



Trends of genital wart in Korea according to treatment method classification: Big data analysis of health care in 2010–2019

Eun Jae Kim¹ , Jae Chul Lee¹ , Don Hee Lyu¹ , Useok Choi¹ , Jin Bong Choi² , Kang Sup Kim¹ ,
Bong Hee Park¹ , Sooyoun Kim³ , Seung-Ju Lee⁴ , Chang Hee Han¹ , Sangrak Bae¹

¹Department of Urology, Uijeongbu St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, ²Department of Urology, Bucheon St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, ³Institute of Health and Environment, Seoul National University, Seoul, ⁴Department of Urology, St. Vincent's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea

Purpose: The purpose of this study is to investigate disease trend of genital wart through changes in each treatment method over the past 10 years in Korea.

Materials and Methods: From 2010 to 2019, surgical treatment including cauterization, excision, cryotherapy, and laser therapy, non-surgical treatment such as podophyllin, and surgical treatment for anorectal lesion were extracted and analyzed from 2010 to 2019. For each treatment method, characteristics such as sex, age, region, medical cost and average number of procedures were analyzed.

Results: The number of patients following all treatment modalities increased every year. Surgical treatment of genital wart and anorectal wart showed a significant increase in male patients. Number of non-surgical treatment decreased in males but increased in females. Surgical removal of the anorectal wart increased more than 250% in over 10 years, and males underwent surgery 4 times more than females. In both surgery and non-surgery, the mean session was higher in males. Most of them were carried out in primary medical institutions. In Seoul and Gyeonggi-do, the largest number of patients received treatment regardless of treatment method.

Conclusions: Treatment for genital warts has increased rapidly over the past 10 years, and the increase in males is remarkable. The main treatment was surgery, and males mainly received surgical treatment, and females mainly received drug treatment. The primary medical institution was in charge of the most treatment. As the number of patients and related medical expenses are increasing rapidly, more attention and response to diseases are needed.

Keywords: Genital wart; Human papilloma virus; Treatment

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INTRODUCTION

Human papilloma virus (HPV) infections refer to infec-

tions caused by the human papilloma virus, and are the most common virus infections that occur in genitourinary organs [1]. HPV infection causes a variety of diseases in fe-

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Corresponding Author: Sangrak Bae <https://orcid.org/0000-0002-8364-704X>

Department of Urology, Uijeongbu St. Mary's Hospital, College of Medicine, The Catholic University of Korea, 271 Cheonbo-ro, Uijeongbu 11765, Korea
TEL: +82-31-820-5354, FAX: +82-31-847-6133, E-mail: robinbae97@catholic.ac.kr

males and males. Some are associated with benign diseases such as genital warts and laryngeal papillomatosis, others are associated with malignant tumors such as cervical cancer, penile cancer, oropharyngeal cancer, anal cancer and vulvovaginal cancer [2].

It is also one of the most common sexually transmitted infections. A disease called genital wart or condyloma acuminata is known to be mainly caused by a low-risk group among human papilloma viruses represented by genotype 6 and 11 [3]. Soft and noncancerous growth that can form on the skin or mucosal layer on vagina, anus, cervix and male genital organ such as penis and scrotum epithelium are classified as benign HPV disease. It is transmitted to each other by sexual intercourse or skin contact. And these genital warts may invade the anus or rectum along with the genital area. Treatment of genital wart is largely divided into surgical and non-surgical treatment. Surgical treatments are excision, electro-cauterization and cryotherapy, and non-surgical treatments involve drug application such as Imiquimod and Podophyllin.

It can be confirmed that the prevalence of these sexually transmitted diseases is increasing mainly in the younger age group [4]. There have been some studies on the prevalence of genital warts in Korea. The research on big data using Korea's Health Insurance Review and Assessment or Healthcare Bigdata Hub [5-7] and a study centered on the urologic clinic has been published [8]. Foreign countries have also reported high prevalence in sexually active age [9]. Thus, it is required to better understand the diseases itself, its prevalence, and trend of the treatment. In the case of females, it has been closely related to cervical cancer not only in Korea but also worldwide, and has received a lot of research and attention in the field of cancer that can be prevented by vaccines [10-13]. However, given that HPV infection is a sexually transmitted infection, it is essential to understand that not only females but also males can get disease. Also, there are not many studies about trend of genital wart and its treatment in Korea. Recently, interest in HPV-related diseases and genital warts is increasing. The age of females vaccination for HPV infection-related diseases has been extended, indications for head and neck cancer have been added, discussions on the necessity of vaccination for adolescent boys are taking place.

Therefore, the research team tried to extract and analyze data for classification according to treatment methods, that is, surgical treatment, non-surgical treatment, and surgical treatment data of anogenital wart through data from the 'Healthcare Bigdata Hub'. The analysis will investigate the change in the treatment of genital wart and the change of

disease through it.

MATERIALS AND METHODS

1. Data characteristics of healthcare big data hub

This study was analyzed using data from the National Health Insurance Big Data Hub from 2010 to 2019. It is data obtained by analyzing and refining information collected from various channels, such as medical institutions, pharmaceutical companies, and related institutions, as well as nation-wide medical information. It is data based on claims data from over 87,000 medical institutions, including data on injuries and illnesses, surgery/treatment, and prescription/dispensing of medicines.

2. Subjectives

All patients included in the National Health Insurance data who were diagnosed with A63.0 genital wart in the ICD-10 code as a major diagnosis or a minor diagnosis within the period and who received treatment in various ways within the study period were included in the subjects. It was analyzed using data registered in the Health and Medical Big Data Hub, and included treatment codes are R4305 surgical treatment of genital wart, R4306 non-surgical treatment of genital wart, and Q3050 surgical treatment of ano-rectal wart.

