

The distribution of different surgical types for female stress urinary incontinence among patients' age, surgeons' specialties and hospital accreditations in Taiwan: a descriptive 10-year nationwide study

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Abstract This study aims to identify the changing trends of different surgical types for female stress urinary incontinence (SUI) and the distribution amongst various providers' characteristics. A total of 17,532 women who had undergone surgery for SUI during 1996–2005 were identified from the National Health Insurance Research Database for analysis. Retropubic urethropexy (RPU) was the most common surgical type (43%), followed by tension-free mid-urethral sling (MUS; 24%), and traditional pubovaginal sling (15%). MUS

had an annual growth rate of 20.5%, whilst traditional pubo-vaginal sling was reduced by 11.3% annually after 2002. RPU was the most common procedure by both gynecologists and urologists. Gynecologists performed more Kelly plications, whereas urologists performed more traditional pubovaginal sling. MUS was more commonly performed in medical centers than in regional and local hospitals. There has been a notable growth and changing trend in various surgical types for female SUI in Taiwan.

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Introduction

Urinary incontinence is a storage symptom and defined as the complaint of any involuntary loss of urine that is a social and hygienic problem [1]. Urinary incontinence may be further defined according to the patient's symptoms, stress urinary incontinence (SUI), urgency urinary incontinence (UUI), mixed urinary incontinence (MUI), and so on. SUI is the complaint of involuntary leakage on effort or exertion or on sneezing or coughing [1]. It is a prevalent disease which has significant quality of life impacts on women; however, it is both greatly underestimated and widely untreated [2]. A community-based survey on the health of the population in Taiwan revealed that the prevalence of female urinary incontinence, with or without related symptoms, was as high as 53.7% amongst Taiwanese women. From a patient's perspective, the perceived prevalence of isolated SUI was 18.0% [1, 3]. Approximately two thirds of all incontinent women tend to be restricted in their social activities due to embarrassment

and inconvenience, whilst 19.0% note that their sex life is affected. Nevertheless, only 27.1% of the respondents, who suffered from urinary incontinence, and/or related symptoms, had sought medical services to relieve these problems [3].

Many surgical types for SUI have been described following the 1914 Kelly report on sub-urethral fascia plication through the years [4]. The main categories were retro-pubic urethropexy (RPU), needle suspension, traditional pubovaginal sling, tension-free mid-urethral sling (MUS), injectables, and so on. These surgeries were designed to prevent involuntary loss of urine from the urethra during periods of increased intra-abdominal pressure by repositioning, stabilizing urethra, creating support for urethral compression, improving urethral coaptation, and offering dynamic mid-urethral support [4].

RPU includes the initial Marshall–Marchetti–Kranz (MMK) procedure in 1949, and subsequent modified Burch colposuspension [5], with the primary aim to place the urethra in a high retro-pubic position to correct the descent of the bladder neck and proximal urethral hypermobility [6]. The traditional pubovaginal sling procedure, which was introduced by Goeball and Stoeckel in 1917 and modified by Raz, placed a strip of rectus fascia sub-urethrally at bladder neck level to increase urethral coaptation or compression [7]. As a result of the costs of hospitalization, the loss of productivity during convalescence, and the physiological risks inherent in certain surgical procedures, surgeons and researchers have continued to modify various approaches into minimally invasive therapy, and to improve surgical efficacy, safety, and cost-effectiveness [4]. Tension-free MUS was originally introduced in 1995 by Ulmsten, using the innovative ‘Tension-free Vaginal Tape’ (TVT) method (Gynecare, Johnson and Johnson, Ethicon Inc, Summerville, NJ) [8]; thereafter, various modifications were introduced by Petros, Delorme, and de Leval [9]. The impressive success rates of the MUS procedure, using the original retro-pubic and modified trans-obturator approaches, has very quickly gained worldwide popularity [10–12].

This study is a 10-year population-based study to describe the trend of surgeries for SUI based upon the National Health Insurance (NHI) claims data in Taiwan. The main purposes of the study were to identify: (1) the changing trends in the various surgical types for SUI; (2) the preferences for the various types of surgeries by gynecologists, urologists, and other specialists; and (3) the characteristics of the medical institutions in which the operations were performed.

