

DOI: <https://doi.org/10.17816/RFD71196>



The prevalence of urinary incontinence and its relationship with physical and cognitive status in older adults: Results of the Crystal and the Eucalyptus studies

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BACKGROUND: Urinary incontinence worsens the psychological state of older adults, increases the risk of developing anxiety, depression, falls-related injuries, leads to a decrease in the quality of life, and a decrease in the level of physical activity in old age.

AIM: To assess the prevalence of urinary incontinence according to the data of the Crystal and Eucalyptus studies, to identify factors associated with the development of urinary incontinence, as well as factors that reduce the risk of urinary incontinence in old age.

MATERIALS AND METHODS: A random sample of 1007 people aged 65 and older. The main parameters: urinary incontinence, frailty, nutritional status, anemia, CRP, functional status, depression, dementia, chronic diseases, grip strength, level of physical functioning, falls. The observation time is 2.5 years.

RESULTS: According to the Eucalyptus study, urinary incontinence syndrome was detected in 48.0%, in the Crystal study — in 41.2%. In 62.4% cases urinary incontinence was diagnosed for the first time. Urinary incontinence was associated with a higher prevalence of COPD, history of stroke, sensory deficits, frailty and other geriatric syndromes. Improved nutrition and increased protein intake led to the disappearance of urinary incontinence complaints in 47.7% of cases. The disappearance of complaints of urinary incontinence was associated with an improvement in the emotional status. A decline in cognitive function has been associated with an increased risk of urinary incontinence in old age.

CONCLUSIONS: Despite the high prevalence of urinary incontinence, it often remains undiagnosed. The correct wording of the question in the conversation with the patient allows to identify 30% more cases of urinary incontinence. Given the high prevalence of urinary incontinence among patients with COPD, stroke, sensory deficits, frailty and other geriatric syndromes, all patients in these groups should be purposefully asked about the presence of symptoms of urinary incontinence. Improved nutrition and increased protein intake are associated with the disappearance of urinary incontinence complaints.

Keywords: prevalence of urinary incontinence; frailty, nutritional status; COPD; geriatric syndromes.

To cite this article:

Turusheva AV. The prevalence of urinary incontinence and its relationship with physical and cognitive status in older adults: Results of the Crystal and the Eucalyptus studies. *Russian Family Doctor*. 2021;25(2):29–37. DOI: <https://doi.org/10.17816/RFD71196>

Received: 02.06.2021

Accepted: 15.06.2021

Published: 30.06.2021

DOI: <https://doi.org/10.17816/RFD71196>

Распространенность синдрома недержания мочи и его взаимосвязь с показателями физического и психического здоровья у пожилых людей по данным исследований «Хрусталь» и «Эвкалипт»

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Обоснование. Синдром недержания мочи ухудшает психологическое состояние пожилого человека, повышает риск развития тревоги, депрессии, травм, связанных с падениями, ведет к снижению качества жизни, уровня физической активности в пожилом и старческом возрасте.

Цель исследования — оценить распространенность недержания мочи по данным исследований «Хрусталь» и «Эвкалипт», выявить факторы, ассоциированные с развитием недержания мочи в пожилом и старческом возрасте, а также факторы, снижающие риск развития недержания мочи.

Материалы и методы. Случайная выборка из 1007 человек в возрасте от 65 лет и старше. Основные оцениваемые параметры: синдром недержания мочи, синдром старческой астении, нутритивный статус, анемия, уровень С-реактивного белка, функциональный статус, депрессия, деменция, хронические заболевания, сила сжатия, уровень физического функционирования, падения. Срок наблюдения — 2,5 года.

Результаты. Синдром недержания мочи, по данным исследования «Эвкалипт», был выявлен у 48,0 % участников, в исследовании «Хрусталь» — у 41,2 %. В 62,4 % синдром недержания мочи был выявлен впервые. Синдром недержания мочи был ассоциирован с более высокой распространенностью хронической обструктивной болезни легких, острого нарушения мозгового кровообращения в анамнезе, с сенсорными дефицитами, а также с синдромом старческой астении и другими гериатрическими синдромами. Улучшение питания и повышение в рационе содержания белка привело к исчезновению жалоб на недержание мочи у 47,7 % участников исследования. Исчезновение жалоб на недержание мочи было ассоциировано с улучшением эмоционального фона, снижением когнитивных функций — с увеличением риска развития недержания мочи в пожилом и старческом возрасте.