The total number of patients, the number of patients by sex, age group by five years, total number of treatments, cost, number of patients by grade and by type of medical institution, and number of patients by region were analyzed. Changes by year were analyzed for each item. Mean treatment session was confirmed by dividing the total number of treatments provided by the total number of patients. Total number of treatments is measured by prescriptions made to claim insurance to Korea's health insurance. The total medical expense is the cost of treatment for health insurance patients at medical institutions, which is the sum of the insurer's contribution and the patient's own expenses (excluding non-insurance). The number of patients by age is the age calculated based on the recipient's date of birth written on the medical expense statement. Region is based on the location of the nursing institution. The number of patients for each treatment, mean treatment session, and cost were compared with 2010 according to the annual flow to confirm the increase/decrease rate in 2019.

As this study used publicly available data, the receipt of consent was exempted. Institutional ethics review was sought and approved by Institutional Review Board (approval no. XC19ZIDI0101).

RESULTS

1. Changes in patients according to treatment methods

At 2010, a total of 15,032 males received surgical treatment, and 10,176 females received surgical treatment. Both males and females showed a steady increase until 2019, males increased about 228% to 49,283 in 2019, while females increased by only about 56% to 15,920 (Fig. 1A). The non-surgical treatment was higher in female patients than in

males. It showed an increase of about 34% from 8,482 in 2010 to 11,380 in 2019, and males showed a 16% decrease from 1,207 in 2010 to 1,020 in 2019 (Fig. 1B).

In the case of surgical treatment for anorectal warts, the number of patients increased from 692 in 2010 to 1,898 in 2019, about 174%. The number of females increased by 154% from 181 in 2010 to 459 in 2019 (Fig. 1C). While the surgical treatment of genital warts in male patients showed the largest increase in the number of patients, male non-surgical showed the only decrease.

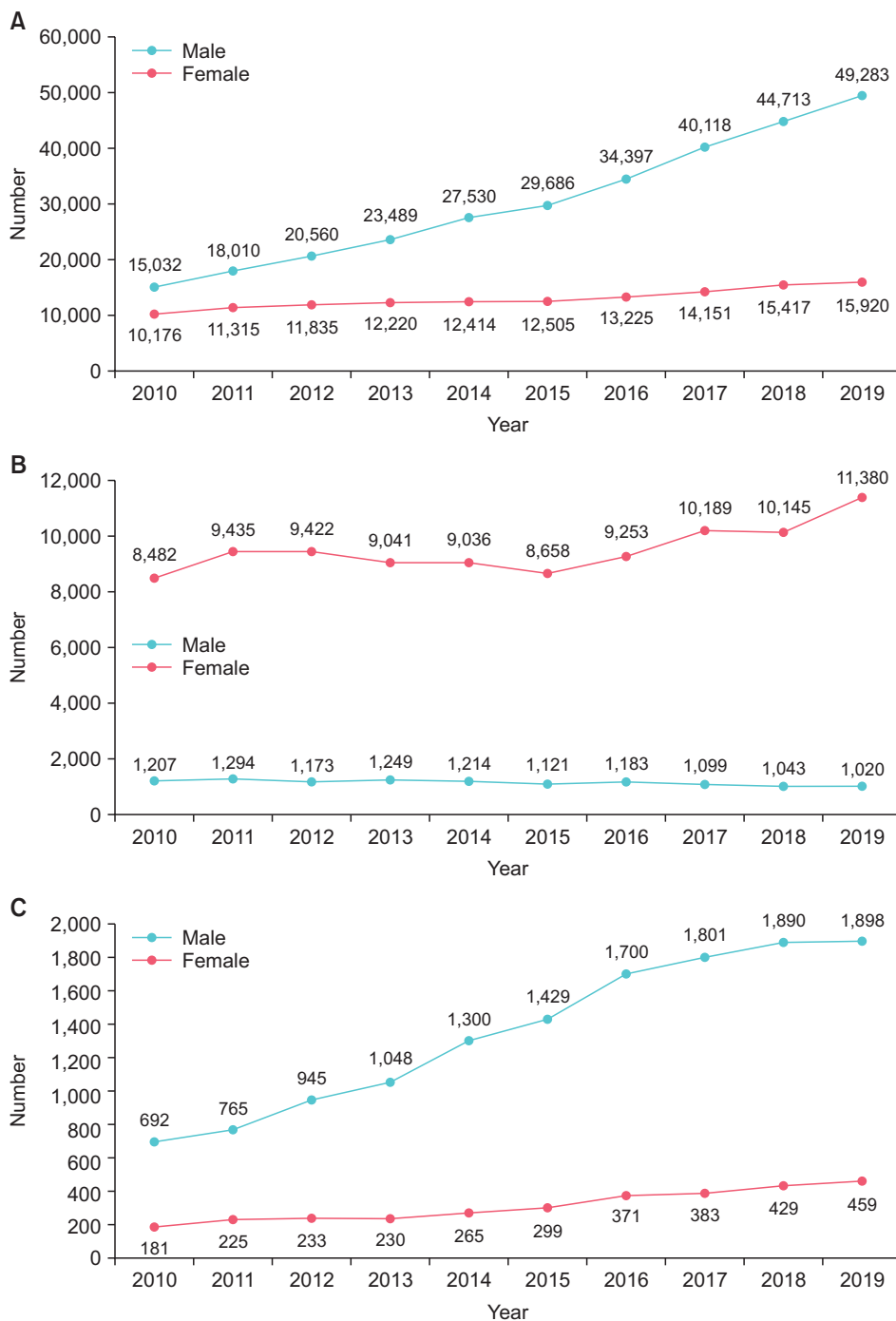


Fig. 1. Changes in number of patients in each treatment methods. (A) Annual patients in surgical treatment. (B) Annual patients in non-surgical treatment. (C) Annual patients in surgical treatment for anorectal wart.

