



The Prevalence of Urinary Tract Infections in Institutionalized vs. Noninstitutionalized Elderly Persons

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This review involves the prevalence of urinary tract infections (UTIs) in elderly persons in Korea. The global average life expectancy has been increasing due to recent advances in medical technology, economic development, and availability of hygienic environment. UTIs and asymptomatic bacteriuria are common diseases in both genders of all ages, but have been particularly increasing in elderly populations. The common causes of this increase are overactive bladder, benign prostatic hyperplasia, and neurogenic bladder. Institutionalized patients are susceptible to bacterial infections due to urinary incontinence, fecal contamination, and poor perineal hygiene. UTIs are the second most common infection, constituting 25% of all infection occurrences in elderly populations living at home. Several studies involving elderly persons living in the community have reported that the prevalence of UTIs is 0.07/person-year in postmenopausal women, 0.12/person-year in elderly persons with diabetes mellitus, and 0.05/person-year in men. The incidence of UTIs in elderly individuals increases with age, particularly in institutionalized elderly patients compared with those at home. However, no study has compared the prevalence of UTIs between institutionalized and noninstitutionalized elderly persons in Korea. Such comparison and evaluation may help to prevent UTIs in elderly Korean people.

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INTRODUCTION

The global average life expectancy has been increasing recently due to advancements in medical technology, economic development, and availability of hygienic environment. Consequently, the world population is getting older. The progression of aging in Korea is more rapid than that in other countries. Therefore, significant social and economic impacts are expected as a result [1]. As the number of elderly persons is increasing constantly, the proportion of population over the age of 65 years, which

was 12.7% of the total population in 2014, is projected to be as high as 20% by 2026, 24.3% by 2030, and 40.1% by 2060. The number of elderly persons who need institutional care, rehabilitation, and treatment is also increasing, since long average life expectancy would naturally increase the number of chronic diseases, such as neurological problems, diabetes mellitus, and physical disabilities. A total of 43% of the American population that turned 65 in 1990 reportedly spend some period in a long-term care facilities, such as adult day care units, residential care facilities, rehabilitation facilities, nursing

homes, chronic disease hospitals, and Veteran's Affairs nursing home care units [2].

In the past, family members provided care for the elderly. However, in a modern society, changes in the traditional family system necessitate institutionalization for the elderly. According to the Korean national survey data published in 2014, the number of nursing hospitals for the elderly has increased by about 10.9 times since 2004 (113 in 2004 to 1,232 in 2013). The number of elderly patients hospitalized in nursing hospitals was found to increase by 10 times (32,634 in 2004 to 331,726 in 2013) [3].

CHARACTERISTICS OF ELDERLY PERSONS

The characteristics of elderly persons include lack of physical activity, nutritional deficiencies, and comorbidities, such as chronic diseases, neurological diseases—including dementia, peripheral vascular, and cerebrovascular disease, chronic pulmonary conditions, diabetes mellitus, functional impairment, malnutrition, presence of invasive devices, and polypharmacy—including 5-10 medications (Table 1) [4-6].

These characteristics lead to a modification of the inflammatory response, with increased circulating levels of inflammatory cytokines, oxidative stress, suppressed muscle autophagy, and increased apoptosis by an alteration of the intra- and extra-cellular processes [7]. Thus, alterations in the immune system are detected with aging [8]. There is

Table 1. Characteristics and physiologic changes of elderly persons [4-6]

Characteristic	Function
General characteristics	Lack of physical activity Nutritional deficiencies Comorbid disease
Comorbid diseases	Chronic diseases-neurological diseases, peripheral vascular and cerebrovascular disease, chronic pulmonary condition Diabetes mellitus Invasive devices Functional impairment
Specific immunity	Decrease T lymphocytes Decreased antibody production Decrease interleukin-2
Skin	Decrease epidermal thinning Decrease elasticity
Respiratory tract	Decrease cough reflex Decrease mucociliary transport
Gastrointestinal tract	Decrease gastric acidity Decrease motility
Urinary tract	Increase perineal-vaginal colonization Increase prostate size Decrease urine osmolality

a consistent decline in T-lymphocyte function and cell-mediated immunity with aging, and the humoral immune response may be quantitatively diminished, although it is relatively well maintained [6]. Therefore, elderly persons are susceptible to infections, including urinary tract infections (UTIs), respiratory tract infections, skin infections, and gastrointestinal infections. Infections acquired from institutions are among the major causes of death and morbidity among patients hospitalized for long-term care. They are a significant burden for both patients and public health professionals. Additionally, voiding problems are common in elderly patients. Urinary incontinence is particularly common and caused by decreasing physical and mental abilities. The prevalence of urinary incontinence in elderly patients residing in nursing and care hospitals in Korea is 43.1-65.5% [9-12].