Materials and methods

The National Health Insurance (NHI) Program in Taiwan

The NHI program in Taiwan was put into effect in March of 1995, and is primarily funded by payroll tax with additional

subsidies from general government revenues. The coverage rate of NHI increased from 93.1% in 1996 to 98.0% in 2005. Up to the end of 2007, the system has covered almost 98.6% of the 22.6 millions population of Taiwan. The proportion of the NHI-contracted Western medical hospitals was 96.6% in 1996 and 97.1% in 2006. The average proportion of the NHI-contracted Western medical hospitals from 1996 to 2006 was 95.8% [13].

The benefits package of the NHI is extremely comprehensive, including preventive medicine, dental care services, outpatient, and inpatient services, prescription drugs and Chinese herbal remedies. Health care providers are reimbursed by the NHI for the services based on a points system according to ‘fees for service’ schedules and case payment schedules, within the constraints of five separate global budget systems for dental services, Chinese medicine, office-based clinics practicing Western medicine, hospitals, and outpatient renal dialysis. Patients are free to select the health-care providers of their choice, although they are required to make co-payments for the outpatient/inpatient services and drugs consumed.

Data source

The data used in this study were obtained from the National Health Insurance Research Database (NHIRD). The NHIRD was established by the National Health Research Institute, in cooperation with the National Health Insurance Bureau, with the aim of undertaking research into current and emerging issues in Taiwan.

Three types of files from the NHIRD were used in this study. First, the inpatient expenditure by admission contains all information of NHI-reimbursed hospital discharges on inpatient characteristics, the dates of admission and discharge, the type of disease (based upon the International Classification of Diseases, 9th Revision, Clinical Modification, ICD-9-CM), the surgery code, ownership of the medical facilities where the services were delivered, itemized expenditure on physician services, ward services, drugs, and prescription services, as well as anonymous identifiers of the patient, the medical institutions, and the physician delivering the services. Second, the registry of contracted medical facilities provides data on each medical institution’s accreditation level and geographical location. Third, the registry for medical personnel provides data on each medical professional’s date of birth, sex, types of profession, and specialty.

Anonymous identifiers of the medical institutions and the physician were used to link the hospital discharges data to the physician and hospital registries. All discharges from 1996 to 2005 were included in this study. Data of the year of 1995 were excluded because of the possible errors with data collection and reporting practices in the first year of the NHI program. At the time of performing the analysis for

this study, only data up to the year of 2005 were available for analysis.

The confidentiality assurance, addressed by abiding the data regulations of the Bureau of NHI and the Institutional Review Board (IRB) approval, was waived.

Study subjects

The study subjects were female patients who had received surgeries for SUI in Taiwan between 1 January 1996 and 31 December 2005. A total of seven surgical types for SUI are reimbursed by the NHI, including the Marshall–Marchetti–Krantz procedure or Burch colposuspension (RPU; ICD-9-CM 59.5), traditional pubovaginal sling operations (ICD-9-CM 59.4), MUS including TVT, its modification and other similar design with surgeon-tailored mesh placed in mid-urethra (ICD-9-CM 59.79), urethra-vesical junction plication (Kelly; ICD-9-CM 59.3), bladder neck needle and para-urethral suspensions (Needle; ICD-9-CM 59.6), levator ani muscle suspension for urethrovesical suspension (LS; ICD-9-CM 59.71) and the injection of implants into the urethra/bladder neck (Injection; ICD-9-CM 59.72). TVT was initially introduced in 1995 by Dr. Wang and formally launched by Gynecare, Johnson and Johnson, Ethicon Inc. in August 2001 in Taiwan [11]. Moreover, some surgeon-tailored mid-urethral slings with different mesh materials placed sub-urethrally were also categorized as MUS with ICD-9-CM coding of 59.79.

Of the total of 18,271 inpatients who had undergone surgeries for SUI during the period under examination, 17,756 were females. After eliminating 224 patients for whom there was incomplete information, we were left with a total of 17,532 female patients for analysis in this study.

Variable definitions

The variables used in this study fall into the following three categories: (1) patient characteristics (age); (2) surgeon characteristics (specialty, age, and gender); and (3) hospital characteristics (accreditation level and hospital ownership).