2. Mean treatment session

In the case of male patients in surgical treatment, a total of 15,032 patients underwent 21,711 surgeries in 2010, and the average treatment session was about 1.44 sessions. For females, in 2010, 10,176 patients underwent 13,144 surgeries, so the mean treatment session was 1.29. In 2019, males had about 1.60 sessions and females had 1.33 sessions (Fig. 2A). In the case of non-surgical treatment, the number of preceding patients was higher in females, but the mean treatment session was higher in males. In the case of males, in 2010,

1,207 people received 2,872 treatments, an average of 2.38 sessions, and for females, 8,482 people received 18,882 sessions and received 2.23 sessions, and in 2019, males performed 2.26 and females performed 2.22 sessions (Fig. 2B). In the case of surgical treatment of anorectal warts, males showed 1.50 sessions in 2010 and 1.17 sessions for females, and 1.57 sessions for males and 1.19 sessions for females in 2019 (Fig. 2C). Regardless of the treatment method, the average number of sessions was higher in males, and there was no significant difference in the number of sessions per year.

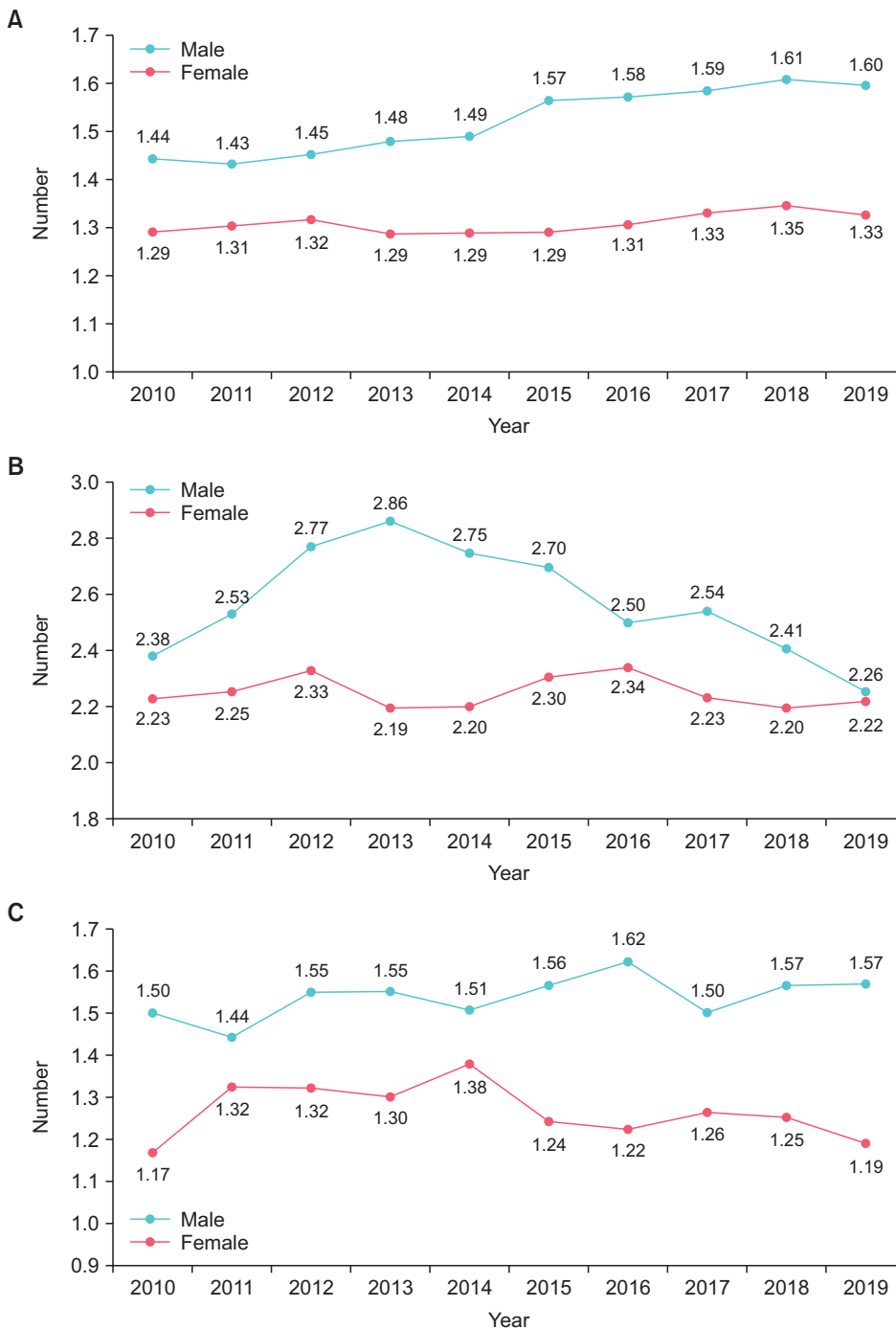


Fig. 2. Changes in mean treatment session of anogenital wart by methods. (A) Average number of surgical treatment session. (B) Average number of non-surgical treatment session. (C) Average number of treatment session for anorectal wart.

