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Factors associated with long-term urinary catheterisation and its impact on urinary tract infection among older people in the community: a population-based observational study in a city in Japan

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ABSTRACT

Objectives This study aimed to identify factors associated with long-term urinary catheterisation (LTUC) in community-dwelling older adults and to evaluate the risk of urinary tract infection (UTI) among people with LTUC.

Design Population-based observational study.

Setting Medical and long-term care insurance claims data from one municipality in Japan.

Participants People aged ≥75 years living at home who used medical services between October 2012 and September 2013 (n=32 617).

Outcome measures (1) Use of LTUC, defined as urinary catheterisation for at least two consecutive months, to identify factors associated with LTUC and (2) the incidence of UTI, defined as a recorded diagnosis of UTI and prescription of antibiotics, in people with and without LTUC.

Results The 1-year prevalence of LTUC was 0.44% (143/32 617). Multivariable logistic regression analysis showed that the male sex, older age, higher comorbidity score, previous history of hospitalisation with in-hospital use of urinary catheters and high long-term care need level were independently associated with LTUC. The incidence rate of UTI was 33.8 and 4.7 per 100 person-years in people with and without LTUC, respectively. According to multivariable Poisson regression analysis, LTUC was independently associated with UTI (adjusted rate ratio 2.58, 95% CI 1.68 to 3.96). Propensity score-matched analysis yielded a similar result (rate ratio 2.41, 95% CI 1.45 to 4.00).

Conclusions We identified several factors associated with LTUC in the community, and LTUC was independently associated with the incidence of UTI.

Strengths and limitations of this study

- This study was a population-based study based on claims data, and its findings are more likely to be generalisable to older people living in the community.
- Our study compared the risk of urinary tract infection between people with and without long-term urinary catheterisation (LTUC) in the community, taking co-morbidity and physical function status into account.
- We could not identify the exact duration of urinary catheterisation with month-based claims data.
- Although we investigated background diagnoses in patients with LTUC, exact reasons for LTUC remained uncertain, precluding the identification of the appropriateness of LTUC for each individual.

INTRODUCTION

Indwelling urinary catheters are widely used for various purposes in community and hospital settings.[1] In acute care, for example, urinary catheters are used to measure urine volume for patients who receive large-volume infusions or diuretics during surgery.[2 3] It is recommended to remove the urinary catheter within 24 hours after surgery and to minimise urinary catheter use and duration of catheterisation in acute care, according to the 'Guideline for Prevention of Catheter-associated Urinary Tract Infections 2009', published by the Centers for Disease Control and Prevention (CDC).[4] In long-term care settings, urinary catheters are indicated for people with severe lower urinary tract dysfunction, such as neurogenic bladder and prostatic hypertrophy.[5 6] Urinary catheterisation for 28 consecutive days or longer is defined as long-term urinary catheterisation (LTUC).[4] A UK study estimated the point prevalence of LTUC in the community as 0.57% among people aged over 70 years.[7] Another study in the USA reported that LTUC was more prevalent among men and older people.[8] However, to the best of our knowledge, no study has sufficiently investigated the associations between LTUC and detailed patient

characteristics, such as comorbidity and previous history of hospitalisation.

Potential harms associated with urinary catheterisation include urinary tract infection (UTI).[9 10] A US study reported that UTI occurred in 50% of people with LTUC in the community.[11] However, this study did not include a comparison group of people without LTUC, and the relative risk of UTI in people with LTUC was not reported.

Therefore, we aimed i) to identify factors associated with LTUC among older people living in the community, and ii) to compare the incidence rate of UTI between people with and without LTUC.

METHODS

Data source

Medical and long-term care insurance claims data between April 2012 and September 2013 were obtained from Kashiwa City, Chiba Prefecture, Japan. The population of Kashiwa City was over 400 000, and 8.7% of the population was aged ≥75 years as of October 2012. Briefly, as part of the current Japanese public medical insurance system, all people aged ≥75 years are covered by the late-elders' medical insurance when using inpatient and outpatient medical services.[12] Under the public long-term care insurance system, older people who need living assistance can receive long-term care services, based on the seven levels of long-term care need certification: support 1 and 2 and care 1 (least disabled) to 5 (most disabled).[13 14] Services to prevent having disability are provided to people certified as support, whereas people certified as care usually have disability. Long-term care need levels are determined using a nationally standardised process, which consists of a computer-aided assessment based on interviews, physicians' documents and a subsequent review by the Care Need Certification Board. In this process, an individual's physical and cognitive functions are assessed.[15]

The ethics committee of the University of Tsukuba approved this study (approval number: 1182). Informed consent from individuals was waived because the claims data were anonymised using dummy identification numbers before the data were made available to the researchers. Moreover, people were grouped into 5-year categories by age during the anonymising process. For example, people born between 1930 and 1934, whose ages were between 77 and 81 as of 1 January 2012, were grouped to mitigate the risk of personal identification.