The patients are divided into ten 5-year age groups, from <30 years of age to ≥ 70 years of age. The three categories of surgeon specialties, ‘gynecology’, ‘urology’, or ‘others’, are defined by reference to the department into which the patient was admitted. The surgeon’s age is divided into eight 5-year age groups, from <30 years of age to ≥ 60 years of age. The hospitals are classified into three accreditation levels based upon clinical capabilities and bed capacity evaluated by Taiwan Joint Commission on Hospital Accreditation (TJCHA): medical centers (minimum 500 beds), regional hospitals (minimum 250 beds), and local hospitals (minimum 20 beds). Hospital ownership is classified as private not-for-profit hospitals, government-owned hospitals, or private for-profit hospitals.

Statistical analysis

Chi-square tests are performed to examine the differences in the distribution of the seven surgical types for SUI amongst the patients, surgeons, and hospital characteristic groups. The significance of the statistics is determined using a *p*-value of <0.05. All of the analyses in this study were carried out using the SAS system software for Windows, Version 9.01.

Results

Overall surgical changing trend

A total of 17,532 female inpatients had undergone surgeries for SUI during the period under examination (Table 1). The most frequently used surgical type during the study period was RPU, with a total of 7,610 cases over the 10-year period (accounting for 43% of all cases), followed by 4,196 MUS operations (24%), and 2,645 traditional pubovaginal sling operations (15%).

Figure 1 illustrates the rising trend in the occurrence of the various surgical types for SUI, from 770 to 2,466 cases during the period of this study, indicating an average annual growth rate of 22%. Of the various types of surgery, MUS demonstrates the highest rise in the number of cases, from 450 in 2002, to 819 in 2005, giving an annual growth rate of 21%. In contrast, there was an annual reduction of 11% in the occurrence of traditional pubovaginal sling operations, from 558 cases in 2002, to 307 in 2005.

Types of surgery amongst different patients’ age

There were significant differences in the distribution of the different surgical types for SUI amongst patients of various age groups ($\chi^2=1,137.75$; *p*-value<0.0001; Table 2). There was a gradual increase in the incidences of such operations with advancing age, with the peak occurring in the 45–49 age group (20% of all cases), and a decline thereafter, whilst incidences of such surgery occurring amongst elderly patients (≥ 65 years) accounted for one fifth (19%) of the total cases. There were more RPU found amongst patients in the 40–44, 45–49, and 50–54 age groups, whilst more Kelly plication and injection for the younger age group (<35 years) and the older age group (≥ 65 years).

Types of surgery by surgeons’ specialties

Significant differences were discernible in the distribution of incidences of the various surgical types for SUI between gynecologists and urologists ($\chi^2=2,037.33$, *p*-value<0.0001; Table 3). A total of 13,736 of all surgeries (78%) were performed by gynecologists, whilst 3,690 (21%) were performed

Table 1 Surgical types for stress urinary incontinence by year

Year	Types of surgery (ICD-9-CM code) ^a														Total
	RPU (59.5) ^b		Sling (59.4) ^c		MUS (59.79) ^d		Kelly (59.3) ^e		Needle (59.6) ^f		LS (59.71) ^g		Injection (59.72) ^h		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
1996	281	36	82	11	84	11	95	12	196	25	32	4	–	–	770
1997	332	35	81	9	168	18	91	10	200	21	76	8	–	–	948
1998	732	54	105	8	294	22	68	5	100	7	63	5	–	–	1,362
1999	786	49	143	9	375	23	105	6	97	6	112	7	–	–	1,618
2000	713	42	239	14	461	27	85	5	102	6	110	6	–	–	1,710
2001	914	42	413	19	490	23	78	4	146	7	123	6	–	–	2,164
2002	974	42	558	24	450	20	106	5	120	5	100	4	–	–	2,308
2003	850	43	395	20	451	23	71	4	79	4	87	4	26	1	1,959
2004	1,035	46	322	14	604	27	99	4	54	2	66	3	47	2	2,227
2005	993	40	307	12	819	33	102	4	71	3	84	3	90	4	2,466
1996–2005	7,610	43	2,645	15	4,196	24	900	5	1,165	7	853	5	163	1	17,532

^a Percentages may not sum to 100 because of rounding.

^b RPU refers to retro-pubic urethropexy operations.

^c Sling refers to traditional pubovaginal sling operations.

^d MUS refers to mid-urethral sling operations.