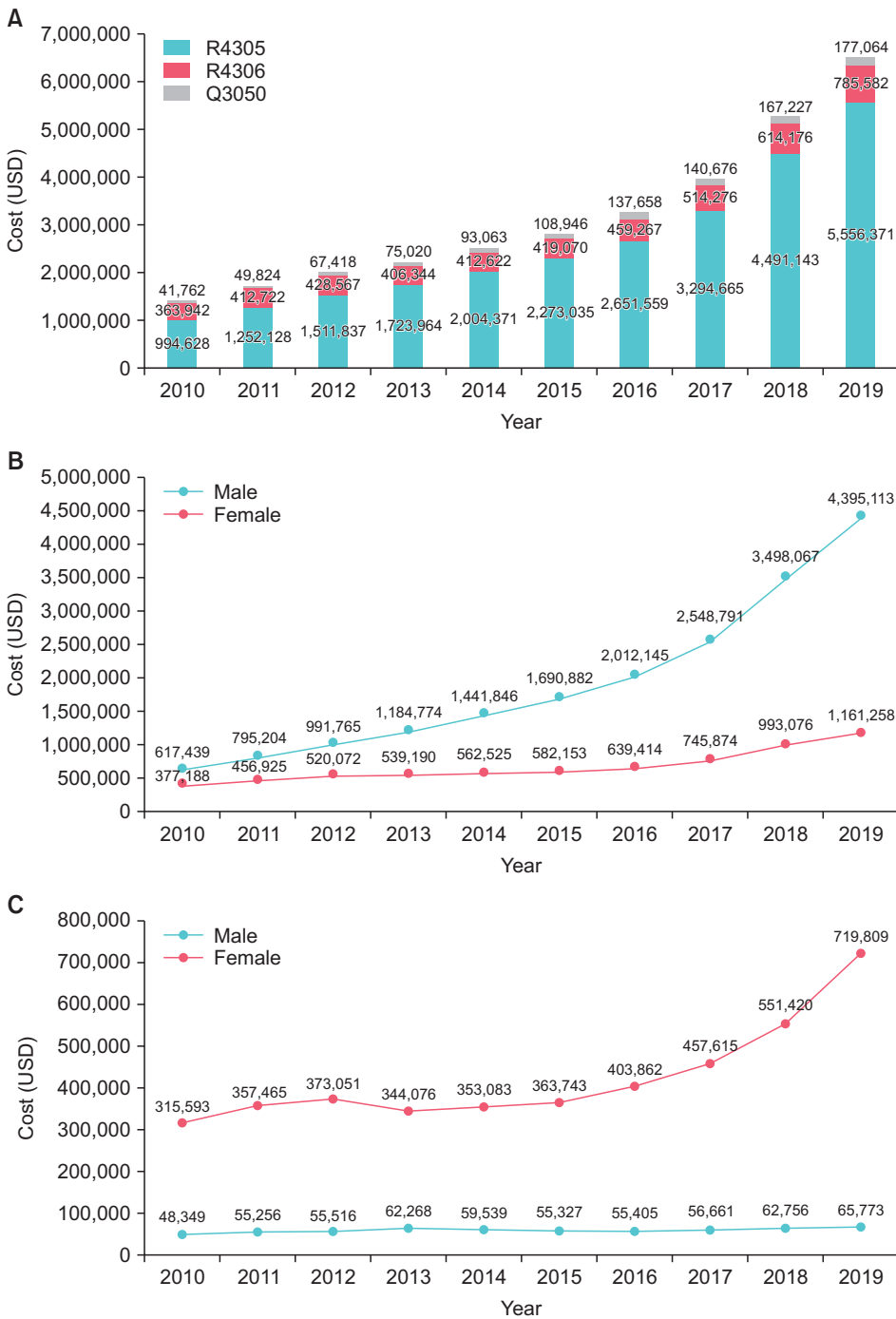


Fig. 3. Medical cost of treatment in genital wart by different modality (1 dollar=1,166.11 won, dollar to won exchange rate for 2019). (A) Medical cost by treatment methods. (B) Medical cost of surgical treatment for genital wart. (C) Medical cost of non-surgical treatment for genital wart. (D) Medical cost of surgical treatment for anorectal wart.

3. Total medical cost

The cost of treatment for genital warts shows a “J” shape curve that increases year by year, sharply (Fig. 3A). The total cost of treatment increased by 366% from 1,400,332 dollars in 2010 to 6,519,017 dollars in 2019. The total cost of surgical treatment of genital wart was about 617,439 dollars for males in 2010 and 377,188 dollars for females, but in 2019, it increased 7.12 fold to 4,395,113 dollars for males, and 3.08 fold to 1,161,258 dollars for females (Fig. 3B). In the case of non-surgical treatment of genital warts, males increased

by 1.36 fold from 48,349 dollars in 2010 to 65,773 dollars in 2019. For females, it increased 2.28 fold from 315,593 dollars to 719,809 dollars, and the increase was clear in females (Fig. 3C). Surgical treatment for anorectal warts increased by 4.30 times from 34,626 dollars in 2010 to 149,003 dollars in males in 2010, and increased 3.93 times in females from 7,136 dollars in 2010 to 28,061 dollars in 2019 (Fig. 3D). There was an increase in both males and females.

The original data about cost were on Korean won and they were changed to US dollars (exchange rate was 1,166.11

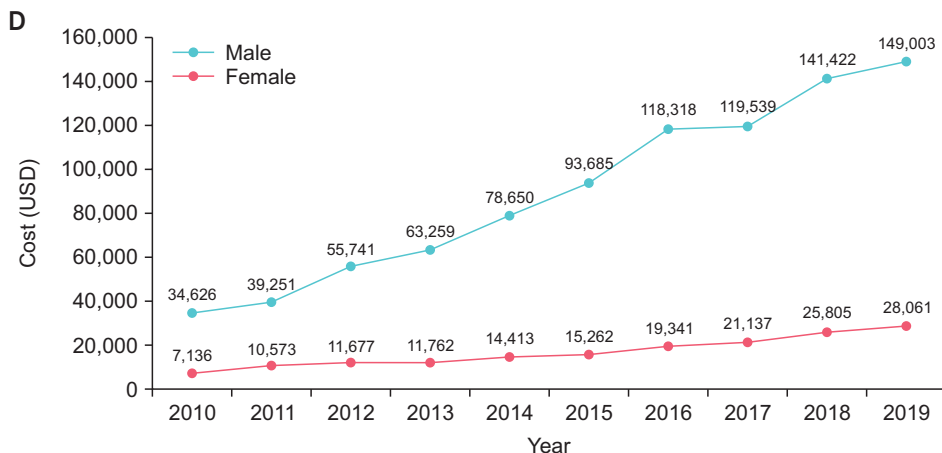


Fig. 3. Continued.

won for 1 dollars, average exchange rate for 2019).