Заключение. Несмотря на высокую распространенность синдрома недержания мочи, он часто остается недиагностированным. Правильная формулировка вопроса в беседе с пациентом позволяет выявить на 30 % больше случаев недержания мочи. Учитывая высокую распространенность недержания мочи среди пациентов с хронической обструктивной болезнью легких, острым нарушением мозгового кровообращения, сенсорными дефицитами, синдромом старческой астении и другими гериатрическими синдромами, всех пациентов данной группы необходимо целенаправленно расспрашивать о наличии симптомов недержания мочи. Улучшение питания и увеличение в рационе содержания белка ассоциировано с исчезновением жалоб на недержание мочи.

Ключевые слова: распространенность недержания мочи; синдром старческой астении; питание; хроническая обструктивная болезнь легких; гериатрические синдромы.

Как цитировать:

Турушева А.В. Распространенность синдрома недержания мочи и его взаимосвязь с показателями физического и психического здоровья у пожилых людей по данным исследований «Хрусталь» и «Эвкалипт» // Российский семейный врач. 2021. Т. 25. № 2. С. 29–37. DOI: <https://doi.org/10.17816/RFD71196>

BACKGROUND

Urinary incontinence is a pathological condition characterized by any involuntary loss of urine from the urethra [1]. Available literature shows that the prevalence of urinary incontinence varies from 5% to 70%, increases with age, and is more common in women than in men, depending on the population and research methods [2]. The most commonly reported prevalence range of urinary incontinence in the free-living population accounts for 25%–45% [2].

Despite its high prevalence, urinary incontinence belongs to the class of unmet and often unexplained needs of geriatric patients. According to studies, only 30%–45% of women and 22% of men seek medical care for urinary incontinence in developed countries [1, 3].

Reasons for infrequent visits to a doctor may vary. Some people believe that urinary incontinence is a natural condition in old age, and others are embarrassed to talk about this problem or are unaware of the kind of medical care provided. Moreover, doctors do not deliberately ask older patients about urinary incontinence and frequently do not know how to help this category of population.

Therefore, according to a study involving 5,506 participants aged 30–79 years, only 60% of patients received treatment after visiting a doctor with complaints of urinary incontinence [3]. However, 50% of treated women and 40% of treated men subsequently reported treatment failure [3].

Urinary incontinence is a serious factor that significantly worsens the psychological state of the elderly, increases the risk of developing anxiety, depression, and fall-related injuries, leads to a decreased quality of life and level of physical activity, and increases burden on caregivers and financial costs.

Therefore, prevalence studies about urinary incontinence in the population should be conducted to identify both risk factors for urinary incontinence and factors that lead to a decreased risk of developing urinary incontinence in old age.

This study aimed the following:

- 1) assess the prevalence of urinary incontinence according to the Crystal and Eucalyptus studies;
- 2) identify the factors associated with urinary incontinence development in old age; and
- 3) identify the factors that reduce the risk of developing urinary incontinence in old age.

MATERIALS AND METHODS

Study design: The work was performed as a part of the Crystal prospective cohort study and the Eucalyptus cross-sectional cohort study.

The Crystal study was conducted in two stages. In the first stage, 611 participants aged ≥ 65 years were

selected by random sampling from the population assigned to the Municipal Outpatient Clinic No. 95 of the city of Kolpino. The second examination was undertaken after an average of 33.4 ± 3 months and included 379 participants (102 participants died before the second examination and 130 declined further participation). The Eucalyptus study included 396 randomly sampled participants aged ≥ 65 years that were assigned to four municipal outpatient clinics of the city of Saint Petersburg.

The study was approved by the local ethical committee of the I.I. Mechnikov North-Western State Medical University, and informed consent was obtained from all participants.