Study population

People aged ≥75 years who used medical services between April 2012 and September 2013 were included. The exclusion criteria were (1) people who did not use outpatient services, including home care services, at least two separate months between October 2012 and September 2013; (2) those who used ureteral stents or suprapubic catheters and (3) those who stayed at long-term care facilities. We excluded people with ureteral stents or suprapubic catheters, because these procedures were rare in the current cohort and were expected to be used for specific conditions (eg, urological cancer).

Factors associated with LTUC

First, factors associated with LTUC were evaluated. LTUC was defined as having an indwelling urinary catheter based on medical intervention codes for at least two consecutive months at outpatient visits between October 2012 and September 2013. For each individual, the following baseline and clinical information potentially associated with LTUC were collected: age, sex, Charlson Comorbidity Index (CCI), recent history of hospitalisation with and without in-hospital use of urinary catheters, recent episodes of intermittent catheterisation and long-term care need level. Age was categorised into four groups every 5 years in the anonymising process (age 75–76, 77–81, 82–86 and ≥87 years). The updated version of CCI (originally developed by Quan *et al*[16]) was used, which was validated in the Japanese administrative data.[17] CCI is a measure of the burden of chronic diseases, calculated as the sum of the weighted components of the following diseases: congestive heart failure (2 points), dementia (2 points), chronic pulmonary disease (1 point), rheumatological disease (1 point), mild liver disease (2 points), diabetes mellitus (1 point), hemiplegia and paraplegia (2 points), renal disease (1 point), malignancy (2 points), moderate/severe liver disease (4 points), metastatic solid tumour (6 points) and HIV/acquired immunodeficiency syndrome (4 points).[17] In this study, CCI was categorised into four groups (0, 1, 2 and ≥3). Recent history of hospitailsation is defined using records of hospitalisation and in-hospital use of urinary catheters (no recent history of hospitalisation, hospitalised without urinary catheter use, hospitalised with urinary catheter use) during a period between April 2012 and time of indwelling urinary catheterisation at outpatient (for people with LTUC) or September 2013 (for people without LTUC), because we hypothesised that recent episodes of hospitalisation (particularly those with use of urinary catheters) could lead to LTUC. We also identified recent episodes of intermittent catheterisation, an alternative method of indwelling urinary catheters, performed by people themselves or by their carers. Long-term care need level is a nationally standardised certification that incorporates the individual's physical and cognitive functions.[18] The care need level was categorised into four groups (none, support levels 1 and 2, care need levels 1 and 2, and care need levels 3–5). These covariates were defined using data between April 2012 and September 2012.

As an additional investigation, in people with LTUC, we identified recorded diagnoses potentially associated with LTUC, including neurogenic bladder, urinary retention, benign prostatic hypertrophy (BPH), spinal cord injury and pelvic fracture. A patient with LTUC could have one or more conditions.

Incidence of UTI in people with and without LTUC

Next, the incidence rate of UTI in people with LTUC was estimated and compared with that in people without LTUC. UTI was defined as meeting both diagnosis codes suggestive of UTI and the prescription of antibiotics in the same month. For this analysis, the follow-up started at the next month after LTUC was confirmed for the LTUC group, and at the first month of outpatient or inpatient visit for the non-LTUC group. The LTUC group was followed up from the next month to avoid immortal time bias. The follow-up ended at the first incidence of UTI after cohort entry, at death or by September 2013.

Statistical analysis

After people with LTUC were identified, characteristics of people with and without LTUC were compared using the χ^2 test for binary variables (except for intermittent catheterisation, which was assessed by Fisher's exact test) and Wilcoxon rank-sum test for ordinal variables.