4. Differences in patients treated by medical institution grade

In all treatment methods, clinic treated most of the patients, and higher-level medical institutions treated lesser patients (Table 1). Surgical treatment of genital wart was responsible for the highest rate with an average of 88.5%, non-surgical treatment was responsible for 71.9%, and surgical treatment for anorectal wart was responsible for 50.2%. Clinics play a pivotal role in the treatment of genital warts.

5. Classification by region

Of the total number of treatments, all treatment methods are most frequently implemented in Seoul, followed by Gyeonggi Province. Sejong-si had the fewest patients, and overall, metropolitan-level regions tended to have more patients (Table 2). The area with the highest increase rate was Ulsan (433.9%) for surgical treatment, Daegu (217.7%) for non-surgical treatment, and Jeju (540.0%) for surgical treatment of anorectal wart. In the case of non-surgical treatment, Incheon (78.4%), Daejeon (54.5%), Gwangju (84.6%), Ulsan (88.4%), Chungbuk (73.5%), and Gyeongbuk (57.7%) tended to decrease in 2019 compared to 2010.

DISCUSSION

Genital wart is one of the most common sexually transmitted disease and has the highest prevalence among HPV-related diseases. In general, it is delivered by skin-to-skin contact. It looks like lump or growth in the vagina, penis, scrotal skin, perineum and anus, and rectum. Of about 180 very large families of dsDNA, about 30 to 40 species cause diseases in the ano-genital tract. Genital wart invades and replicates only in fully differentiated squamous epithelium

[14]. Histopathologically, HPV infects the basal layer of the stratified epithelium through a microwound and wart rises above the skin surface as the dermal papillae enlarges. In females, it invades the mucosal layer of the vagina and stays for a long time, causing lesions such as cervical cancer.

In principle, a genital wart has no cure. All existing treatments are to remove visible lesions, and they may disappear spontaneously without treatment. Studies show that 80% of patients with HPV clear their infection within 18 months. Treatment for macroscopically visible genital wart lesions can be divided into surgical and non-surgical treatment [15]. Surgical treatments focus on ablative/excisional therapy by physically removing the lesion, consist of cryotherapy, scissor excision, laser therapy, and electrocauterization [16]. Non-surgical treatments using drugs include cytotoxic agents, podophyllotoxin, trichloroacetic acid, Imiquimod, and immunostimulants. Genital warts can spread not only to the genital area but also to the anus or rectum, and the genital warts of the anorectum are treated through surgical removal. The use of an antiviral agent against HPV protein or the concept of therapeutic vaccination targeting E1-E2 protein as an antiviral target are also being introduced.

According to this study, surgical treatment was used more than drug removal, and it showed a steady increase within the period. In addition, it was found that males receive more surgical treatment than females, and females mainly receive non-surgical treatment with drugs. This is thought to be related to the anatomical difference between females and males. However, additional research is needed for the exact reason. In the case of genital warts of the anorectum, surgical removal showed a steady increase in both males and females, and it was confirmed that the increase in males was slightly larger. Males underwent more sessions regardless of the treatment method. Medical expense related to diseases have also increased by about 4.7 times over the