Basic study parameters:

1. Urinary incontinence survey: When conducting a survey, complaints of urinary incontinence were considered, and participants were asked in detail about situations that provoke urinary incontinence. The amount of leaking urine, use of absorbent hygiene products, further visits to a doctor, and degree of discomfort associated with urinary incontinence were assessed.
2. Comorbidity and received medication: Data on acute and chronic diseases and drugs taken were obtained by interviewing participants and analyzing outpatient records.
3. Geriatric syndromes:
 - The frailty was diagnosed using four diagnostic models: “Vozrast ne pomekha” (*the Age is not a blocking factor model*) questionnaire [4], Osteoporotic Fractures Frailty Index [5], Groningen Frailty Indicator questionnaire (Groningen Frailty Index, GFI) [6], and L. Fried’s criteria [7].
 - Malnutrition was assessed using the Mini Nutritional Assessment [4]; the cut-off point was ≤ 23.5 .
 - Cognitive decline was assessed in the Crystal study using the Mini-Mental State Examination (MMSE) [4], and in the Eucalyptus study using the Mini-Cog test [4]. Cut-off points were < 24 for MMSE and < 3 for Mini-Cog test, respectively [4].
 - The Geriatric Depression Scale [4] was used to diagnose suspected depression; the cut-off point was ≥ 5 [4].
 - Autonomy decline was assessed using the Barthel Index of Activities of Daily Living; the cut-off point was < 95 [4].
 - Decrease in handgrip strength was assessed by a handgrip test using a DK-50 mechanical wrist dynamometer (Nizhny Tagil Medical Instrument Plant, Russia) in deca-newtons (daN) according to the protocol of the Groningen Fitness Test for the Elderly [8]; the value below 10th centile was taken as the cut-off point [9].
 - A decrease in the level of physical functioning was diagnosed using the Short Physical Performance Battery [4, 10]; the cut-off point was ≤ 7 [11].
4. Laboratory tests: Complete blood count and C-reactive protein measurements were performed. Anemia was

diagnosed as hemoglobin levels of <120 and <130 g/L in women and men, respectively.

Statistical analysis: The mean and its standard deviation (mean $\pm$ SD) were calculated to analyze continuous data with normal distribution. Intergroup differences were determined using Mann-Whitney and Chi-square tests; data were analyzed using SPSS 20.0 (SPSS Inc., Chicago, IL, USA) and MedCalc 11.5.00 (MedCalc Software, Oostende) software. A p -value of ≤ 0.05 was considered as the critical significant point.

RESULTS

1. Prevalence of urinary incontinence.

1.1. Results of the Eucalyptus study.

Urinary incontinence was diagnosed in 48.0% ($n = 190$) of participants, and the frequency of detection of this syndrome in the study population depended largely on how the question was asked. The "Vozrast ne pomekha" questionnaire allowed detection of urinary incontinence in 72.1% ($n = 137$) of the participants with urinary incontinence, and the Barthel Index <95 was found in 54.5% ($n = 103$). The following two questions were the most sensitive to detect urinary incontinence: "Do you have urinary incontinence when coughing or sneezing?" and "Do you have involuntary loss of urine in a pronounced urge to urinate (on the way to the toilet)?" The first question allowed detection of urinary incontinence in 100% ($n = 26$) of men and 94.5% ($n = 155$) of women with urinary incontinence syndrome, whereas the second question in 92.0% ($n = 23$) and 68.9% ($n = 113$) of men and women, respectively.

Isolated stress urinary incontinence was detected in 23.2% ($n = 44$) of participants, and mixed type urinary incontinence was found in 71.6% ($n = 136$), whereas incontinence was associated with being bedridden after stroke and needing a bedpan in 5.2% ($n = 10$) of participants. Mixed type urinary incontinence was observed more frequently in men, whereas stress urinary incontinence was more frequent in women ($p < 0.05$).

In the study population, only 37.6% ($n = 71$) of participants visited a doctor regarding urinary incontinence. The frequency of visits to a doctor is directly dependent on the severity of discomfort and volume of leaking urine.

Absorbent products were used by 48.7% ($n = 92$) of participants, whereas 14.3% ($n = 27$) of participants did not use, but wished to use these products. The frequency of using incontinence liners depended on how much incontinence caused discomfort in daily life, the amount of leaking urine, and the financial status ($p < 0.05$). Participants with higher financial status were 21.0% (9.9–30.3, $p < 0.05$) and more likely use absorbent products. The proportion of participants who noted lack of money for groceries and difficult financial situation

was higher among those who wanted, but could not use urological pads. However, this difference was not statistically significant. In 98.5% ($n = 62$) of cases, urological pads were used more frequently by women ($p < 0.05$).

