

Epidemiological Trends of Syphilis Infections in Japan and South Korea From 2011 to 2019

Myeong-Jin Lee^{a, b}, Shoko Komatsu^a

Abstract

Background: This study aimed to investigate and compare the epidemiological trends of syphilis infections in Japan and South Korea from 2011 to 2019 and examine the factors contributing to the disparities in the incidence of syphilis between the two countries.

Methods: A retrospective analysis was conducted using syphilis data from the National Institute of Infectious Diseases in Japan and the Korea Disease Control and Prevention Agency. Incidence rates were calculated and analyzed by gender and age group, with a focus on annual trends. Statistical analysis was performed using EZR (Easy R), and appropriate tests were conducted to evaluate the statistical significance of the results.

Results: Japan experienced a substantial rise in syphilis cases, with an eight-fold increase (from 827 cases in 2011 to 7,007 in 2018) primarily among women aged 20 - 29 years ($P < 0.05$). In contrast, South Korea underwent a more modest increase, with a 1.82-fold rise in cases (from 965 in 2011 to 1,753 in 2019) predominantly among men aged 20 - 39 years ($P < 0.05$). The incidence rate in Japan increased by 8.09 times, while South Korea saw a 1.76-fold increase over the same period. In addition, Japan experienced an increase in congenital syphilis cases, whereas South Korea saw a decline.

Conclusions: The contrasting syphilis trends in Japan and South Korea highlight the need for country-specific public health strategies. Japan's sharp increase in syphilis cases, particularly among young women, necessitates an urgent reassessment of current preventive measures. In contrast, the relatively stable trend in South Korea suggests more effective disease management, although further investigation is needed to identify the contributing factors. These findings underscore the importance of tailored public health interventions to address the unique epidemiological challenges in each country.

Keywords: Japan; South Korea; Syphilis; Infection; Trends

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Introduction

Syphilis, a chronic bacterial infection caused by the spirochete *Treponema pallidum* subspecies *pallidum*, has resurged as a major global health concern, posing significant challenges to public health systems worldwide. This sexually transmitted infection (STI), with the potential for congenital transmission, progresses through distinct clinical stages, starting from primary syphilis, characterized by a chancre, to advanced stages that include potentially severe tertiary syphilis and neurosyphilis [1, 2]. The wide spectrum of clinical manifestations of syphilis, combined with its risk for serious neurological and cardiovascular complications [3], highlights the critical need for early detection and prompt intervention.

The global resurgence of syphilis represents a pressing challenge to existing prevention and control strategies. The World Health Organization has reported an increase in global syphilis cases, indicating the need for a thorough understanding of its epidemiological trends to devise more effective public health responses. The World Health Organization estimates that 7.1 million adults between the ages of 15 and 49 acquired syphilis in 2020 [4]. This resurgence is alarming, especially given the advancements in diagnostic and therapeutic approaches for syphilis, and it suggests a gap in current public health strategies against this infection.

It is within this context that the contrasting epidemiological trends of syphilis in Japan and South Korea present a compelling case for study. Despite their geographical proximity and cultural similarities, both countries have demonstrated markedly different patterns in syphilis incidence. Japan has witnessed a significant upsurge in cases [5], whereas South Korea has experienced a relatively modest increase [6, 7]. This disparity between two geographically close countries raises fundamental questions about the factors contributing to these differing epidemiological patterns.

In this study, we analyzed the epidemiology of syphilis in Japan and South Korea over 9 years, from 2011 through 2019. This timeframe provided an opportunity to examine the extensive data sets available for both countries, allowing for a comprehensive analysis of epidemiological trends in syphilis. We aimed to elucidate the various factors contributing to the distinct incidence rates observed in these nations. By examining aspects such as public health policies and social behaviors, this research attempted to uncover the underlying dynamics shaping these trends.

Understanding these factors is crucial for developing more

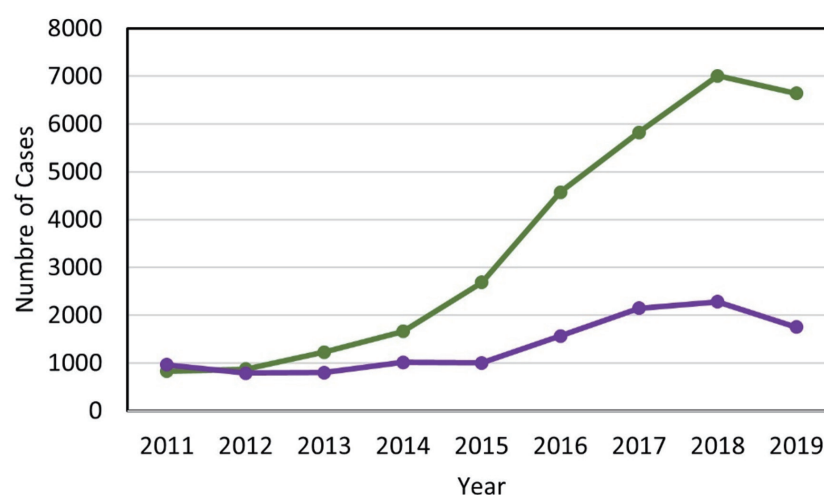


Figure 1. Trends in syphilis cases in Japan and South Korea from 2011 to 2019. Lines represent the number of reported cases in Japan (green) and South Korea (purple).