Table 1. Regional distribution of genital and anorectal wart treatment

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| R4305 | | | | | | | | | | |
| Tertiary general hospital | 399 (1.57) | 446 (1.51) | 448 (1.37) | 429 (1.19) | 390 (0.97) | 422 (0.99) | 454 (0.95) | 383 (0.70) | 403 (0.67) | 380 (0.58) |
| General hospital | 866 (3.41) | 1,014 (3.43) | 1,184 (3.63) | 1,230 (3.42) | 1,359 (3.38) | 1,369 (3.22) | 1,595 (3.33) | 1,599 (2.93) | 1,682 (2.78) | 1,649 (2.52) |
| Hospital | 1,934 (7.62) | 2,324 (7.87) | 2,554 (7.83) | 2,992 (8.32) | 3,171 (7.88) | 3,299 (7.77) | 3,438 (7.17) | 3,627 (6.64) | 3,705 (6.12) | 3,335 (5.09) |
| Clinic | 22,187 (87.40) | 25,760 (87.19) | 28,444 (87.17) | 31,309 (87.07) | 35,314 (87.77) | 37,379 (88.01) | 42,457 (88.56) | 48,981 (89.73) | 54,752 (90.44) | 60,189 (91.82) |
| Total | 25,386 | 29,544 | 32,630 | 35,960 | 40,234 | 42,469 | 47,944 | 54,590 | 60,542 | 65,553 |
| R4306 | | | | | | | | | | |
| Tertiary general hospital | 287 (2.93) | 266 (2.45) | 297 (2.77) | 247 (2.37) | 166 (1.60) | 117 (1.18) | 106 (1.01) | 83 (0.73) | 84 (0.74) | 63 (0.50) |
| General hospital | 419 (4.28) | 422 (3.88) | 446 (4.16) | 441 (4.24) | 483 (4.67) | 425 (4.30) | 446 (4.23) | 420 (3.69) | 374 (3.32) | 268 (2.15) |
| Hospital | 1,773 (18.11) | 1,990 (18.31) | 2,118 (19.74) | 2,352 (22.60) | 2,334 (22.56) | 2,512 (25.43) | 2,618 (24.84) | 3,081 (27.07) | 2,868 (25.42) | 2,692 (21.55) |
| Clinic | 7,310 (74.68) | 8,189 (75.36) | 7,866 (73.33) | 7,366 (70.79) | 7,361 (71.16) | 6,823 (69.08) | 7,370 (69.92) | 7,797 (68.51) | 7,956 (70.52) | 9,470 (75.80) |
| Total | 9,789 | 10,867 | 10,727 | 10,406 | 10,344 | 9,877 | 10,540 | 11,381 | 11,282 | 12,493 |
| Q3050 | | | | | | | | | | |
| Tertiary general hospital | 49 (5.57) | 64 (6.41) | 84 (7.08) | 99 (7.66) | 116 (7.37) | 95 (5.46) | 133 (6.37) | 136 (6.16) | 168 (7.19) | 145 (6.08) |
| General hospital | 162 (18.41) | 166 (16.62) | 187 (15.77) | 222 (17.18) | 276 (17.53) | 269 (15.46) | 303 (14.52) | 359 (16.26) | 317 (13.57) | 336 (14.08) |
| Hospital | 274 (31.14) | 311 (31.13) | 359 (30.27) | 383 (29.64) | 434 (27.57) | 467 (26.84) | 556 (26.64) | 513 (23.23) | 517 (22.13) | 585 (24.52) |
| Clinic | 395 (44.89) | 458 (45.85) | 556 (46.88) | 588 (45.51) | 748 (47.52) | 909 (52.24) | 1,095 (52.47) | 1,200 (54.35) | 1,334 (57.11) | 1,320 (55.32) |
| Total | 880 | 999 | 1,186 | 1,292 | 1,574 | 1,740 | 2,087 | 2,208 | 2,336 | 2,386 |

Data are presented as number (%).

Table 2. Regional distribution and change of each treatment modality between 2010 and 2019

| Region | 2010 | | | 2019 | | | Change | | |
|-----------|--------|-------|-------|--------|--------|-------|--------|--------------------|--------|
| | R4305 | R4306 | Q3050 | R4305 | R4306 | Q3050 | R4305 | R4306 | Q3050 |
| Total | 25,208 | 9,689 | 873 | 65,203 | 12,400 | 2,357 | 258.7% | 128.0% | 270.0% |
| Seoul | 7,302 | 3,011 | 365 | 17,961 | 4,791 | 869 | 246.0% | 159.1% | 238.1% |
| Busan | 2,041 | 802 | 52 | 4,497 | 1,430 | 204 | 220.3% | 178.3% | 392.3% |
| Incheon | 1,239 | 776 | 42 | 3,662 | 608 | 140 | 295.6% | 78.4% ^a | 333.3% |
| Daegu | 1,795 | 334 | 35 | 4,938 | 727 | 101 | 275.1% | 217.7% | 288.6% |
| Gwangju | 875 | 143 | 19 | 2,705 | 121 | 66 | 309.1% | 84.6% ^a | 347.4% |
| Daejeon | 901 | 235 | 29 | 2,680 | 128 | 152 | 297.4% | 54.5% ^a | 524.1% |
| Ulsan | 560 | 181 | 16 | 2,430 | 160 | 28 | 433.9% | 88.4% ^a | 175.0% |
| Gyeonggi | 5,405 | 1,981 | 160 | 13,759 | 2,235 | 412 | 254.6% | 112.8% | 257.5% |
| Gangwon | 412 | 76 | 8 | 1,088 | 95 | 23 | 264.1% | 125.0% | 287.5% |
| Chungbuk | 602 | 853 | 9 | 1,435 | 627 | 42 | 238.4% | 73.5% ^a | 466.7% |
| Chungnam | 1,003 | 196 | 36 | 2,350 | 262 | 78 | 234.3% | 133.7% | 216.7% |
| Jeonbuk | 709 | 121 | 43 | 1,663 | 164 | 54 | 234.6% | 135.5% | 125.6% |
| Jeonnam | 455 | 57 | 10 | 1,225 | 82 | 32 | 269.2% | 143.9% | 320.0% |
| Gyeongbuk | 905 | 588 | 25 | 1,883 | 339 | 44 | 208.1% | 57.7% ^a | 176.0% |
| Gyeongnam | 1,064 | 354 | 27 | 2,601 | 615 | 85 | 244.5% | 173.7% | 314.8% |
| Jeju | 160 | 37 | 5 | 655 | 55 | 27 | 409.4% | 148.6% | 540.0% |
| Sejong | 0 | 0 | 0 | 410 | 19 | 14 | - | - | - |

^a:Tended to decrease in 2019 compared to 2010.

past 10 years, with the surgical treatment of genital warts being the most prominent at about 7.1 times. As such, when the treatment expense for a specific disease increases by nearly 5 times, and the specific treatment method increases more than 7 times, it can be seen that not only the cost of the disease but also the burden of the disease itself increases rapidly. Although it is indirect, it can be inferred from the analysis of actual treatment that the frequency of the disease itself rapidly increases.

Among HPV-related diseases, cervical cancer or vulvovaginal cancer in females has received much attention, and vaccine development and therapeutic interest, national support, and close cooperation between countries have also been made. In Korea, HPV is also called “cervical cancer virus”. On the other hand, other anorectal malignancy, head & neck malignancy, penile malignancy, and genital wart have received relatively little attention. They received less attention because of the low possibility of developing into a malignant tumor, as well as the low prevalence of the disease itself and the low medical burden associated with the disease. There were not many studies on prevalence rates indicating changes in the disease, and studies on prevalence rates in males were particularly lacking [8,17,18].