Interestingly, over half of the participants (55.8%, $n = 39$) who reported the need to use incontinence liners experienced varying degrees of discomfort associated with urinary incontinence.

Participants with urinary incontinence syndrome who visited doctors were 17.4% more likely to use absorbent urological products (95% CI 2.2%–31.6%, $p < 0.05$).

A total of 71.4% ($n = 10$) of participants who used adult diapers were either disabled or unable to perform activities of daily living due to the severe cognitive decline or stroke effects. Of these, 21.4% ($n = 3$) were able to move around the house independently, but did not go outside, and 7.1% ($n = 1$) were able to go outside independently. No statistically significant differences were found in using adult diapers between men and women ($p < 0.05$).

1.2. Results of the Crystal study.

No statistically significant differences were found between the prevalence of urinary incontinence in the Crystal and Eucalyptus studies ($p < 0.05$). Urinary incontinence at the first examination was detected in 41.2% of cases ($n = 251$). The incidence of urinary incontinence increased with age and was higher among women ($p < 0.05$). In the younger age group (65–74 years), the incidence of urinary incontinence was 41.1% among women ($n = 86$) and 19.1% among men ($n = 18$), whereas in the older age group (≥ 75 years), it amounted for 51.9% ($n = 121$) and 35.6% ($n = 26$), respectively ($p < 0.05$).

Benign prostatic hyperplasia (BPH) led to urinary incontinence in 71.1% and 76.9% of men in Crystal and Eucalyptus studies, respectively. After adjusting for age, men with BPH had 3.7-fold higher risk of developing urinary incontinence [OR (95% CI) 3.696 (1.174–11.637)] compared with patients without BPH.

According to the Crystal study, urinary incontinence in women was associated with vaginal or uterine wall prolapse in 58% of cases ($n = 62$), stress urinary incontinence in 11.6% ($n = 13$), and Parkinson's disease in 0.9% ($n = 1$).

In 29.0% of cases, urinary incontinence in men and women was of unknown etiology.

2. Correlation of urinary incontinence with the prevalence of chronic diseases.

According to the Eucalyptus study, urinary incontinence was associated with a higher prevalence of chronic obstructive pulmonary disease (COPD), previous stroke, and intake of β -blockers, diuretics, and centrally acting antihypertensive drugs. Given the close correlation between these parameters, the most significant indicators associated with urinary incontinence (after adjusting for gender and

age) were determined using Backward Elimination method, i.e., COPD [OR (95% CI) 3.624 (1.092–12.032)], stroke [OR (95% CI) 1.841 (1.120–3.026)], diuretics [OR (95% CI) 1.662 (1.046–2.643)], and central antihypertensive drugs [OR (95% CI) 1.814 (1.011–3.253)].

Diuretic use and COPD were more strongly associated with an increased risk of stress [OR (95% CI) 1.716 (1.101–2.674)], but not urgent urinary incontinence [OR (95% CI) 1.060 (0.673–1.668)]. By contrast, the use of central antihypertensive drugs was associated with a higher risk of developing both types of urinary incontinence — OR (95% CI) 2.077 (1.203–3.585) and 1.728 (1.012–2.950), respectively.

The association between all episodes of urinary incontinence and involuntary urination when coughing/sneezing and in COPD was statistically significant after adjusting for gender, age, intake of diuretics and central antihypertensive drugs, nutritional malnutrition, a history of stroke and transient ischemic attack, smoking, and decreased grip strength with OR (95% CI) 3.635 (1.039–12.712) and 4.191 (1.217–14.430), respectively. No association was found between COPD and amount of leaking urine.

In both Crystal and Eucalyptus studies, urinary incontinence was associated with a higher prevalence of atrial fibrillation and COPD. The association remained statistically significant after adjusting for gender, age, and intake of β -blockers and angiotensin-converting enzyme inhibitors [OR (95% CI) 1.910 (1.327–2.749) for atrial fibrillation and 1.696 (1.134–2.536) for COPD].