effective syphilis prevention and control strategies that are tailored to the specific needs and contexts of each country. The insights gained from this study are expected to contribute to the global body of knowledge on syphilis epidemiology and aid public health authorities in Japan and South Korea in formulating targeted interventions. By shedding light on the unique epidemiological characteristics of syphilis in these two countries, our research endeavors to pave the way for more effective and context-specific public health initiatives in the future.

Materials and Methods

We conducted a retrospective analysis of reported syphilis data in Japan and South Korea between 2011 and 2019. The Japanese data were sourced from the National Institute of Infectious Diseases, Infectious Disease Weekly Report (IDWR), which has a publicly accessible website [5]. The Korean syphilis data were obtained from the Korea Disease Control and Prevention Agency website [6] and the Korean Statistical Information Service [7]. These databases provided annual reports of syphilis cases, which was a mandatory reportable disease under the notifiable disease surveillance system during this period, thus ensuring the accuracy and completeness of the data. The population data for calculating the incidence rate was obtained from the websites of the statistical bureaus of Japan and South Korea [8, 9].

From 2020 onwards, South Korea reclassified syphilis as a sentinel surveillance disease, resulting in a limited approach to data collection. Therefore, this study was restricted to a comparative analysis up to and including 2019. The analysis focused on the annual incidence of syphilis infections categorized by gender and age group. Graphical representations to depict trends over time were created using Microsoft Excel [10]. All statistical analyses were performed with EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria) [11]. A P value of less than 0.05 was considered statistically significant.

Ethical declarations

This manuscript uses statistical data published by the government and does not include any identifiable individual information, making Institutional Review Board approval and ethical compliance with human subjects not applicable.

Results

An analysis of the incidence of syphilis in Japan and South Korea from 2011 to 2019 uncovered distinct trends (Figs. 1, 2a, b), with the data indicating a substantial increase in the number of syphilis patients within this timeframe. In Japan, a remarkable rise in cases was observed, with patient numbers increasing from 827 in 2011 to a peak of 7,007 in 2018, before declining slightly to 6,442 in 2019. This represents an eight-fold increase over the 9-year study period, as shown in Figure 1. Disaggregation of these data by gender (Fig. 2a) further revealed that the increase was more pronounced among women, whose numbers increased 12.74-fold (from 117 to 2,255), compared with men, who showed a 6.75-fold rise (from 650 to 4,387).

Conversely, in South Korea, the pattern was different, with a less dramatic increase in syphilis cases, with 965 cases in 2011 to a peak of 2,280 in 2018, and a subsequent decrease to 1,753 cases in 2019, resulting in an overall increase of 1.82 times (Fig. 1). Gender-specific data (Fig. 2b) indicated a sharp surge in the number of male patients by 3.45 times in 2018 (from 470 to 1,623), and 2.72 times in 2019 (from 470 to 1,278), while the number of female patients increased only marginally, peaking at 1.53 times in 2018 (from 495 to 657) and then, in 2019, declining to fewer than the number of cases counted in 2011 (from 495 to 475).

The incidence of syphilis, adjusted for population differences between Japan and South Korea, is illustrated in Figure 3. The incidence rate in Japan increased by 8.09 times, from