Next, univariable and multivariable logistic regression analyses were performed to examine factors associated with LTUC, where the outcome in the regression model was LTUC and the exposures were age, sex, CCI, recent history of hospitalisation (with and without in-hospital use of urinary catheters) and care need level. Recent episode of intermittent catheterisation was not included in the subsequent multivariable models due to small number of patients with this factor (as shown later).

Next, the incidence rate of UTI in people with and without LTUC was estimated, and univariable and multivariable Poisson regression analyses were conducted to estimate the strength of the association between LTUC (ie, exposure in the Poisson regression model) and UTI (ie, outcome in the model), adjusting for age, sex, CCI, recent history of hospitalisation and care need level. In addition, to minimise the influence of measured confounding factors, we performed a propensity score-matched analysis regarding the association between LTUC and UTI. Propensity scores were generated from all the aforementioned covariates, and the non-LTUC and LTUC groups were matched in a 3:1 ratio using the nearest neighbour matching method. Calliper of SD multiplied by 0.2 was set as acceptable. After the propensity score matching, the balance of covariates between the groups was checked by estimating the standardised differences of means of each covariate. Thereafter, the incidence rates and incidence rate ratio between people with and without LTUC were estimated. P values and 95% CIs were calculated, and a p value of <0.05 (two sided) was considered statistically significant.

As a post hoc analysis, among patients with LTUC, we identified the frequency of urinary catheter change (once a month or twice or more in a month) and compared the rate of UTI between the groups to examine whether a more frequent change of urinary catheters could reduce the incidence of UTI.

All statistical analyses were conducted using Stata V.14.

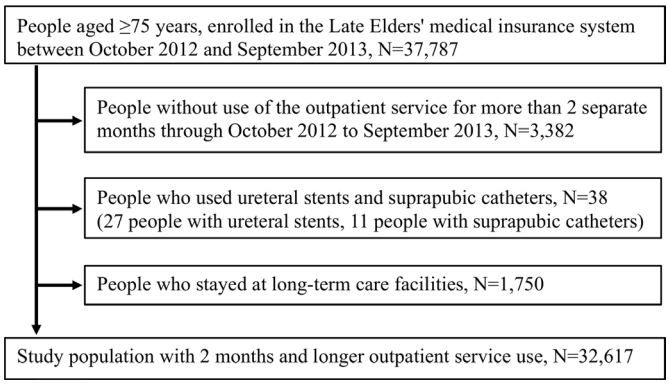

Figure 1 Flow of the population selection.

Patient involvement

No patients were involved in setting the research question or the outcome measures, nor were they involved in developing plans for the design of the study. No patients were asked to advise on interpretation or writing up of results. There are no plans to disseminate the results of the research to study participants or the relevant patient community.

RESULTS

Of 37 787 people aged ≥75 years and enrolled in medical insurance, 32 617 were included in the analyses. The detailed study population selection is shown in figure 1. Among the 32 617 eligible people, 143 were managed with LTUC, yielding a 1-year prevalence of 0.44%.

Table 1 shows the characteristics of people with and without LTUC. Compared with people without LTUC, those with LTUC were more likely to be men, older, have higher CCI, experience recent hospitalisation with in-hospital use of urinary catheters and have high care need level certification.

Among the 143 patients with LTUC, 71 (49.7%), 65 (45.5%), 74 (51.8%), 5 (3.5%) and 4 (2.8%) had recorded diagnoses of neurogenic bladder, urinary retention, BPH, spinal cord injury and pelvic fracture, respectively.

Table 2 shows the results of univariable and multivariable logistic regression analyses to identify factors associated with LTUC. The male sex (adjusted OR (aOR) 3.29), older age (aOR 3.26 in age group 82–86 and aOR 3.85 in age group ≥87, compared with age group 75–76), higher comorbidity score (aOR 2.80 in CCI ≥3, compared with CCI 0), recent history of hospitalisation with in-hospital use of urinary catheters (aOR 2.46, compared with no recent history of hospitalisation) and high care need level (aOR 2.99 in care need levels 3–5, compared with no need of long-term care) were independently associated with LTUC. History of hospitalisation without in-hospital use of urinary catheters was not significantly associated with LTUC.