Kim [13] reported that about 48.1-65.3% of the elderly population experienced urinary incontinence, and the most common management was absorptive pad usage, which induced poor hygiene, skin problems, and pressure ulcers.

URINARY TRACT INFECTIONS

UTI is defined as an inflammatory response of the urothelium to bacterial invasion. According to the microbiological criteria, UTI is defined as a positive quantitative urine culture ($\geq 10^5$ microorganisms/ml, with a maximum of two isolated microbial species). Bacteriuria or asymptomatic urinary infection is defined as the presence of a minimum of 10^5 CFU/ml of a uropathogen isolated from voided urine samples in the absence of symptoms of UTI. UTIs are common in men and women of all ages, and they are one of the most frequent bacterial infections affecting individuals in the community and in hospitals.

The occurrence of bacterial inoculation, colonization, and infection of the urinary tract depends on bacterial virulence and host defense mechanisms. Bacteriuria is defined as the presence of bacteria in the urine and can be divided into either symptomatic bacteriuria and asymptomatic bacteriuria, depending on the presence or absence of UTI symptoms, respectively. Bacteriuria or asymptomatic urinary infection is a common finding in healthy women and in both men and women with abnormalities of the genitourinary tract. Risk factors associated with UTIs include female sex, sexual intercourse, diabetes, obesity, and family

Table 2. Risk factors for bacteriuria in general [14,15]

Sexual activity: nonpregnant women ages 18-40
Use of diaphragm with spermicide
Older age
Female sex
Diabetes mellitus
Neurogenic bladder
Hemodialysis
Urinary retention
Urinary catheter use
Indwelling
Intermittent
External (condom)

history (Table 2) [14,15].

UTIs occur most frequently between the ages of 16 and 35 years, with an annual infection rate of 10% in women and 40-60% of women develop UTI at some point in their lifetime. UTIs occur four times more frequently in women than in men [16]. Laupland et al. [17] reported that the overall annual incidence of UTIs was 17.5 per 1,000 in a population-based assessment in Canada.

It is widely known that women are more susceptible to UTIs than men are because the urethra in women is much shorter and closer to the anus. As a woman's estrogen levels decrease with menopause, the risk of UTIs increases due to the loss of protective vaginal flora. Additionally, vaginal atrophy that can sometimes occur after menopause is associated with recurrent UTIs [18].

THE PREVALENCE OF BACTERIURIA AND UTIs

UTIs are the most common bacterial infection, and their incidence increases with age. The occurrence of UTIs and asymptomatic bacteriuria has particularly been increasing in elderly persons.

The rate of its incidence is 1.2% of all office visits by women and 0.6% of all office visits by men [19,20]. Asymptomatic bacteriuria is often encountered in clinical practice, and the incidence appears to vary depending on conditions like age, sex, presence of chronic disease, or spinal cord injury. Asymptomatic bacteriuria has been reported in about 1.5-43% of all people over 65 years of age [15]. The overall prevalence of bacteriuria in women has been estimated at 3.5%, with prevalence generally increasing with age. Surveys screening for bacteriuria have shown that about 1% of schoolgirls (aged 5 to 14 years)

Table 3. Prevalence of asymptomatic bacteriuria in selected populations

Reference	Age (y)	Population	Prevalence (%)
Nicolle et al. [1]	≥ 65	General	1.5-43
Juthani-Mehta [23]	> 65	General	20 (women) 10 (men)
Woodford and George [25]	> 75	General	7-10 (men)
Zhanel et al. [26]	> 65	Community-dwelling Long-term care	3.6-19.0 (men) 25-50 (women) 15-40 (men)

and about 4% of young adult females have bacteriuria, and an additional 1-2% develop bacteriuria per decade of age [21]. Nearly 30% of women will have had a symptomatic UTI requiring antimicrobial therapy by the age of 24 years. The prevalence of bacteriuria in young women is 30 times more than that in men. With increasing age, the ratio of prevalence of bacteriuria between women and men progressively decreases. At least 20% women and 10% men over the age of 65 years have bacteriuria [22,23]. The prevalence of asymptomatic bacteriuria has been reported to be 20-25% in women who are able to walk, 10% in men, and 50% in women over the age of 80 years [24].