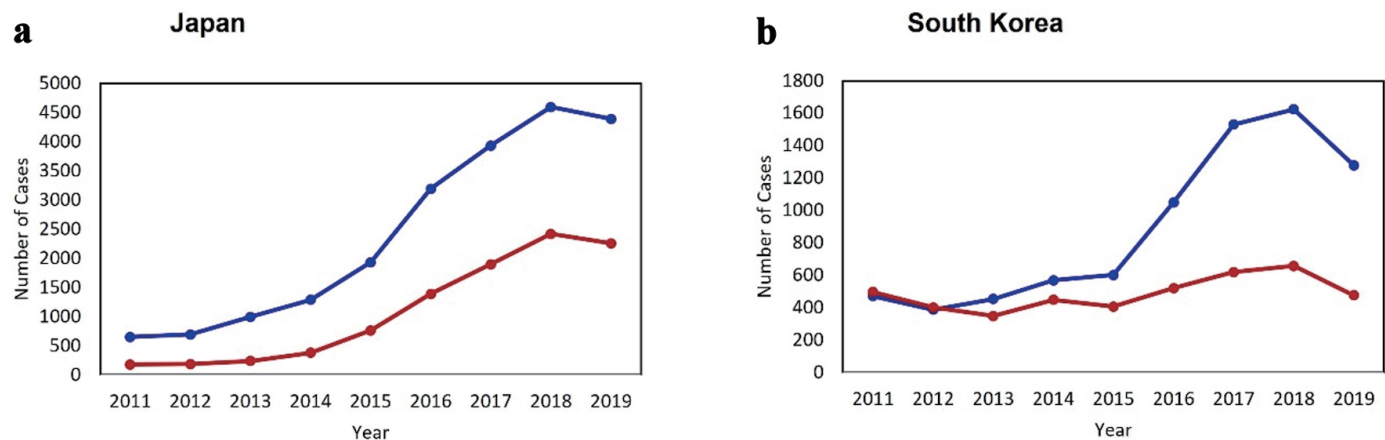


Figure 2. Trends in syphilis cases of male and female in Japan (a) and South Korea (b), from 2011 to 2019. Lines represent the number of reported cases of male (blue) and female (red) in both countries.

0.65 per 100,000 people in 2011 to 5.26 in 2019. Meanwhile, the incidence rate in South Korea started at a higher rate (1.93 in 2011) but increased by a smaller magnitude to 3.39 in 2019, which was 1.76 times higher than in 2011. A comparative analysis of the incidence rates between the two countries revealed that, while the incidence was initially 2.97 times higher in South Korea in 2011 (0.65 in Japan vs. 1.93 in South Korea), by 2019, Japan's incidence rate had surpassed South Korea's by 1.55 times (5.26 in Japan vs. 3.39 in South Korea).

The gender-specific incidence rates between Japan and South Korea (Fig. 4a, b) highlight drastic differences. The incidence rate among Japanese men substantially increased from 2015, whereas for South Korean men, the rate increased, but to a lesser extent (Fig. 4a). Specifically, the incidence rate for Japanese men increased 6.84 times (from 1.04 to 7.14), while for South Korean men, it increased 2.63 times (from 1.87 to 4.93). Consequently, the incidence rate ratio between Japanese and South Korean men increased 2.59-fold, from 0.56 in 2011 (1.04 in Japan vs. 1.87 in South Korea) to 1.45 in 2019 (7.14 in Japan vs. 4.93 in South Korea).

The incidence rates among Japanese women (Fig. 4b) were exceedingly low in 2011 but surpassed those in South Korea by 2016 and continued to climb through 2019. Specifically, the incidence rate increased 12.9 times during the study period (from 0.27 to 3.48), while for South Korean women, it slightly decreased by 0.92 times (from 1.99 to 1.84). Consequently, the incidence rate ratio between Japanese and South Korean women increased 14.54 times, from 0.13 in 2011 (0.27 in Japan vs. 1.99 in South Korea) to 1.89 in 2019 (3.48 in Japan vs. 1.84 in South Korea). These data indicate a pronounced disparity between the gender-specific incidence rates in both countries.

In Japan and South Korea, there are notable differences in the trends of female-to-male incidence rates for syphilis. Specifically, Japan experienced an increase in this ratio, rising from 0.26 in 2011 to 0.49 in 2019, which corresponds to an increase of 1.88 times. In contrast, South Korea saw a sharp decline in the ratio, decreasing from 1.06 in 2011 to 0.37 in 2019, representing a decrease of 2.86 times. These trends are illustrated here (Supplementary Material 1, cii.elmerpub.com), highlighting the contrasting gender dynamics in the prevalence

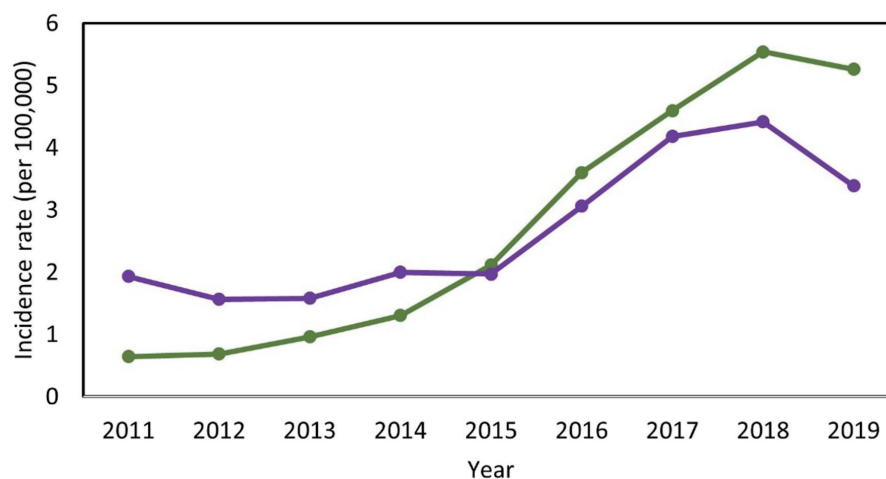


Figure 3. Trends in syphilis incidence rate of Japan and South Korea (2011 - 2019). Lines represent incidence rate of Japan (green) and South Korea (purple).