^e Kelly refers to urethra-vesical junction plication operations.

^f Needle refers to bladder neck needle suspension and para-urethral suspension operations.

^g LS refers to levator ani m. suspension operations.

^h Injection refers to operations to inject an implant into the urethra/bladder neck.

by urologists. Nevertheless, a comparison between the practice patterns of surgeons with different specialties reveals that RPU was the most commonly adopted surgery by both gynecologists and urologists.

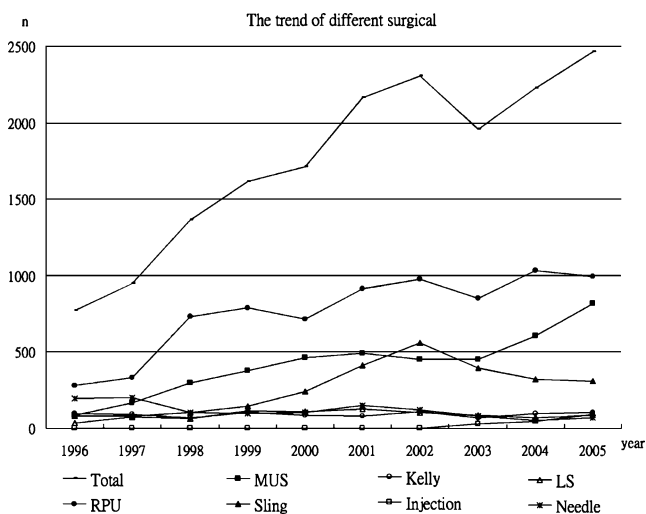


Fig. 1 The trend in the various surgical types for stress urinary incontinence in Taiwan during 1996–2005. RPU refers to retro-pubic urethropexy operations. Sling refers to traditional pubovaginal sling operations. MUS refers to mid-urethral sling operations. Kelly refers to urethra-vesical junction plication operations. Needle refers to bladder neck needle suspension and para-urethral suspension operations. LS refers to levator ani m. suspension operations. Injection refers to operations to inject an implant into the urethra/bladder neck

Gynecologists were found to be 1.6 times more likely to perform RPU (47%/29%), whilst there was almost equal distribution in the respective adoption of MUS and needle operations in a comparison between gynecologists (24% and 6%) and urologists (25% and 7%). The use of Kelly plication was more commonly found amongst gynecologists than urologists (6% vs 0.2%); conversely, the use of traditional pubovaginal sling operations was found to be slightly more popular amongst urologists than gynecologists (20% vs 14%).

Types of surgery by hospital accreditation levels and ownership types

Significant differences were discernible in the distribution of incidences of the seven surgical types for SUI amongst different hospital accreditation levels ($\chi^2=814.69$, p -value<0.0001) and types of hospital ownership ($\chi^2=1,284.20$, p -value<0.0001; Table 4). RPU was the most commonly adopted procedure for hospitals of all accreditation levels (ranging from 40% to 49%), whilst medical centers performed the highest proportion of MUS operations (3,371/4,196=80%).

Medical centers were found to be 2.2 times more likely to perform MUS than regional hospitals (29% vs 14%) and 2.3 times more likely to perform MUS than local hospitals (29% vs 13%). The results showed that regional hospitals tended to perform slightly more traditional pubovaginal sling operation than either medical centers (18%/14%) or local hospitals (18%/15%), with the latter being more likely

Table 2 Surgical types for stress urinary incontinence, by patient age

Patient age ^b	Types of surgery ^a														Total	
	RPU ^c		Sling ^d		MUS ^e		Kelly ^f		Needle ^g		LS ^h		Injection ⁱ		No.	%
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
<30	39	28	12	9	33	24	10	7	13	9	5	4	28	20	140	1
30–34	194	47	48	12	96	23	25	6	32	8	16	4	4	1	415	2
35–39	631	49	159	12	289	22	46	4	91	7	59	5	10	1	1,285	7
40–44	1,501	52	407	14	561	19	114	4	189	7	97	3	12	0	2,881	16
45–49	1,729	49	527	15	752	21	120	3	255	7	145	4	12	0	3,540	20
50–54	1,128	46	359	14	625	25	85	3	156	6	109	4	15	1	2,477	14
55–59	636	38	288	17	436	26	91	5	111	7	96	6	7	0	1,665	10
60–64	652	38	258	15	462	27	115	7	118	7	100	6	12	1	1,717	10
65–69	499	32	270	17	442	28	133	9	104	7	87	6	20	1	1,555	9
≥70	601	32	317	17	500	27	161	9	96	5	139	7	43	2	1,857	11
Total	7,610		2,645		4,196		900		1,165		853		163		17,532	100

^a Percentages may not sum to 100 because of rounding.