Table 3 shows the results of univariable and multivariable Poisson regression analyses for the incidence of UTI in people with and without LTUC. Twenty-two (15.4%) and 1263 (3.9%) episodes of UTI were identified among

Table 1 Characteristics of people with and without LTUC

	People with LTUC, n (%)	People without LTUC, n (%)	P value
Total	143	32 474	
Sex (men)	100 (69.9)	14 079 (43.4)	<0.001
Age, n (%)			
75–76 (born 1935–1936)	26 (18.2)	12 185 (37.5)	
77–81 (born 1930–1934)	36 (25.2)	11 154 (34.4)	
82–86 (born 1925–1929)	48 (33.6)	5949 (18.3)	
≥87 (born before 1924)	33 (23.1)	3186 (9.8)	<0.001
Charlson Comorbidity Index			
0	30 (21.0)	13 896 (42.8)	
1	5 (3.5)	2765 (8.5)	
2	30 (21.0)	7515 (23.1)	
≥3	78 (54.6)	8298 (25.6)	<0.001
Recent history of hospitalisation and in-hospital use of urinary catheter			
No recent history of hospitalisation	78 (54.6)	23 568 (72.6)	
Hospitalised without urinary catheter use	35 (24.5)	7203 (22.2)	
Hospitalised with urinary catheter use	30 (21.0)	1703 (5.2)	<0.001
Recent episodes of intermittent catheterisation, n (%)	<5	31 (0.1)	0.131
Long-term care need level			
None	83 (58.0)	24 897 (76.7)	
Support levels 1 and 2	6 (4.2)	2381 (7.3)	
Care need levels 1–2	12 (8.4)	3139 (9.7)	
Care need levels 3–5	42 (29.4)	2057 (6.3)	<0.001

LTUC, long-term urinary catheterisation.

people with and without LTUC, respectively. The incidence rate of UTI was higher among people with LTUC (33.8 per 100 person-years, 95% CI 22.3 to 51.3) than among people without LTUC (4.7 per 100 person-years, 95% CI 4.4 to 4.9). LTUC was independently associated with the incidence of UTI (unadjusted rate ratio: 7.22, 95% CI 4.74 to 11.00, p<0.001), and this association remained significant after adjusting for all the confounding factors (adjusted rate ratio: 2.58, 95% CI 1.68 to 3.96, p<0.001).

Table 4 shows the results of the propensity score-matched analysis, in which 143 persons with LTUC and 429 persons with non-LTUC were matched. The incidence rate of UTI was higher in those with LTUC (33.8 per 100 person-years, 95% CI 22.3 to 51.3) than in those without LTUC (14.4 per 100 person-years, 95% CI 10.5 to 22.3). Similar to the results before propensity score matching, LTUC was independently associated with an increased risk of UTI (rate ratio: 2.41, 95% CI 1.45 to 4.00, p=0.001).

In our post hoc analysis, among the 143 patients with LTUC, 136 (95.1%) changed their catheter once a month, while 7 (4.9%) changed twice or more in a month.

The rates of UTI were 33.8 (95% CI 22.0 to 51.8) per 100 person-years and 34.8 (95% CI 4.9 to 246.9) per 100 person-years, respectively (p=0.977). Such small number of LTUC patients with frequent change of urinary catheters did not allow us to conduct a multivariable analysis.

DISCUSSION

Main findings

This population-based study showed that 0.44% of people aged ≥75 years in the community were managed with LTUC. The male sex, older age, higher comorbidity score, previous history of hospitalisation with in-hospital use of urinary catheters and high long-term care need level were independently associated with LTUC. LTUC was independently associated with the incidence of UTI after adjusting for comorbidities and long-term care need level.

Possible explanation of findings

The multivariable logistic regression analysis of the association between participant characteristics and LTUC showed that a recent history of hospitalisation with in-hospital use of urinary catheters was associated with LTUC, although a recent history of hospitalisation without in-hospital use of urinary catheters was not. Thus, hospitalisation with in-hospital use of urinary catheters

Table 2 Univariable and multivariable logistic regression analyses for factors associated with long-term urinary catheterisation