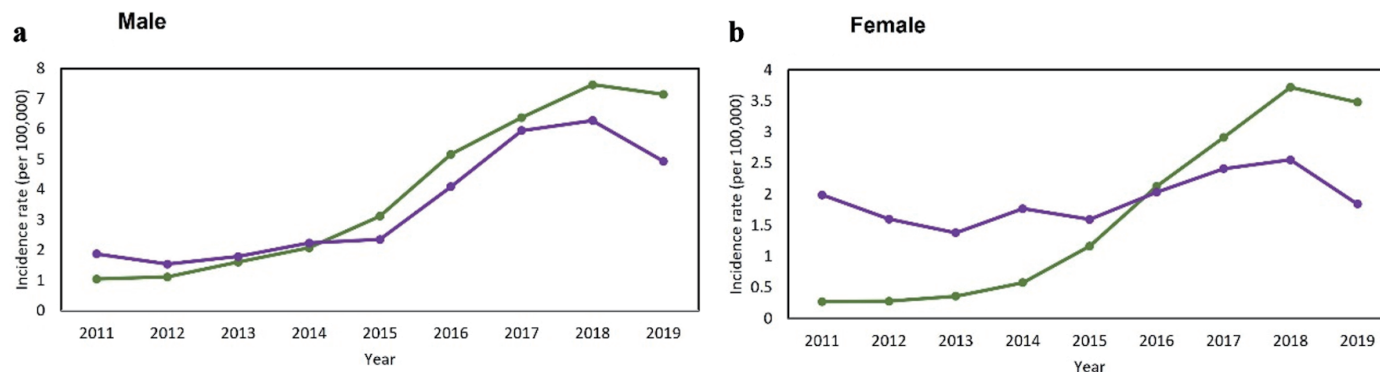


Figure 4. Trends in syphilis incidence rate of male and female in Japan (a) and South Korea (b) (2011 - 2019). Lines represent the number of reported cases of Japan (green) and South Korea (purple).

of syphilis among patients in the two countries.

An age-specific analysis of male patients in Japan (Fig. 5) suggests that young and middle-aged men, particularly those aged 20 - 49 years, were most affected by syphilis during the study period and increased significantly ($P < 0.05$), with a significant spike in 2015. Older age groups showed a gradual but consistent upward trend, although the absolute number of cases remained lower compared with younger groups. In South Korea (Fig. 6), the most notable rise was seen in the 20 - 29 age group ($P < 0.05$), followed by the 30 - 39 age group ($P < 0.05$). A significant peak was observed in 2016, and the incidence remained considerably high compared with other age groups. In 2019, syphilis cases slightly decreased in nearly all age groups for men in Japan and South Korea.

Figure 7 illustrates the trends in age-specific syphilis cases among women in Japan during the study period. The number of cases consistently increased from 2011 to 2019, with the most significant growth occurring in the 20 - 29 age group ($P < 0.05$), highlighting a substantial infection prevalence among younger generations. Overall, there was a clear upward trend in the number of syphilis cases, particularly between 2011 and 2018. Beyond the 20 - 29 age group, the number of cases progressively decreased in individuals in their 30s and 40s, with fewer cases reported in older age groups. One notable feature was the sharp increase in the number of patients aged 70 and over since 2016, a trend not observed in the 60 - 69 age group.

As shown in Figure 8, women in South Korea also experienced the highest incidence of infection in the 20 - 29 age

