National data analysis and systematic review for human resources for cervical cancer screening in Japan: Who should take Pap smears for cervical cancer screening?

Chisato Hamashima (chamashi@med.teikyo-u.ac.jp)
https://orcid.org/0000-0003-2585-8479

Seiju Sasaki
St.Luke's International Hospital

Keika Hoshi
National Institute of Public Health

Satoyo Hosono
Nagoya City University

Takafumi Katayama
Hyogo Prefecture University

Teruhiko Terasawa
Fujita Medical University

Research article

Keywords: Cervical cancer, Cancer screening, Human resources, Gynecologist, Pap smear

Posted Date: March 3rd, 2020

DOI: https://doi.org/10.21203/rs.3.rs-15711/v1

Abstract

Background: Although cervical cancer screening has been performed as a national program since 1983 in Japan, taking Pap smears from the cervix has usually been performed by gynecologists and obstetricians in their offices. Conventionally, general physicians and midwives cannot take Pap smears of cervical cancer screening in Japan. Accessibility is one of the important factors to consider when planning to increase the participation rate in cancer screening programs. Gynecologists also play a primary role in the diagnosis and treatment of cervical cancers. Discussions regarding the needed human resources for cancer screening programs have remained scared in Japan.

Methods: We examined the number of gynecologists and obstetricians based on a national survey. Candidate literature was searched using Ovid-MEDLINE and Ichushi-Web until the end of January 2019. Then, a systematic review regarding accessibility to cervical cancer screening was performed. The results of the selected articles were summarized in the tables.

Results: Although the total number of all physicians in Japan increased from 1996 to 2016, the proportion of gynecologists and obstetricians has remained at approximately 5% over the last 2 decades. However, 43.6% of municipalities have no gynecologists and obstetricians in 2016. Five articles identified from Ovid-MEDLINE and Ichushi-Web were eligible and assessed. Two Japanese studies showed consistent results regarding the association of resources as gynecologists and obstetricians with participation rates in cervical cancer screening. Another article reported on the national distribution of gynecological oncologists and compared the treatment outcomes between hospitals with and without certified gynecologists. The number of certified gynecological oncologists has remained insufficient with a biased distribution. Thus, the survival rate of cervical cancer patients was different between hospitals with and without accreditation by academic society. Although the perspectives of selected articles were different, the results suggested the burden to access to cervical cancer screening and consequent diagnosis and treatment.

Conclusions: The human resources for taking Pap smears for cervical cancer screening has remained insufficient with a huge disparity among municipalities in Japan. Enabling general physicians to take Pap smears or the introduction of self-sampling HPV testing may be considered to augment the limited access to cervical cancer screening.

Background

Cervical cancer screening has commonly performed worldwide because of the heavy burden of the disease. Although the mortality from cervical cancer has decreased and has subsequently flattened in Japan, the incidence of cervical cancer has slightly increased over the last decade [1]. In 2017, the age-standardized incidence by world population was 11.7 (/100,000) and age-standardized mortality was 2.2 (/100,000) [1]. Similar trends of mortality from cervical cancer have been observed in developed countries [2]. Incidentally, most of these developed countries have established national programs for cervical cancer screening and have maintained high participation rates [3]. In contrast, although cervical cancer screening has been performed as a national program in Japan since 1983 [4], the participation rate has remained lower than those of other developed countries [5].

In Japan, the instituted cancer control plan has helped to achieve about 50% of the goals of cancer screening programs [6]. Since then, the national average participation rate of cervical cancer screening in communities has gradually increased, although it has remained around 20% [7]. Even if the participants in opportunistic screening were added, the participation rate was still under 50% [1]. Although sending invitation letters to the target population for the cancer screening program is a basic requirement across countries [8], there is, unfortunately, no national registry in Japan at present. Local municipalities have encouraged their constituents to participate in cancer screening through several promotion strategies such as sending invitation letters and conducting awareness campaigns using posters and leaflets [9]. These promotion strategies have been used nationwide. However, their effects have been limited to a temporal increase but not a continuous increase. Moreover, a low participation rate has been a common problem for all cancer screenings. In addition, the low participation rate in diagnostic examinations using colposcopy has been a serious problem in cervical cancer screening in Japan [1].