^b $\chi^2=1,137.75$; p -value<0.0001.

^c RPU refers to retro-pubic urethropexy operations.

^d Sling refers to traditional pubovaginal sling operations.

^e MUS refers to mid-urethral sling operations.

^f Kelly refers to urethra-vesical junction plication operations.

^g Needle refers to bladder neck needle suspension and para-urethral suspension operations.

^h LS refers to levator ani m. suspension operations.

ⁱ Injection refers to operations resulting in the injection of an implant into the urethra/bladder neck.

than either medical centers or regional hospitals to perform Kelly plication, needle, and LS.

RPU was also found to be the most commonly adopted procedure amongst hospitals of all ownership types (ranging from 36% to 53%), whilst MUS operations were mainly performed in not-for-profit hospitals (64%). The proportion of MUS performed in the not-for-profit hospitals (28%) was, nevertheless, similar to that for government-owned hospitals (24%); both of these were higher than the proportion for private hospitals (14%).

Discussion

The significant annual increase in the total number of surgeries for SUI performed during the period of the study points to an increase in the popularity of these operations amongst medical professionals and the general awareness of the importance of female SUI. Meanwhile, the waxing and waning amongst the different surgical types implies a revolutionary change following the launch of MUS. A rapid rise in the adoption of MUS surgeries in this study, at an annual growth rate of 20.5% from 2002 to 2005, associated with a corresponding decline in the use of traditional pubovaginal sling surgery. RPU has remained steady. This may be due to its stable short-term and long-term success rate (85–90% within one year, 70% for over five years) [14], the

training background of many gynecologists and/or the emergence of laparoscopic approaches for RPU [15].

The most rapid growth rate is demonstrated by MUS, whilst there was a reduction in the number of traditional pubovaginal sling operations after 2002. Despite the high success rate of tradition sling operation, the loss of popularity may be due to the higher risk of post-operative voiding dysfunction, UUI, urinary tract infection, or prolonged catheterization [16–18]. The concurrent growth in MUS and decline in traditional pubovaginal sling operations reveals the changing trends which have taken place in the different surgical modalities during the period of this study, particularly after 2002. It draws the attention to the need for evaluation of both the efficacy and adverse effects or co-morbidity of the booming in MUS under different approaches. Nilsson et al. reported TVT successful rate, 85% completely cured, 11% improved at 5 years [12]; completely 81% cured, and 16% improved at 7 years [19]. Kondo et al. reported that TVT was significantly superior to the traditional pubovaginal sling in terms of operation time, post-operative pain, and hospital charges, but not in cure rates [20]. This current trend toward less invasive surgical treatments was also encountered by other researchers [15]. A questionnaire study from Scotland and Wales reported TVT as the most common option among several different choices of primary procedure [21]. A similar finding was also noted in the 2002 International Urogynecological Association (IUGA) survey [22].

Table 3 Surgical types for stress urinary incontinence by surgeon specialty, age, and gender

Variables	Types of surgery ^a														Total	
	RPU ^b		Sling ^c		MUS ^d		Kelly ^e		Needle ^f		LS ^g		Injection ^h		No.	%
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Surgeon specialtyⁱ																
Gynecology	6,495	47	1,899	14	3,263	24	884	6	888	6	306	2	1	0	13,736	78
Urology	1,086	29	733	20	905	25	6	0	266	7	540	15	154	4	3,690	21
Others	29	27	13	12	28	26	10	9	11	10	7	7	8	8	106	1
Surgeon ageⁱ																
<30	–	–	2	40	3	60	–	–	–	–	–	–	–	–	5	0
30–34	421	42	139	14	170	17	48	5	171	17	63	6	1	0	1,013	6
35–39	1,535	43	650	18	907	25	141	4	261	7	84	2	5	0	3,583	20
40–44	2,117	45	942	20	998	21	225	5	268	6	145	3	4	0	4,699	27
45–49	1,812	42	525	12	911	21	306	7	321	7	408	9	58	1	4,341	25
50–54	1,435	53	263	10	494	18	157	6	132	5	132	5	95	4	2,708	15
55–59	230	23	118	12	608	61	16	2	9	1	12	1	–	–	993	6
≥60	60	33	6	3	101	56	7	4	1	1	5	3	–	–	180	1
Surgeon genderⁱ																
Male	7,169	44	2,364	14	3,962	24	888	5	1,013	6	842	5	160	1	16,398	94
Female	441	40	281	25	230	20	12	1	150	13	7	1	3	0	1,124	6
Total	7,610		2,645		4,196		900		1,165		853		163		17,532	100.00