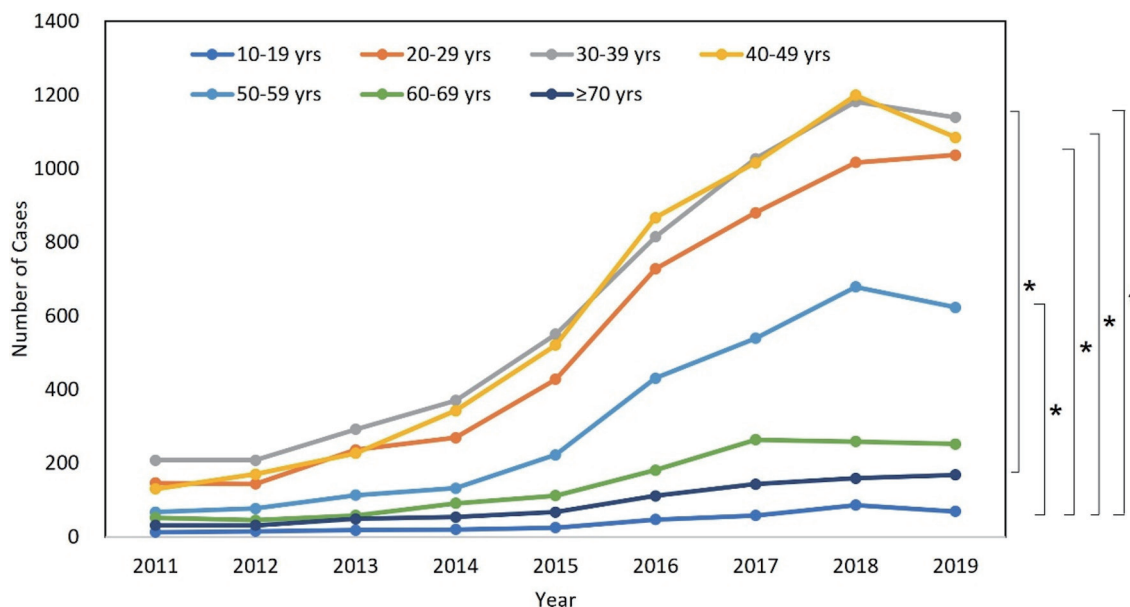


Figure 5. Trends in age-specific syphilis cases of male in Japan (2011 - 2019). The number of syphilis cases for each year is shown for different age groups. The statistical analysis was performed with Kruskal-Wallis test for a global assessment among the age-specific groups, followed by Bonferroni-adjusted pairwise comparisons, with a P value of 0.05 as the significance level. There were significant differences between 10 - 19 years and 20 - 29 years ($P = 0.001$), 10 - 19 years and 30 - 39 years ($P = 0.009$), 10 - 19 years and 40 - 49 years ($P = 0.001$), 10 - 19 years and 50 - 59 years ($P = 0.006$), and 30 - 39 years and ≥ 70 years ($P = 0.009$). The asterisks indicate the significant intergroup difference with the P value of less than 0.05. yrs: years.

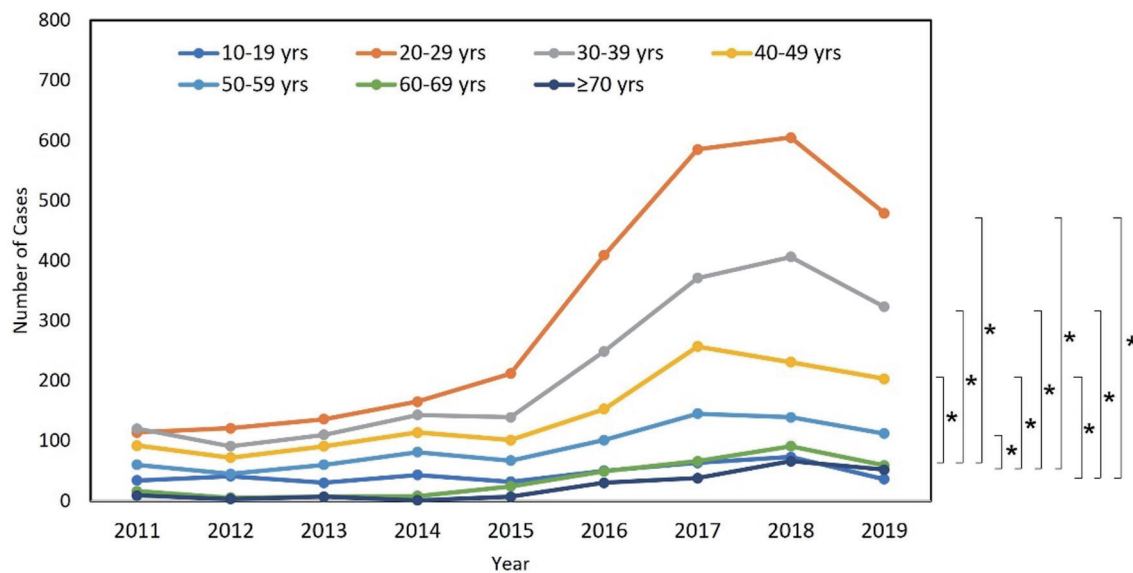


Figure 6. Trends in age-specific syphilis cases of male in South Korea (2011 - 2019). The number of syphilis cases for each year is shown for different age groups. The statistical analysis was performed with Kruskal-Wallis test for a global assessment among the age-specific groups, followed by Bonferroni-adjusted pairwise comparisons, with a P value of 0.05 as the significance level. There were significant differences between 10 - 19 years and 20 - 29 years ($P = 0.001$), 10 - 19 years and 30 - 39 years ($P = 0.001$), 10 - 19 years and 40 - 49 years ($P = 0.002$), 20 - 29 years and 60 - 69 years ($P = 0.001$), 20 - 29 years and ≥ 70 years ($P = 0.009$), 30 - 39 years and 60 - 69 years ($P = 0.01$), 30 - 39 years and ≥ 70 years ($P = 0.009$), 40 - 49 years and 60 - 69 years ($P = 0.01$), 40 - 49 years and ≥ 70 years ($P = 0.009$), and 50 - 59 years and ≥ 70 years ($P = 0.03$). The asterisks indicate the significant intergroup difference with the P value of less than 0.05. yrs: years.

group, similar to the trend in Japan. However, the age distribution of cases remained relatively stable compared with Japan. One remarkable difference with Japan was the rapid increase in the number of patients with syphilis in the 60 - 69 age group,

similar to the trend seen in those aged 70 and over.