The rates of asymptomatic bacteriuria among men over the age of 75 years are 7-10% [25]. In particular, asymptomatic bacteriuria has been reported in 20-25% of elderly patients without urethral catheter and 100% of elderly patients with urethral catheter in hospitals and long-term care institutions [24]. Table 3 illustrates a summary for the prevalence of asymptomatic pyuria [1,23,25,26].

One Canadian research group investigated the community-onset of UTIs and reported that the annual cases of UTIs were 30,851, among the total of 40,618 [17]. Nicolle et al. [6] reported that the most frequent endemic infections are respiratory tract, urinary tract, skin and soft tissues, and gastrointestinal infections, and the prevalence rates of UTIs range from 25-50% in long-term care facilities. The incidence of UTIs in institutionalized elderly patients is increasing due to the presence of overactive bladder, benign prostatic hyperplasia, and neurogenic bladder [27]. Moreover, institutionalized patients are susceptible to bacterial infection because of urinary incontinence, fecal contamination, and poor perineal hygiene. A total of 80% of all UTIs in institutions are associated with indwelling bladder catheter [28,29]. UTI is the most common bacterial infectious disease, consuming as much as 2.5 trillion USD of healthcare resources in the United States in the year

Table 4. Prevalence of urinary tract infections in selected populations

Reference	Age (y)	Population	Prevalence
Laupland et al. [17]		General	17.5/1,000 populations
Nicolle et al. [6]		Long-term care residents	17-55% (women) 15-31% (men)
Jackson et al. [33]		Long-term care	0.1-2.4 cases/1,000 resident days
Caljouw et al. [36]	55-75	Community-dwelling	7/100 patients years (women)
Griebling [34]	86-90	Community-dwelling	12.8/100 patient years (women)
Griebling [34]	75-84	Community-dwelling	2.8-6.7/1,000 population (men)
Monane et al. [35]	>85	Community-dwelling	4.3-7.8/1,000 population (men)
	>65	General	10% (women)

2000 [30]. A total of 12.6% of the US population is over 65 years of age, and of these, 33% die due to sepsis associated with UTIs [31]. UTIs are the second most common infection and accounts for 25% of all infections diagnosed in elderly people living at home [32]. Several studies involving elderly people living in the community reported that the prevalence of UTIs is 0.07/person-year in postmenopausal women, 0.12/person-year in elderly persons with diabetes mellitus, and 0.05/person-year in men [33-35]. The incidence of UTIs in elderly individuals living in nursing homes is approximately 12-30% [37]. A total of 20-60% of those living in nursing homes have been prescribed with antibiotics as the treatment of UTIs [38]. There is a wide variation of prevalence of UTIs dependent on patient population and definition of UTIs in both institutionalized and noninstitutionalized elderly persons. Although the incidence and prevalence of UTIs across the literature can be difficult to evaluate, the incidence of UTIs in both institutionalized and noninstitutionalized elderly persons varies with gender and has been shown to increase with age. The incidence of UTIs in institutionalized elderly person is higher than in noninstitutionalized counterpart. A summary of the prevalence of UTIs is shown in Table 4 [6,17,33-36]. However, there is no exact data of prevalence of UTIs in elderly persons in Korea.

The incidence UTIs caused by different bacteria in urine cultures accounts for 40-95% [39,40]. *Escherichia coli* is by far the most common cause of UTIs, which accounts for 85% of community-acquired and 50% of hospital-acquired infections [14].

Nicolle [41] reported that complicated UTIs, which are associated with structural or functional abnormalities of the urinary tract, occur in elderly persons, and that UTIs are usually caused by a single organism, such as *E. coli*, other *Enterobacteriaceae*, *Pseudomonas aeruginosa*, and *Candida*

albicans, or other gram-positive organisms, but by as many as 3-5 organisms.

Although there is a variance of pathogens of UTIs, *E. coli* is the most common bacteria in institutionalized and noninstitutionalized elderly persons [42].

Approximately 5-10% of patients in long-term care facilities have urinary drainage managed with chronic indwelling catheters. To prevent the occurrence of UTIs while using urinary catheters, these centers should minimize the time of catheter use as much as possible and appropriate care must be taken while handling the catheters [43].

Catheters should be inserted using sterile techniques in hospitals; however, non-sterile techniques may be appropriate in those who self-catheterize [44].

CONCLUSIONS

The incidence of UTIs in elderly persons increases with age, particularly in institutionalized elderly patients rather than in those at home. The prevalence of UTIs in the institutionalized and noninstitutionalized elderly persons in Korea remains unknown. Further research is needed to improve the prevention of UTIs in such patients.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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