^a Percentages may not sum to 100 because of rounding.

^b RPU refers to retro-pubic urethropexy operations.

^c Sling refers to traditional pubovaginal sling operations.

^d MUS refers to mid-urethral sling operations.

^e Kelly refers to urethra-vesical junction plication operations.

^f Needle refers to bladder neck needle suspension and para-urethral suspension operations.

^g LS refers to levator ani m. suspension operations.

^h Injection refers to operations resulting in the injection of an implant into the urethra/bladder neck.

ⁱ Surgeon specialty $\chi^2=2,037.33$, p -value<0.0001; surgeon age $\chi^2=2,004.83$, p -value<0.0001; surgeon gender $\chi^2=258.95$, p -value<0.0001

Table 4 Surgical types for stress urinary incontinence by hospital accreditation level and ownership

Variables	Types of surgery ^a														Total	
	RPU ^b		Sling ^c		MUS ^d		Kelly ^e		Needle ^f		LS ^g		Injection ^h		No.	%
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Hospital accreditation levelⁱ																
Medical Center	4,727	41	1,577	14	3,371	29	570	5	544	5	539	5	113	1	11,441	65
Regional Hospital	2,400	49	884	18	667	14	234	5	458	9	196	4	48	1	4,887	28
Local Hospital	483	40	183	15	157	13	96	8	163	14	118	10	2	0	1,202	7
Hospital Ownershipⁱ																
Not-for-profit	4,067	43	1,436	15	2,685	28	516	5	350	4	335	4	134	1	9,523	54
Government-owned	1,478	36	553	14	973	24	93	2	575	14	403	10	14	0	4,089	23
Private	2,065	53	656	17	538	14	291	7	240	6	115	3	15	0	3,920	22
Total	7,610		2,645		4,196		900		1,165		853		163		17,532	100

^a Percentages may not sum to 100 because of rounding.

^b RPU refers to retro-pubic urethropexy operations.

^c Sling refers to traditional pubovaginal sling operations.

^d MUS refers to mid-urethral sling operations.

^e Kelly refers to urethra-vesical junction plication operations.

^f Needle refers to bladder neck needle suspension and para-urethral suspension operations.

^g LS refers to levator ani m. suspension operations.

^h Injection refers to operations resulting in the injection of an implant into the urethra/bladder neck.

ⁱ Hospital accreditation level $\chi^2=814.69$, p -value<0.0001; hospital ownership $\chi^2=1,284.20$, p -value<0.0001.

The increasing range of available procedures allows surgical treatment of SUI to be individualized for the patients.

Although MUS is found to have demonstrated the most rapid rate of growth during the period under examination, the long-term performance of this more progressive and minimally invasive technique remains controversial [14]. From a recent meta-analysis study based upon 37 randomized controlled trials, in terms of post-operative continence rates, TVT outperformed Burch colposuspension in terms of post-operative continence rate with significantly less failure events (an odds ratio (OR) of 0.38 to 0.59), according to the different end points, e.g., presence of negative stress test and negative pad test. When comparing TVT and traditional pubovaginal sling operations, these two types of surgeries were found to be similar following TVT with OR of 0.82–1.03 [23].

The choice of surgical modality should of course vary according to the condition and characteristics of the patients, including urodynamic parameters, age, physical status, concomitant genital prolapse, and previous surgical history [4]. According to the recommendation of the International Scientific Committee on the 3rd International Consultation on Incontinence, urodynamic stress incontinence with some degree of bladder neck and urethral mobility, RPU, and bladder neck/sub-urethral sling operations were suggested [1]. For patients with intrinsic sphincter deficiency (ISD) and limited bladder neck mobility, pubovaginal sling procedures, injectable bulking agents and the artificial urinary sphincter can be considered [1]. However, an inherent limitation of the descriptive characteristics in the present study was the lack of availability of urodynamic study data, which made definitive diagnosis of the patient condition not feasible.