3. Correlation of urinary incontinence with other geriatric syndromes.

According to the Crystal and Eucalyptus studies, urinary incontinence was associated with a higher prevalence of all geriatric syndromes, i.e., decreased physical functioning, grip strength, malnutrition, depression, cognitive decline, and frailty, as determined by various diagnostic approaches and increased dependence on physical assistance ($p < 0.05$). The identified autonomy decline remained statistically significant after adjusting for gender and age ($p < 0.05$).

4. Dynamic changes in complaints of urinary incontinence within 2.5 years of follow-up according to the Crystal study.

After 2.5 years of follow-up, 47.7% ($n = 71$) of participants who complained of urinary incontinence at the first examination were free of any complaints. Of these, 91.5% ($n = 65$) were women. The main factors associated with the condition improvement of participants were improved cognitive functions, emotional status, and nutrition. After adjusting for gender and age, the most significant indicators associated with the disappearance of complaints of urinary incontinence were determined using Backward Elimination method, and they included improvement in nutritional status

and emotional status and improvement in cognitive functions [OR (95% CI) 3.146 (1.450–6.827) and 3.160 (1.291–7.736), respectively]. Nutritional analysis revealed a positive association between the amount of protein consumed per day and disappearance of urinary incontinence complaints. High protein intake reduced the risk of new urinary incontinence by 59%, regardless of cognitive status, stroke history, and level of physical functioning [OR (95% CI) 0.407 (0.187–0.885)]. After adjusting for gender, age, stroke, improved nutritional status, and cognitive decline, the disappearance of urinary incontinence complaints was also found to be associated with improved emotional status [OR (95% CI) 2.949 (1.316–6.608)].

New cases of urinary incontinence among those without complaint at the first examination were reported in 38.0% ($n = 87$) of cases. Of these, 64.4% ($n = 56$) were women. The main factor associated with new cases of urinary incontinence was cognitive decline. This association remained statistically significant even after adjusting for gender, age, stroke history, decreased physical functioning, degree of dependence on physical assistance, and amount of protein intake [OR (95% CI) 2.734 (1.559–4.795)].

DISCUSSION

Despite the high prevalence of urinary incontinence, this study found that the syndrome remains undetected in 62.4% of cases, since elderly patients do not consult a doctor regarding this problem. Moreover, the direct question “Do you have urinary incontinence?” is not always answered positively by the elderly, since the term “urinary incontinence” is sometimes understood ambiguously. Prevalence of urinary incontinence is significantly higher among patients with history of COPD and stroke, sensory deficits, frailty, and other geriatric syndromes. Improved nutrition and increased protein intake led to the disappearance of urinary incontinence complaints in 47.7% of participants. The disappearance of urinary incontinence complaints in the elderly was also associated with an improved emotional functioning. Cognitive decline is one of the main factors, which is associated with an increased risk of urinary incontinence in old age.

According to Eucalyptus and Crystal studies, urinary incontinence was detected in 48.0% and 41.2% of cases, respectively. Obtained data were consistent with the results from other studies, in which the prevalence of urinary incontinence in the community-living older persons most frequently ranged from 25% to 45% [2].

In this study, urinary incontinence syndrome was associated with a higher prevalence of frailty and other geriatric syndromes. The physiological mechanisms of urinary control should be mentioned to understand the possible relationship between urinary incontinence and the

aforementioned clinical conditions. Effective urinary control will require:

- an adequate stimulus to initiate urinary reflex;
- neuromuscular and structural integrity of the urogenital system;
- preservation of cognitive functions, which allow adequate interpretation and response to the feeling of bladder fullness and motivation for urinary retention; and
- preservation of mobility, which allows getting to the toilet before the urge to urinate surpasses the restraining ability of a person.

Therefore, four clinical types of urinary incontinence can be distinguished, i.e., urge, stress, overflow or functional incontinence [1].

Stress urinary incontinence is clinically manifested by complaints of spontaneous urine passage when coughing, sneezing, or exercising [4]. Two main causes that lead to the development of this type of urinary incontinence were identified.

1. Weakness of the pelvic floor muscles, dislocation, and weakening of the ligamentous apparatus of the unchanged urethra and urethrovesical segment, which may also be observed in patients with uterine or vaginal prolapse, obesity or, conversely, malnutrition, chronic constipation, sarcopenia, or frailty.
2. Changes in the urethra and the sphincter that lead to dysfunction of the closure apparatus (for example, after prostatectomy).