There is still a lack of research on the prevalence of HPV in Korea, especially in males. However, many foreign studies have suggested that males HPV prevalence is reaching significant levels. By Han et al. [9], a total of 1,868 males

aged 18 to 59 years, overall genital HPV infection prevalence for males aged 18 to 59 years was 45.2% (95% confidence interval [CI], 41.3%–49.3%), and the high-risk HPV prevalence defined by DNA testing was 25.1% (95% CI, 23.0%–27.3%). By Gargano et al. [19], the nationally representative prevalence data on genital HPV in males in the United States, using findings from the National Health and Nutrition Examination Survey, 2013–2014, overall estimated prevalence of any genital HPV was 42.2% (95% CI, 38.3%–46.1%) among males aged 14 to 59 years and of high-risk HPV was 23.4% (95% CI, 21.3%–25.6%). By Ventimiglia et al. [20], HPV has an overall prevalence of >20% among males, although a minority of individuals develop external genital lesions (EGLs). The risk of acquiring a new HPV infection is robustly linked to sexual behavior, with the most commonly infected sites being the prepuce, shaft, glans, corona, and scrotum. Of all cancer cases among males, 2% are attributable to HPV. But up to 50% of penile cancers are estimated to be either directly or indirectly driven by HPV, with HPV-16 subtype is most frequently isolated. Currently there are two different vaccines approved for males, with a good immunogenic profile and efficacy of up to 80% against EGLs; however, efficacy data regarding malignant lesions are still limited.

Genital warts caused by HPV are sexually transmitted diseases, and in males, they may remain asymptomatic and latent infection without causing lesions. In addition, when a disease occurs, not only the person who has the disease

but also the carrier can transmit the pathogen to the other party and spread the disease. Due to the nature of infectious diseases, there are ways to prevent diseases by physically blocking them from contact, or acquiring immunity to viruses. In the case of HPV infection, using condoms prevents skin contact and thus prevent disease, and HPV vaccination makes host to acquire immunity to the virus.

Among HPV infections, genital wart accounts for the largest number of patients, and in many studies, genital wart is increasing [18,21,22]. In this study, the increasing trend was more pronounced in males than in females. Also, in terms of treatment methods, surgical treatment was absolutely common for males, and non-surgical treatment was absolutely common for females. Overall, the average number of therapy taken was higher in males and higher costs were incurred in males. In Korea, cervical cancer in females was the fourth most common cancer in females, but in recent surveys it ranks 9th and 10th [23]. Genital warts also showed a decreasing trend in previous domestic population-based studies [18]. These can be explained by various causes, such as National Immunization Program (NIP) for females, catch-up vaccination, and screening test for cervical cancer. If the vaccination rate reaches a certain level, the incidence rate of cervical cancer is likely to be lowered even further. However, in the case of males, as in this study, there is a rapid increase, and there are not many measures to prevent this. Circumcision is helpful for the prevention of genital warts [24], but male circumcision rate is decreasing in Korea. In addition, males are excluded from the NIP, and the age for adaptation is also limited to 26, so there are many limitations. Based on the rapidly increasing trend, like other countries, education on HPV infection and effectiveness of vaccination, and improvement of parental awareness are thought to be necessary [25].

This study also has some limitations. First, the recurrence rate or retreatment rate by each treatment method was unknown. The average number of procedures was confirmed by dividing the total number of trials by the total number of patients. Because of the lack of information, it was not possible to distinguish the cases of resistance to treatment from the cases of treatment for a lesion that was overlooked during prior treatment. Second, It was not based on the analysis of the actual prevalence and incidence of genital warts as an analysis of the treatment method. However, it was possible to infer the indirect tendency to the disease through the actual treatment trend and analysis.

It was confirmed that the prevalence of HPV-related diseases in Korea is increasing. In addition, within 10 years, the prevalence of males increased compared to females,

and the treatment characteristics according to sex could be confirmed. It was found that the related medical expenses increased rapidly regardless of the treatment method. In addition, it was confirmed that primary medical institutions are in charge of more than 90% of the disease and that they are playing a very important role in diagnosing and treatment of the disease. Regionally, the occurrence was more pronounced in areas with high population. Although it is not a malignant disease, it is necessary to study and respond to more accurate prevalence and incidence rates based on the clear results of the increase in the disease. In addition, along with diseases related to HPV infection in males, vaccines or various measures to prevent it should be considered.

CONCLUSIONS

Treatment for genital warts has increased rapidly over the past 10 years, and the increase in males is remarkable. The main treatment method was surgical excision. Males mainly received surgical treatment, and females mainly received drug treatment. Medical expenses related to treatment have also risen sharply. The primary medical institution was in charge of the main treatment. As the number of patients is rapidly increasing and the related medical expenses are clearly rising, more attention and response to diseases are needed.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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AUTHORS' CONTRIBUTIONS

Research conception and design: Useok Choi, Kang Sup Kim, Bong Hee Park, Sooyoun Kim, Seung-Ju Lee, Chang Hee Han, and Sangrak Bae. Data acquisition: Eun Jae Kim, Jae Chul Lee, Don Hee Lyu, and Jin Bong Choi. Statistical analysis: Eun Jae Kim, Jin Bong Choi, and Sangrak Bae. Data analysis and interpretation: Eun Jae Kim and Sangrak Bae. Drafting of the manuscript: Eun Jae Kim. Critical revision of the manuscript: Eun Jae Kim. Obtaining funding: Sangrak Bae and Seung-Ju Lee. Administrative, technical, or material support: Useok Choi, Kang Sup Kim, Bong Hee Park, Sooyoun Kim, Seung-Ju Lee, Chang Hee Han, and

Sangrak Bae. Supervision: Sangrak Bae. Approval of the final manuscript: Sangrak Bae.