This study has, however, revealed the diversity in the distribution of the various types of surgery amongst patients in different age groups; there were more RPU performed amongst middle-age patients, whereas more Kelly plication amongst younger patients and more injection operations amongst the older age groups. Kelly plication remains in contemporaneous use largely because of the relatively low morbidity and its familiarity for gynecologists to use anterior colporrhaphy for prolapse [24]. It also may be due to the minor degree of SUI in these two extreme age groups. This study also confirms that patients' age is one of the factors that the appropriate surgical type selection should take into account. Our study revealed that more surgeries for SUI were performed in middle-aged women (40–55 years) as compared with the older women (≥ 65 years), which is in concordance with the finding that the highest prevalence rates reported in women in their 50s (up to 43%) [15]. Also, the higher incidence of MUI and pure UI in older age groups might also be the factor in the decision for the choices of surgical type. This finding may be attributable to the higher expectations of quality-of-life amongst middle-aged women, including their active engagement in social activities.

Although the prevalence rate of urinary incontinence is high in women, the consultation and treatment rates remain quite low [25]. Certain factors may limit the intention of the patients to seek medical treatment, e.g., illiteracy, perceiving urinary incontinence as being part of the normal aging process, feelings of embarrassment and the limited understanding of the lower urinary tract dysfunction (LUTD) [26, 27]. Lack of referral and consultation information in our data base, it is difficult to estimate the either untreated or unconsulted population.

Variations were found in this study in the preferences of surgeons of different specialties towards the different modalities for SUI. Our study found RPU was the most commonly used method by both gynecologists (47%) and urologists (27%); MUS and needle suspension was almost equally adopted by gynecologists (24% and 6%) and urologists (25% and 7%). Gynecologists performed more Kelly plication while urologists performed more traditional pubovaginal slings. According to the 2002 IUGA survey on pelvic floor dysfunction management practice patterns, the preferred anti-incontinence surgery method amongst the 152 members (gynecologists 89%, and urologists 11%) was 49% in favor of TVT, and 44% for Burch colposuspension [22].

In addition to the patients' conditions, the choices of surgical procedures are partly dependent, to some extent, on the hospitals that they attend and the specialties of the surgeons with whom they consult [28]. This variability would, in turn, have implications for both the patients and the surgical modalities selected [28]. There were significant differences in the distribution of the seven surgical types between hospital accreditation levels and types of hospital ownership. It is worth noting that MUS, which is regarded as a novel and innovative technique, was performed mostly in the medical centers. This newly-developed instrumentation and technology first got approved by staff in the medical centers, followed by the regional and local hospitals. There should be some proper training prior to performing MUS procedures as has been proposed by the Society of Obstetricians and Gynaecologists of Canada (SOGC) [29].

Results in this study have also indicated that the tendency for traditional pubovaginal sling operations to be performed was greater in regional hospitals than in either of the other two hospital groups. This study also found that local hospitals were more likely to perform Kelly plication and needle suspension than either medical centers or regional hospitals, which may be due to the easy-to-perform and easily available characteristics of the Kelly plication and needle suspension procedures.

Certain limitations remain in this study, which must of course be taken into consideration. Firstly, the lack of availability of appropriate data has made the definitive diagnosis of the urodynamic condition of the patients unavailable. Secondly, there was a lack of information on concomitant surgical

procedures for pelvic organ prolapse. Nevertheless, despite these limitations, this study has provided a descriptive analysis of SUI, based upon a 10-year nationwide databank including the surgical types, the patients' age, and the surgeons' specialties.

In conclusion, our study indicates the increase in the overall number of surgeries for SUI, which revealed the attention amongst medical professionals and the awareness of the general population to seek treatment. MUS, which has the greatest gain in popularity, could potentially revolutionize the practice of surgery for SUI. The increasing availability of the various types of treatment modality present the possibility of tailoring therapies to the desires and needs of individual patients [4].

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Conflicts of interest None.

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