	Univariable			Multivariable		
	OR	95% CI	P value	OR	95% CI	P value
Sex (women)	Reference			Reference		
Men	3.04	2.12 to 4.35	<0.001	3.29	2.27 to 4.76	<0.001
Age						
75–76 (born 1935–1936)	Reference			Reference		
77–81 (born 1930–1934)	1.51	0.91 to 2.51	0.108	1.32	0.79 to 2.19	0.290
82–86 (born 1925–1929)	3.78	2.34 to 6.10	<0.001	3.26	1.99 to 5.34	<0.001
≥87 (born before 1924)	4.85	2.90 to 8.13	<0.001	3.85	2.20 to 6.72	<0.001
Charlson Comorbidity Index						
0	Reference			Reference		
1	0.84	0.32 to 2.16	0.714	0.82	0.32 to 2.13	0.688
2	1.85	1.11 to 3.07	0.017	1.39	0.83 to 2.32	0.211
≥3	4.35	2.86 to 6.64	<0.001	2.80	1.81 to 4.34	<0.001
Recent history of hospitalisation and in-hospital use of urinary catheter						
No recent history of hospitalisation	Reference			Reference		
Hospitalised without urinary catheter use	1.47	0.98 to 2.19	0.060	0.89	0.58 to 1.35	0.572
Hospitalised with urinary catheter use	5.32	3.48 to 8.13	<0.001	2.46	1.54 to 3.92	<0.001
Long-term care need level						
None	Reference			Reference		
Support levels 1 and 2	0.76	0.33 to 1.73	0.509	0.56	0.24 to 1.31	0.181
Care need levels 1 and 2	1.15	0.63 to 2.10	0.658	0.70	0.37 to 1.31	0.267
Care need levels 3–5	6.12	4.21 to 8.90	<0.001	2.99	1.93 to 4.63	<0.001

suggests underlying diseases for which urinary catheters were preferred or a poor health status. Several studies have investigated underlying diseases in people with LTUC in Japan and other countries.[5 6 19] One Swedish study reported that 80% of underlying diseases for which LTUC was indicated were residual urine or urinary retention in people in nursing homes.[5] One Japanese study also showed that 60% of indications for urinary catheterisation were urinary retention in people in nursing homes and 40% in people living at home.[19]

The strong associations between older men and LTUC could be explained by the high prevalence of BPH (51.8%) as a background diagnosis in patients with LTUC. One longitudinal study in Japan reported that an incidence rate of BPH requiring medication was 12.0 per 1000 person-years among men in their 50s, while the rate was increased to 27.1 per 1000 person-years among men in their 70s.[20] High prevalence of BPH was expected in the current study focusing on people aged ≥75 years living in the community. BPH might have caused urinary retention and subsequent use of urinary catheters, although the exact reasons for LTUC remained unknown in our claims data.

In our post hoc analysis, 4.9% of people with LTUC changed urinary catheters more than once a month. In Japan, there is no insurance regulation on the duration

Table 3 Incidence rate ratio of urinary tract infection in people with and without LTUC before propensity score matching

	Total follow-up length (person-years)	People having episodes of UTI, n (%)	Incidence rate of UTI (per 100 person-years) (95% CI)	Rate ratio for UTI (95% CI) P value	
				Crude	Fully adjusted*
People without LTUC (n=32 474)	26 966	1263 (3.9)	4.7 (4.4 to 4.9)	Reference	Reference
People with LTUC (n=143)	65	22 (15.4)	33.8 (22.3 to 51.3)	7.22 (4.74 to 11.00), p<0.001	2.58 (1.68 to 3.96), p<0.001

*Adjustment covariates: sex, age, comorbidity score, recent history of hospitalisation and long-term care need level.
LTUC, long-term urinary catheterisation; UTI, urinary tract infection.

Table 4 Incidence rate ratio of urinary tract infection in people with and without long-term urinary catheterisation after propensity score matching

	Total follow-up length (person-years)	People having episodes of UTI (n)	Incidence rate of UTI (per 100 person-years) (95% CI)	Rate ratio for UTI (95% CI) P value
People without LTUC (n=429)	328	46	14.4 (10.5 to 22.3)	Reference
People with LTUC (n=143)	65	22	33.8 (22.3 to 51.3)	2.41 (1.45 to 4.00) P=0.001

LTUC, long-term urinary catheterisation; UTI, urinary tract infection.

of urinary catheters in situ. Therefore, for patients who changed urinary catheters more than once a month, we speculate that there are two reasons: (1) patients had catheter blockage and (2) some physicians may routinely change urinary catheters at outpatient to prevent catheter blockage. However, as with indications for LTUC in our study using claims data, there is no way to confirm the exact reasons for frequent catheter change.