The incidence of congenital syphilis, as shown in Figure 9, demonstrates a stark contrast between the two countries, with Japan experiencing an increase and South Korea experienc-

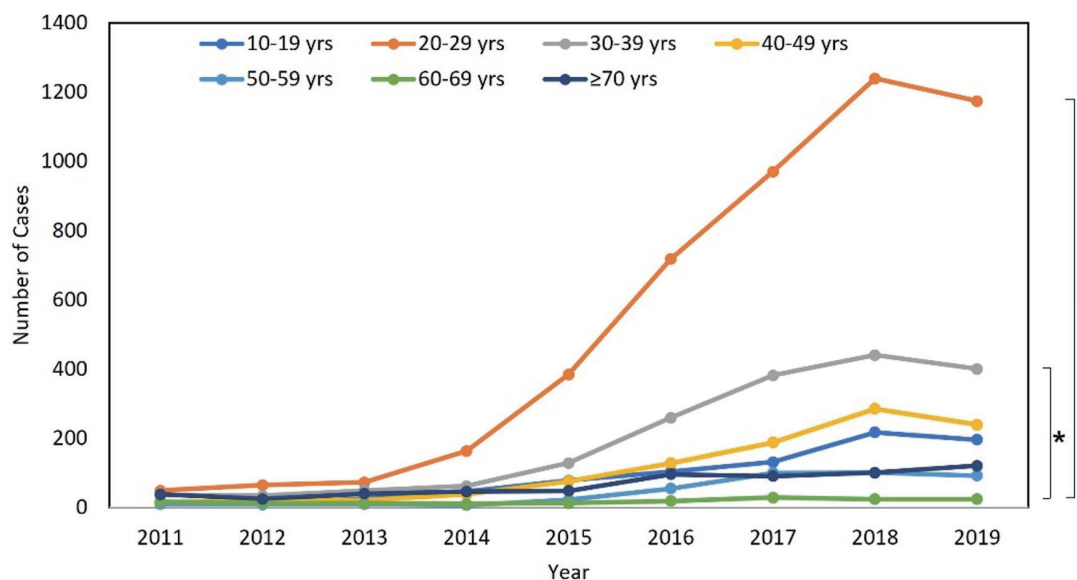


Figure 7. Trends in age-specific syphilis cases of female in Japan (2011 - 2019). The number of syphilis cases for each year is shown for different age groups. The statistical analysis was performed with Kruskal-Wallis test for a global assessment among the age-specific groups, followed by Bonferroni-adjusted pairwise comparisons, with a P value of 0.05 as the significance level. There were significant differences between 20 - 29 years and 60 - 69 years ($P = 0.009$), and 30 - 39 years and 60 - 69 years ($P = 0.009$). The asterisks indicate the significant intergroup difference with the P value of less than 0.05. yrs: years.