Urge urinary incontinence is manifested by an urgent need to urinate that cannot be retained. This type of urinary incontinence is associated with involuntary bladder contractions due to a decreased inhibitory control of the central nervous system or urothelial dysfunction, which results in the activation of afferent bladder reflexes. Urge urinary incontinence is a common type of incontinence in patients with dementia, as well as after stroke [12, 13].

Overflow incontinence is characterized by involuntary urine leakage without the urge to urinate and inability to completely empty the bladder. This type of urinary incontinence is common in the elderly, and its incidence increases with age [14]. Overflow incontinence results mostly from long-term infravesical obstruction and decreased or absent detrusor contractility due to bladder innervation disorders (diabetic polyneuropathy, damage to nerve fibers during pelvic surgeries, cognitive decline, and stroke) [1].

Functional urinary incontinence is characterized by complaints of urinary incontinence due to a person's inability to reach the toilet independently for any reason associated with cognitive decline, decreased mobility, or other environmental factors (limited toilet accessibility).

Thus, urinary incontinence in elderly patients can be considered a multifactorial syndrome that is directly associated with malnutrition, decreased physical functioning,

cognitive decline, and dependence on physical assistance, indicating a deterioration in the general health of the elderly, and it serves as a proxy indicator of frailty development, which is directly confirmed by study results.

A positive association was found between COPD and urinary incontinence when data were analyzed. The association between urinary incontinence and higher prevalence of COPD was also shown in other studies [15–17]. However, its cause is unclear. Most researchers agree that increased prevalence of urinary incontinence in COPD is associated with increased abdominal pressure when coughing, which is a characteristic of COPD [18, 19]. These findings were indirectly confirmed by study results, since stress urinary incontinence was more frequently observed in patients with COPD. However, sarcopenia (as one of the main manifestations of frailty, as well as frailty itself) is significantly more common in patients with COPD and urinary incontinence compared with healthy participants from the control group [20, 21]. In addition, COPD contributes to the skeletal muscle dysfunction at the biochemical, cellular, and structural levels [20], which is an additional risk factor for the development of urinary incontinence. A strong correlation between COPD, decreased lung function, frailty, and urinary incontinence was confirmed in this study [11].

In our study, improved nutrition and increased protein intake were associated with the disappearance of urinary incontinence complaints within 2.5 years of follow-up. In the literature review, no studies confirmed that improved nutrition leads to decreased urinary incontinence complaints in old age. Most studies that assessed the effect of nutrition on urinary incontinence were cross-sectional or conducted on a younger population without frailty or malnutrition [22, 23]. According to the results from these studies, the risk of urinary incontinence was significantly higher in patients who were overweight and consumed large amounts of saturated fat, but was independent of protein and carbohydrate intake [22, 23]. The association found between improved nutrition and disappearance of urinary incontinence complaints can be explained by the treatment of malnutrition, which was diagnosed in study participants at the first examination, and the positive effect of improved nutrition on reducing frailty severity. The association of improved nutrition and increased protein intake corroborates with the findings of previous studies [24].

A possible limitation of this study is that no consultation was made from a urologist and no ultrasound examination was performed to determine the amount of residual urine and establish the type of urinary incontinence. Therefore, the effect of improved nutrition and cognitive functions on decreased urinary incontinence complaints depending on the type of incontinence was not shown in this study. However, according to clinical guidelines, urinary incontinence may be diagnosed only on the basis of pathognomonic complaints, which are characterized by various types of urinary

incontinence, without consulting a urologist and additional instrumental examination [1]. In addition, a mixed type of urinary incontinence is more common in old age [1].

The strength of our work includes the analysis of results from two large cohort studies of a random sample of the population aged ≥ 65 years in several districts of Saint Petersburg. The prospective design of the Crystal study allowed the identification of factors associated with the appearance and disappearance of patients' urinary incontinence complaints. Moreover, this study included those patients who do not frequently visit a doctor at the outpatient clinic, which allows the assessment of more accurate prevalence of urinary incontinence in the studied populations.

CONCLUSIONS

1. Despite the high prevalence of urinary incontinence, this syndrome remains undetected in 62.4% of cases, since elderly patients do not consult a doctor regarding this problem.

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