REFERENCES

- Kombe Kombe AJ, Li B, Zahid A, Mengist HM, Bounda GA, Zhou Y, et al. Epidemiology and burden of human papillomavirus and related diseases, molecular pathogenesis, and vaccine evaluation. *Front Public Health* 2021;8:552028.
- Li Y, Xu C. Human papillomavirus-related cancers. *Adv Exp Med Biol* 2017;1018:23-34.
- Kaliterna V, Barisic Z. Genital human papillomavirus infections. *Front Biosci (Landmark Ed)* 2018;23:1587-611.
- Kim JK. Epidemiological trends of sexually transmitted infections among women in Cheonan, South Korea, 2006-2012. *J Microbiol Biotechnol* 2013;23:1484-90.
- Lee TS, Kothari-Talwar S, Singhal PK, Yee K, Kulkarni A, Lara N, et al. A cross-sectional study estimating the burden of illness related to genital warts in South Korea. *BMJ Open* 2017;7:e014217.
- Oh JK, Choi HY, Han M, Lee JK, Min KJ, Ki M. Prevalence of human papillomavirus-related diseases in the Republic of Korea: a cross-sectional study. *Sex Transm Infect* 2019;95:292-9.
- Yuk JS, Hong JH, Yi KW, Hur JY, Shin JH. Comparing the prevalence of condylomata acuminata between pregnant women and nonpregnant controls in South Korea: a population-based, cross-sectional study. *Sex Transm Dis* 2014;41:292-4.
- Lee CB, Choe HS, Hwang SJ, Lee SJ, Cho YH. Epidemiological characteristics of genital herpes and condyloma acuminata in patients presenting to urologic and gynecologic clinics in Korea. *J Infect Chemother* 2011;17:351-7.
- Han JJ, Beltran TH, Song JW, Klaric J, Choi YS. Prevalence of genital human papillomavirus infection and human papillomavirus vaccination rates among US adult men: National Health and Nutrition Examination Survey (NHANES) 2013-2014. *JAMA Oncol* 2017;3:810-6.
- Serrano B, Brotons M, Bosch FX, Bruni L. Epidemiology and burden of HPV-related disease. *Best Pract Res Clin Obstet Gynaecol* 2018;47:14-26.
- Chelimo C, Wouldes TA, Cameron LD, Elwood JM. Risk factors for and prevention of human papillomaviruses (HPV), genital warts and cervical cancer. *J Infect* 2013;66:207-17.
- de Sanjosé S, Brotons M, Pavón MA. The natural history of human papillomavirus infection. *Best Pract Res Clin Obstet Gynaecol* 2018;47:2-13.
- Schiffman M, Doorbar J, Wentzensen N, de Sanjosé S, Fakhry C, Monk BJ, et al. Carcinogenic human papillomavirus infection. *Nat Rev Dis Primers* 2016;2:16086.
- Bernard HU, Burk RD, Chen Z, van Doorslaer K, zur Hausen H, de Villiers EM. Classification of papillomaviruses (PVs) based on 189 PV types and proposal of taxonomic amendments. *Virology* 2010;401:70-9.
- Yuan J, Ni G, Wang T, Mounsey K, Cavezza S, Pan X, et al. Genital warts treatment: beyond imiquimod. *Hum Vaccin Immunother* 2018;14:1815-9.
- Scheinfeld N. Update on the treatment of genital warts. *Dermatol Online J* 2013;19:18559.
- Shin HR, Franceschi S, Vaccarella S, Roh JW, Ju YH, Oh JK, et al. Prevalence and determinants of genital infection with papillomavirus, in female and male university students in Busan, South Korea. *J Infect Dis* 2004;190:468-76.
- Park YJ, Kim JM, Lee BR, Kim TH, Lee EG. Annual prevalence and economic burden of genital warts in Korea: Health Insurance Review and Assessment (HIRA) service data from 2007 to 2015. *Epidemiol Infect* 2018;146:177-86.
- Gargano JW, Unger ER, Liu G, Steinau M, Meites E, Dunne E, et al. Prevalence of genital human papillomavirus in males, United States, 2013-2014. *J Infect Dis* 2017;215:1070-9.
- Ventimiglia E, Horenblas S, Muneer A, Salonia A. Human papillomavirus infection and vaccination in males. *Eur Urol Focus* 2016;2:355-62.
- Patel H, Wagner M, Singhal P, Kothari S. Systematic review of the incidence and prevalence of genital warts. *BMC Infect Dis* 2013;13:39.
- Hartwig S, Syrjänen S, Dominiak-Felden G, Brotons M, Castellsagué X. Estimation of the epidemiological burden of human papillomavirus-related cancers and non-malignant diseases in men in Europe: a review. *BMC Cancer* 2012;12:30.
- Ha HI, Chang HK, Park SJ, Lim J, Won YJ, Lim MC. The incidence and survival of cervical, ovarian, and endometrial cancer in Korea, 1999-2017: Korea Central Cancer Registry. *Obstet Gynecol Sci* 2021;64:444-53. Erratum in: *Obstet Gynecol Sci* 2022;65:384.
- Albero G, Castellsagué X, Giuliano AR, Bosch FX. Male circumcision and genital human papillomavirus: a systematic review and meta-analysis. *Sex Transm Dis* 2012;39:104-13.
- Choi J, Kim S, Lee SJ, Bae S, Kim S. Human papillomavirus (HPV) vaccination intent among mothers of adolescent sons: a national survey on HPV knowledge, attitudes and beliefs in South Korea. *World J Mens Health* 2022 May 4. [Epub]. <https://doi.org/10.5534/wjmh.210262>.