Since the introduction of cervical cancer screening in Japan, taking Pap smears from the cervix has usually been performed by gynecologists and obstetricians mainly in their consultation offices. If gynecologists and obstetricians were not available in local municipalities, cervical cancer screening opportunities have usually been provided by mobile gynecological clinics. Conventionally, general physicians and midwives cannot take Pap smears of cervical cancer screening. Gynecologists also play a primary role in the diagnosis and treatment of cervical cancers. However, in rural areas in Japan, the insufficient number of clinical physicians, particularly gynecologists and obstetricians, has become a social problem [10]. Accessibility is one of the important factors to consider when planning to increase the participation rate in cancer screening programs [11]. On the other hand, discussions regarding the needed resources for cancer screening programs have remained scared in Japan.

To clarify the burden of accessibility to cervical cancer screening, we examined and analyzed disparity of the number of gynecologists among prefectures based on a national survey. In addition, we performed a systematic review to clarify the current status of accessibility to cervical cancer screening and its subsequent diagnosis and treatment in Japan.

Methods

National data analysis of numbers of gynecologists as human resources

The Japanese government conducts a national survey every 2 years to determine the number of physicians, dentists, and pharmacists who work in Japan as well as their actual working conditions [12]. The information obtained for physicians includes their main specialty, medical working facilities, and their working locations. The current status of human resources for cervical cancer screening was also clarified by determining the number of gynecologists and obstetricians from the above-mentioned national survey. Obstetricians were included as human resources for cervical cancer screening because their roles

have been nearly equal to those of gynecologists in local areas. First, the trend of the number of all physicians, gynecologists, and obstetricians per 100,000 population was observed from 2000 to 2016. Second, the number of gynecologists and obstetricians per 100,000 women in 2016 was recalculated using the resident registered population in 2016 as denominators [13]. The denominator was limited to women aged 20–69 years which was an actual target group for cervical cancer screening. The results were compared among the 47 prefectures. Finally, the numbers of municipalities without gynecologists and obstetricians were calculated and compared the results were compared among the 47 prefectures.

Systematic review

To identify the involved human resources and their impact on cervical cancer screening, diagnosis, and treatments in Japan, we selected articles that included any of the following issues and grouped them into 3 categories: 1) association between municipalities with and without gynecologists and participation rates in cervical cancer screening, 2) distribution of special hospitals with certified gynecological oncologists, and 3) comparison of treatment results (survival rate) with and without certified gynecologists.

We searched articles that may fall under the above-mentioned 3 categories using Ovid-MEDLINE and Ichushi-Web (Igaku Chuo Zasshi). The search terms mainly used were ‘uterine cervical neoplasms’, ‘uterine cervical dysplasia’, ‘gynecologist’, ‘oncologist’, ‘specialty’, ‘physician’, ‘family practice’ or ‘Japan’ until the end of 2018 for Ovid-MEDLINE and until the end of January 2019 for Ichushi-Web. The detailed information for making the searches on Ovid-MEDLINE (Supplements. Doc. S1) and Ichushi-Web (Supplements. Doc. S2) is described in the Supplementary file. The languages of the article included were only English and Japanese because the main topic was limited to the Japanese context. Original articles published after peer-review were included, whereas guidelines, evidence reports, conference proceedings, and abstracts were excluded.

To select the appropriate evidence for our research questions, we performed a two-stage review: the title and abstract were initially checked, and the selected full-text articles were subsequently reviewed. For the initial step, articles without an abstract were excluded. Two reviewers screened the abstracts and titles individually and subsequently reviewed the full texts of potentially relevant studies. If the decision for the full paper review was inconsistent, the appropriateness of these studies was carefully discussed at the meetings. For the final step, adequate studies were selected and divided into 3 categories. The main results of the selected articles were described in summary tables divided into the above-mentioned 3 categories.