Comparison with other studies

One UK study reported the prevalence rate of LTUC as 0.57% among people aged >70 years who were living in a community, with the definition of LTUC as urinary catheterisation for more than 3 months,[7] which was in line with our result.

Evidence on the association between LTUC and detailed patient characteristics has been scarce. A previous study reported that LTUC was more prevalent among men and older people.[8] However, that study did not include clinical characteristics such as comorbidity and history of hospitalisation. Our study showed that not only demographics (men and older age) but also patient characteristics (comorbidity, previous history of hospitalisation and care need level) were significantly associated with LTUC.

Regarding the incidence of UTI, a US study described the incidence rate of UTI as 164 per 100 person-years among people with LTUC.[11] The incidence rate was higher than our result of 33.8 per 100 person-years, and the difference can be explained by the different methods used to identify UTI; a questionnaire was used by interviewers in the US study, and the incidence of UTI was counted multiple times for each individual. Our method led to a lower identification of UTI because we used the incidence of UTI as censoring and did not consider UTI recurrence. To our knowledge, our study is the first to compare the incidence of UTI between people with and without LTUC in the community.

Strengths and limitations

This study has several limitations. First, we were unable to identify the exact duration of urinary catheterisation with claims data on a monthly basis. We attempted to ascertain that the CDC definition of LTUC was met by identifying those with catheter insertion/replacement for at least two consecutive months. Second, we adjusted for confounders that could have been associated with the outcomes in the analyses; however, the observed association between LTUC and the incidence of UTI could have been influenced by residual confounding. We incorporated comorbidity score, recent history of hospitalisation and in-hospital use of urinary catheters, and care need level as proxies of general health status in the propensity score-matched analysis. Yet, underlying diseases for which urinary catheters were inserted were the possible residual confounding factors, and information regarding these diseases was unavailable. Third, we could not compare the severity and characteristics of UTI between people with and without LTUC, mainly because information on urine culture and microbiological patterns were unavailable in claims data. One review reported that *Escherichia coli* was the most common in people with LTUC and that 95% of bacteriuria were polymicrobial among these people.[21] Finally, although we conducted the current study using data from a relatively large city of Japan, statistical power was apparently limited to test the influence of some factors, such as intermittent catheterisation and frequency of urinary catheter change. In adjusted analyses, the sample size and the number of outcomes did not allow us to adjust for each chronic disease. Therefore, we used CCI to roughly estimate the influence of comorbidity burden on LTUC and adjusted it in the association between LTUC and UTI.

Implication for future studies

In addition to the incidence of UTI, serious clinical outcomes, such as mortality and extended length of hospital stay, have been examined in acute care hospitals. A US study reported that inappropriate in-hospital urinary catheter use was associated with higher mortality and longer hospital stay.[22] Appropriate urinary catheter use was introduced in the CDC guidelines, defined as satisfying appropriate indication for urinary catheterisation.[4]

It is necessary to assess the effects of LTUC on clinical outcomes in the community as well as in the acute hospital setting. For appropriate management of LTUC, considering the indications of urinary catheterisation and alternatives were discussed in a recently published paper.[9] Intermittent catheterisation is recommended for people with acceptable cognitive function and for people whose carers could assist in its implementation.[9] A previous study reported that people with intermittent

catheterisation had fewer episodes of UTI compared with those with indwelling urinary catheters.[23] In addition, the association of LTUC with health outcomes, such as adverse events, hospitalisation, mortality, and medical and long-term care expenditure should be examined in future studies, as these findings lead to the legitimate use of urinary catheters.

CONCLUSION

We showed the prevalence of LTUC in a community in Japan and identified factors associated with LTUC, and quantified the risk of UTI among people with LTUC compared with those without. The male sex, older age, higher comorbidity score, high long-term care need level and history of hospitalisation with in-hospital use of urinary catheters were independently associated with LTUC, and the risk of UTI requiring antibiotics was higher among people with LTUC. This finding suggests that LTUC needs to be reconsidered, and further studies including underlying diseases are necessary.

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Contributors MA conceived and designed this study, conducted data processing, analysed the data and wrote the manuscript. MI contributed to the conception and design of this study and wrote the manuscript. NT, TK and SH contributed to the design and critical revision of the manuscript. KI, SY and TI contributed to the acquisition of the data, study design and critical revision of the manuscript. All authors read and approved the final manuscript.

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