of both urge and stress incontinence

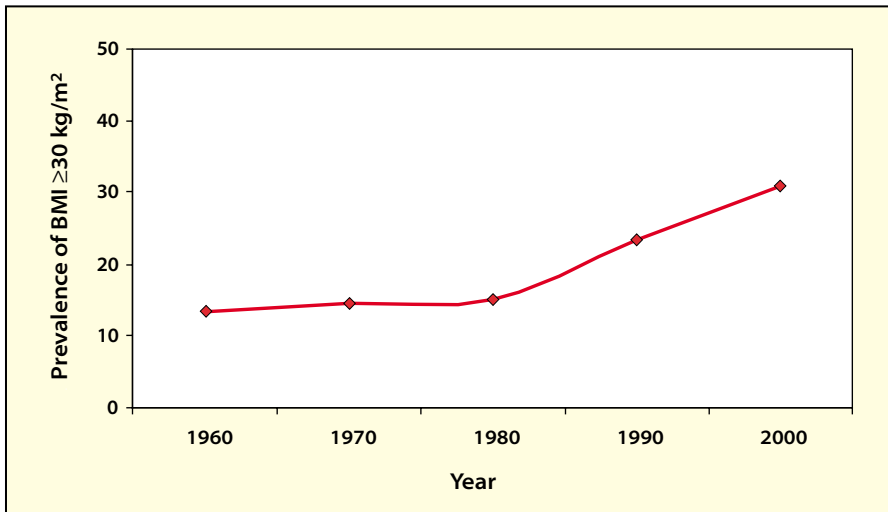


Figure 3. Obesity trends in the US population from 1960 to 2000. BMI, body mass index. Data from Flegal KM et al. JAMA. 2002;288:1723-1727.<sup>15</sup>

increases proportionately to a rising BMI.<sup>12</sup> Indeed, the increase in intravesical pressure created by a rising BMI may reduce the continence gradient between the urethra and the bladder. In this situation, the magnitude of increased intra-abdominal pressure necessary to force urine through the urethra is reduced because the static pressure within the bladder is higher.<sup>13</sup> Of interest, there is early

to increase the prevalence of urinary incontinence in the United States.

#### Smoking

Smoking has also been associated with an increased risk of urinary incontinence. Studies by Hannestad and colleagues<sup>12</sup> and Bump and McClish<sup>16</sup> have shown the relative risk of SUI to be between 1.8 and 2.92 for current smokers. Whether by

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evidence that a subset of women with elevated BMIs and urge incontinence may have a  $\beta_3$ -adrenergic receptor mutation that simultaneously affects both insulin sensitivity and  $\beta_3$ -mediated detrusor muscle relaxation.<sup>14</sup>

There has been an alarming increase in the prevalence of obesity in the United States over the past 2 decades. The proportion of persons with a BMI exceeding 30 kg/m<sup>2</sup> increased from approximately 13.4% in 1960 to 30.5% in 2000 (Figure 3).<sup>15</sup> As with the aging of the population, this high prevalence of obesity is likely

direct effect or indirectly through smoking-related illnesses that cause increased coughing, such as chronic obstructive pulmonary disease, smoking appears to have a striking causal relationship with SUI.

The prevalence of smoking and smoking-related illnesses has increased steadily among women since the early 1960s. Between 1970 and 1994, deaths due to lung cancer among women in the United States have increased almost 3-fold.<sup>17</sup> This trend suggests that an incremental increase in the prevalence of smok-

ing-related SUI among women can be expected.

#### Pregnancy and Childbirth

The data available regarding the role of pregnancy and route of delivery on pelvic floor disorders such as SUI are inconsistent, and the influence of these factors is not well understood. Clearly, the evidence underlying the hypothesis that vaginal delivery has a causal relationship with SUI is mechanistically logical and supported by basic science.<sup>18,19</sup> However, although several epidemiologic studies demonstrate a moderate to significant increase in the relative risk of pelvic floor disorders among parous versus nulliparous women, other studies show little to no increase in risk.<sup>20</sup>

In 1997, Mant and colleagues<sup>20</sup> analyzed a database of 17,032 women attending the Oxford Family Planning Clinic and reported that women with a history of 2 or more pregnancies had a relative risk of surgery to correct pelvic organ prolapse of 8.4 compared with nulliparous women. More recently, Rortveit and colleagues<sup>3</sup> reported the attributable risk of vaginal delivery to be approximately 35% across the age range that they studied. Regrettably, the oldest patients in their study population were in their fifth decade of life and, thus, a meaningful conclusion about aging as a potential confounding variable could not be made.