Results

Human resources for cervical cancer screening

From 1996 to 2016, the total number of all physicians increased; however, for two decades, the proportion of gynecologists and obstetricians has remained at approximately 5% (Fig. 1) [12]. Although the numbers of gynecologists and obstetricians decreased until 2006, these numbers have recovered recently. In 2016, the total numbers of all physicians were 240.1 (/100,000 population) and 10.4 (/100,000 population) for gynecologists and obstetricians, respectively [12]. However, only16 prefectures exceeded the national average of gynecologists and obstetricians in 2016 (Fig. 2). The numbers of gynecologists and obstetricians were higher in western Japan than in eastern Japan. Even if the prefecture average exceeded the national average, there were still municipalities that had no gynecologists and obstetricians (Fig. 3). There were 43.6% municipalities with gynecologists and obstetricians who did not work in local medical facilities [12]. Although Tokyo had the highest number of gynecologists and obstetricians among the prefectures, 10 out of 62 municipalities were without gynecologists and obstetricians. In Hokkaido, the proportion of municipalities without gynecologists and obstetricians was 76.2%.

Literature Search

The total number of articles identified from the literature search using Ovid- MEDLINE and Ichushi-Web was 3,664 articles (Fig. 4). After a two-stage review, 4 English articles and 1 Japanese article were selected. From these 5 articles, the association between human resources and participation rates in cervical cancer screening was examined in 2 articles (Table 1). One article reported on the national distribution of gynecologists (Table 2). Two articles analyzed the treatment results between the hospitals with and without certified gynecologists.

Table 1
Association of the number with gynecologists and participation rate in cervical cancer screening

Authors	Year published	Target region	Number of municipalities	Number of gynecologists	Participation rate	Results	Association of number of gynecologists with participation rate in cervical cancer screening
Morimura Y, et al. [14]	2007	Fukushima Prefecture	64	Unclear	Collaboration municipalities (36) 6.49% Non-Collaboration municipalities (28) 3.92%	The participation rate of municipalities collaborating with neighboring municipalities was significantly higher than that of municipalities not collaborating with neighboring municipalities ($p < 0.01$).	Positive
Sano H, et al. [15]	2017	All Japan	1469	0.151(/1000 women)	60.6%	The marginal effect of the number of gynecologists per 1,000 women was significantly positive in all municipalities (2.54 percent points) and rural municipalities (3.68 percent points).	Positive

Table 2
Summary of the studies related to certified gynecologists and hospitals

Authors	Year published	Target region	Certification	Certification number (year)	Outcomes	Results
Fujii T [16]	2015	All Japan	Gynecological oncologists	720 (2012)	Regional distribution certified gynecologists	There was a huge disparity in the medical facilities with certified gynecologists who regularly worked in the facilities.
Mikami M, et al. [17]	2018	All Japan	Hospitals	119 (2006)	Survival rate (2500 days)	The survival rates of cervical cancer patients in 2500 days after their initial treatments were significantly higher in the JSGO-accredited hospitals than non -accredited hospitals (73.3% vs 68.7%, $p < 0.01$).
Yagi A, et al. [18]	2019	All Japan	Hospitals	147(2010)	5-year survival rate	The 5-year survival rates were higher in hospitals with 2-or more gynecological oncologists than those with 0 or 1 gynecological oncologists (79.0% vs 75.4%, $p < 0.01$).
JSGO: Japan Society of Gynecologic Oncology						

Association of human resources with participation rates in cervical cancer screening

One article analyzed the association of human resources with participation rates among the municipalities in Fukushima prefecture, and another study used the national data (Table 1). Morimura et al. compared the participation rates in 2 types of municipalities: those that allowed only cervical cancer screening in their own municipalities and those that permitted collaboration with neighboring municipalities that had medical facilities with gynecologists. In the latter municipalities, the opportunities for cervical cancer screening were increased [14]. Moreover, the participation rate was significantly higher in the latter municipalities than in the former municipalities (6.5% vs 3.9%, $p < 0.01$). In addition, when the periods for cervical cancer screening extended, a significant increase in the participation rate was observed (correlation = 0.322, $p < 0.01$). Sano et al. reported the association of the participation rate with the number of gynecologists [15]. Marginal effects were observed in that the participation rate was significantly increased by only 2.54 percent points in all municipalities when 1 gynecologist was available per an increase of 1,000 women. These marginal effects were emphasized in rural municipalities, and an increase of 3.68 percent points was expected under the same condition.