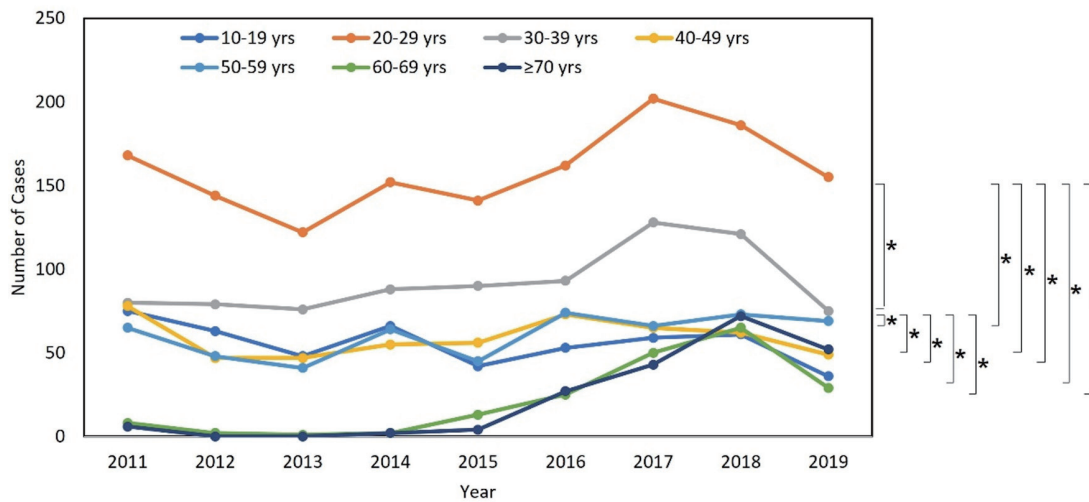


Figure 8. Trends in age-specific syphilis cases of female in South Korea (2011 - 2019). The number of syphilis cases for each year is shown for different age groups. The statistical analysis was performed with Kruskal-Wallis test for a global assessment among the age-specific groups, followed by Bonferroni-adjusted pairwise comparisons, with a P value of 0.05 as the significance level. There were significant differences between 10 - 19 years and 20 - 29 years ($P = 0.001$), 10 - 19 years and 30 - 39 years ($P = 0.01$), 20 - 29 years and 30 - 39 years ($P = 0.002$), 20 - 29 years and 40 - 49 years ($P = 0.009$), 20 - 29 years and 50 - 59 years ($P = 0.001$), 20 - 29 years and 60 - 69 years ($P = 0.009$), 20 - 29 years and ≥ 70 years ($P = 0.009$), 30 - 39 years and 40 - 49 years ($P = 0.02$), 30 - 39 years and 50 - 59 years ($P = 0.001$), 30 - 39 years and 60 - 69 years ($P = 0.009$), and 30 - 39 years and ≥ 70 years ($P = 0.009$). The asterisks indicate the significant intergroup difference with the P value of less than 0.05. yrs: years.

ing a decrease in cases over the study period. The number of congenital syphilis cases in Japan increased 3.83 times (from 6 in 2011 to 23 in 2019), while in South Korea, it decreased 1.7 times (from 40 in 2011 to 23 in 2019).

Discussion

This epidemiological study of syphilis in Japan and South Korea from 2011 through 2019 has uncovered critical dis-

parities and distinct epidemiological patterns. The substantial rise in syphilis cases in Japan, particularly among women and younger age groups, contrasts with the more modest increases in South Korea. This disparity raises important questions about the underlying factors influencing these trends.

In Japan, the nearly eight-fold increase in syphilis cases over the 9-year study period, especially among women, is alarming. This trend may be attributed to several factors, including changes in sexual behavior, increased public awareness leading to more testing, and possibly improved diagnostic

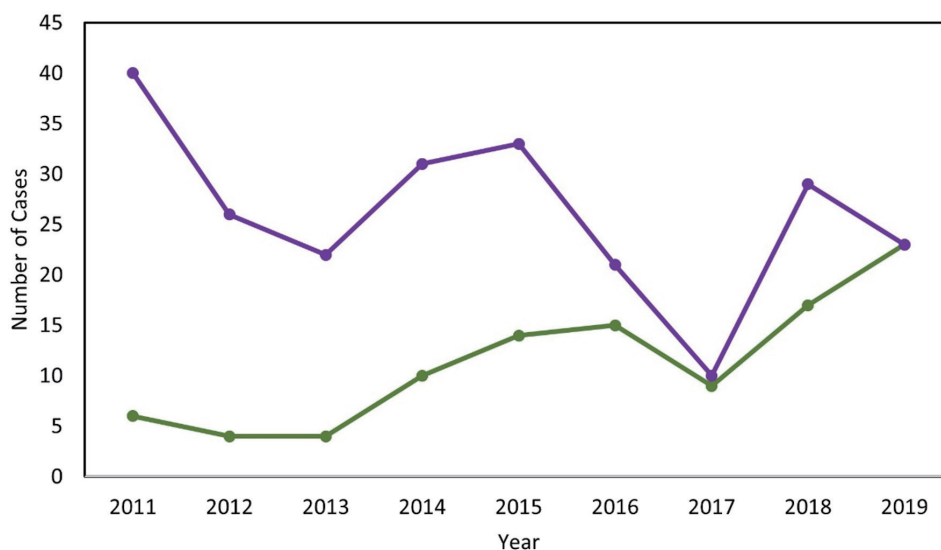


Figure 9. Trends in congenital syphilis cases in Japan and South Korea (2011 - 2019). Lines represent number of cases of Japan (green) and South Korea (purple).

capabilities. The substantial rise in infections among younger women, especially in their 10s and 20s, suggests shifts in sexual practices or a lack of awareness about STIs within this demographic. It is crucial to understand the underlying factors contributing to this increase, such as changes in sexual practices, the impact of online dating and social media, and potential barriers to accessing sexual health services. For instance, it has been reported that the penetration rate of dating apps was significantly associated with the incidence of syphilis in Japan [12]. Thus, the proliferation of social media is a potential contributing factor to the resurgence of syphilis. The implementation of more targeted educational programs focusing on sexual health and safe practices may be necessary to address this trend.