In contrast, MacLennan and colleagues<sup>21</sup> analyzed a population of 1546 women in South Australia and concluded that there was no increased risk of SUI among women who had undergone vaginal delivery compared with those who had delivered by cesarean section. However, closer analysis revealed that, of the 100 women in the cesarean section-only group, only 36 were unlabored. In addition, once again, the population was too young to draw

meaningful conclusions regarding the influence of age.

Data presented by Brown and colleagues<sup>22</sup> indicate no statistically significant increase in risk of SUI in women of increasing parity. In this study, the risk of daily urinary incontinence was between 12% and 15%, regardless of parity. O'Boyle and colleagues<sup>23</sup> recently reported the provocative observation that changes in pelvic floor support may present during the third trimester in nulliparous women.

Unfortunately, these studies are difficult to analyze collectively: they often represent homogeneous populations that cannot be easily generalized and use inconsistent definitions of SUI, many of which have not undergone appropriate psychometric validation. Until a more standardized and validated method of screening large populations for SUI becomes available, extracting meaningful conclusions from these data will remain difficult. Clearly, the relationship between pregnancy and route of

delivery and the development of SUI and other pelvic floor disorders is critical, and more work is needed before we can fully understand how these factors interact.

### Summary

Current evidence indicates that SUI affects 4% to 14% of younger women and 12% to 35% of older women. However, the risk factors that predispose or contribute to the development of this condition are incompletely understood. The risk factors of which we are reasonably confident—aging, obesity, and smoking—are increasing in prevalence among the female population, which will likely result in an increased number of women in the United States with SUI.

Many women with SUI do not seek care for their condition. Some women have SUI of a mild nature and do not feel that treatment of the condition is warranted; others are embarrassed to speak with a health care provider about their condition or fear that treatment will require surgery.

A further barrier to the treatment of SUI is the common lack of education of health care providers in evaluating and caring for the condition.<sup>24</sup> As physicians become more aware of the impact of SUI, as well as its evaluation and treatment, more patients with the disorder will find the appropriate care available to them. Likewise, if less-invasive treatments become more widely available, more patients may be willing to seek care without the fear of surgery. ■

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### Main Points

- The absence of a standardized epidemiologic definition of stress urinary incontinence (SUI) makes it difficult to establish the true prevalence of the disorder. This variation in definition also creates obstacles to more sophisticated epidemiologic analysis, including identification of risk factors and development of prevention programs.
- In 2001, the International Continence Society committee on terminology put forth a well-considered set of definitions for lower urinary tract symptoms, including SUI. The sequence of symptoms, signs, urodynamic observations, and conditions corresponds well to the ascending levels of patient evaluation.
- Although urodynamics studies are not essential for the routine evaluation of a patient with incontinence, they can be invaluable in assessing patients who present with challenging symptom profiles and are a reasonable prerequisite to surgical intervention.
- Within the next 30 years, the number of women older than 60 years will increase an estimated 82%. This aging of the population has profound implications for those providing health care to women with SUI.
- The prevalence of both urge and stress incontinence has been shown to increase proportionately to a rising body mass index (BMI). The proportion of persons with a BMI exceeding 30 kg/m<sup>2</sup> increased from approximately 13.4% in 1960 to 30.5% in 2000. This high prevalence of obesity is likely to increase the prevalence of urinary incontinence in the United States.
- Whether by direct effect or indirectly through smoking-related illnesses that cause increased coughing, such as chronic obstructive pulmonary disease, smoking appears to have a striking causal relationship with SUI.
- The data available regarding the influence of pregnancy and route of delivery on pelvic floor disorders are inconsistent. More research is needed to clearly define the relationship of these factors to the development of SUI.

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