In contrast, in South Korea, the increase was primarily among men in younger age groups, suggesting different societal or behavioral factors at play. This could be related to cultural differences in sexual practices, healthcare access, or the varying effectiveness of public health campaigns between the two countries. Recently, there has been a trend toward the erosion of traditional ethical values, but South Koreans are more conservative than the Japanese, and the influence of women being more sexually conservative than men is possibly affecting this trend. Additionally, the decline in cases among young women in South Korea might be attributed to successful educational campaigns and public health strategies that have effectively reached this demographic. Mandatory and regular health checkups for sex workers [13] may also be a contributing factor to the decrease in syphilis infection rates among women. However, the rise in older age groups suggests a potential oversight in targeting these groups with effective prevention and education programs. This highlights the need for a multifaceted approach in public health strategies - one that caters to different age groups with tailored messages and interventions.

The divergent trends in congenital syphilis between Japan and South Korea are also noteworthy. The increase in Japan might be linked to the overall rise in syphilis cases among women of reproductive age, emphasizing the need for improved prenatal screening and public health messaging targeting this group. In contrast, the decrease in South Korea could be indicative of better prenatal care and screening practices, although the exact reasons require more in-depth analysis. Both Japan and South Korea have implemented public screenings for syphilis in pregnant women, and free testing is available for other individuals as well [14, 15]. However, South Korea also promotes and conducts free pre-pregnancy testing, including a syphilis test for couples planning to conceive [16]. This proactive approach to reproductive health may have contributed not only to the reduction of congenital syphilis, but also to the prevention of syphilis among young people.

The study also highlights the importance of continuous surveillance and the adaptation of public health strategies to address the evolving nature of syphilis epidemiology. In South Korea, comprehensive surveillance of syphilis cases was discontinued in 2020, shifting to a sample-based survey method. This change hindered the detailed tracking of syphilis infection trends, particularly during periods when international travel was restricted due to the coronavirus disease 2019 (COVID-19) pandemic. Consequently, it became challenging

to evaluate the effect of these travel restrictions on syphilis transmission.

In contrast, Japan continued its comprehensive surveillance of syphilis cases, allowing for an accurate assessment of the infection trends during the pandemic. In 2020, Japan recorded 5,872 syphilis cases, showing a slight decrease from 6,641 cases reported in 2019, before any travel restrictions were implemented. However, the number of cases surged to 7,983 in 2021, 13,228 in 2022, and further to 15,092 in 2023 [5]. This rapid surge, despite the reduced entry of foreign nationals due to COVID-19, strongly suggests that domestic transmission has now become the predominant mode of syphilis spread in Japan.

Previously, there have been reports linking the rise in syphilis cases in Japan to the increase in inbound tourism [17], with international travelers being more susceptible to STIs due to their tendency to engage in unprotected intercourse [18]. International travel is considered a risk factor for STIs because of factors such as heightened sexual opportunities, a sense of freedom, and the allure of the sex industry [19]. Studies have shown that the risk of contracting STIs can increase up to threefold during international travel [18], particularly for those traveling to high-risk regions such as Southeast Asia [19, 20].

However, the significant rise in syphilis cases during the period of restricted international travel, when inbound tourism was virtually halted, indicates that syphilis transmission within Japan is occurring independently of foreign visitors. This observation underscores the need to focus on domestic factors driving the spread of syphilis and to address local transmission dynamics in addition to imported cases.

Fortunately, South Korea plans to resume comprehensive surveillance in 2024 [21]. This will enable a detailed comparison of infection trends between the two countries, particularly following the resumption of international travel post-pandemic. Such comparisons will provide valuable insights into the dynamics of syphilis transmission and the effectiveness of public health interventions in both nations, enabling each to develop targeted public health strategies based on the findings.

Based on the results of our study, Japan's situation calls for an urgent reassessment of current preventive measures, particularly those targeting young women. South Korea's relatively stable trend, despite the global resurgence of syphilis, suggests that their current approaches may be more effective, or at least more stable, in managing this infection. More in-depth investigations into the differences in public health infrastructure, accessibility to healthcare, societal norms regarding sexual health, and the effectiveness of health communication strategies could provide valuable insights into developing more effective and culturally sensitive syphilis control strategies.

Conclusions

The contrasting epidemiological trends of syphilis in Japan and South Korea underscore the need for country-specific public health strategies. The unique challenges faced by each country, such as the notable increase among young women in Japan and the predominantly male cases in older age groups in South Ko-

rea, call for tailored approaches. This includes not only medical interventions, but also educational campaigns, behavioral research, and societal changes needed to effectively combat the spread of syphilis. Further research into the specific causes behind these trends is essential for developing more effective and targeted public health policies in the future.

Supplementary Material

Suppl 1. Trends in the ratio of female-to-male syphilis incidence rates in Japan and South Korea (2011 - 2019).

Acknowledgments

None to declare.

Financial Disclosure

No funding was received for this report.

Conflict of Interest

The authors declare that they have no competing interest.

Informed Consent

As this study does not use personal data, informed consent is not required.

Author Contributions

Lee contributed to the design of the study and writing the paper. Komatsu contributed to data collection and analysis. All authors read and approved the final manuscript.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Abbreviations

IDWR: Infectious Disease Weekly Report; STIs: sexually transmitted infections

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