Treatment results and certified gynecological oncologists

To improve treatment results and provide high-quality diagnosis and treatment, the Japan Society of Gynecologic Oncology (JSGO) has developed programs and accredited gynecological oncologist experts mainly based on their operative experiences [15]. JSGO has also accredited hospitals in which certified gynecological oncologists regularly work [16].

Two articles reported the difference of survival rates with and without gynecological oncologists (Table 2). Mikami et al. reported the treatment results of accredited hospitals. The survival rates of cervical cancer patients 2,500 days after their initial treatments were significantly higher in the JSGO-accredited hospitals than in the JSGO-nonaccredited hospitals (73.3% vs 68.7%, $p < 0.01$) [17]. Yagi et al. also reported similar results of the 5-year survival rates among hospitals that had a different number of gynecological oncologists [18].

Despite the nationwide distribution of gynecologic oncologists in Japan, their number has remained insufficient in most prefectures [16]. If the gynecologists were restricted to certified gynecologists, there was a huge disparity in accessing high-quality treatment for cervical cancer. There were only 4 leading

prefectures with 1.4 to 2.0 certified gynecologists per 100,000 women, namely, Toyama, Nara, Tottori, and Fukuoka. Most prefectures had less than 0.7 certified gynecologists per 100,000 women. This insufficient number of gynecologists was shown in the national survey by academic society, which became a barrier to verifying the effects of cervical cancer screening.

Discussion

Since the announcement of the cancer control plan to increase the participation rate in cancer screening programs by the Japanese government [6], various promotion strategies including sending invitation letters and conducting awareness campaigns have been attempted [9, 19]. Although these strategies have been implemented nationwide, they had sadly not achieved the goal of increasing the participation rate to date. In the new WHO screening criteria, accessibility is defined as one of the basic requirements to maintain equity for the target population [11]. However, in Japan, there has been insufficient discussion regarding the resources for cancer screening programs at the introduction of new techniques except for endoscopic screening for gastric cancer [20]. In the U.S. and European countries, the capacity of colonoscopy has been investigated since the introduction of colorectal cancer screening using fecal blood occult testing and total colonoscopy [21–26]. The required numbers were estimated based on the model when the participation rate increased in colorectal cancer screening [25, 26]. From the national survey in Japan, the number of gynecologists and obstetricians has not increased sufficiently despite the increase in the number of all physicians. Also, there are huge disparities in terms of access to gynecologists and obstetricians between urban and rural areas. Two Japanese studies have reported consistent results regarding the association of human resources such as gynecologists and obstetricians with participation rates in cervical cancer screening [14, 15]. Taken together, to significantly improve the participation rate, it is crucial to reconsider how to secure human resources for cervical cancer screening from different perspectives other than promotion strategies alone.

Gynecologists are expected to take the primary role in making a diagnosis and planning the treatment during cervical cancer because of their special knowledge and techniques. Indeed, gynecologists have broad roles from screening to treatment. Unfortunately, their number has remained insufficient to fill each critical role. Cervical cancer screening methods are usually simple, and physicians can perform them regardless of their expertise. Taking Pap smears has been traditionally limited to gynecologists and obstetricians since the introduction of cervical cancer screening in Japan. In actuality, mobile clinics have been very useful in compensating for the insufficient opportunities for cervical cancer screening. However, even mobile clinics have become insufficient, particularly in rural areas. Besides, the number of certified gynecological oncologists has also remained insufficient, and their distribution has been biased [16]. As a result, the survival rates of patients with cervical cancer have been different between JSGO-accredited hospitals and JSGO-nonaccredited hospitals [17]. Based on the recent trend, a rapid increase in the number of gynecologists cannot be expected.

To increase the participation rate and improve treatment results, sharing various screening works with other health professionals, particularly taking Pap smears, should be considered in Japan. In several countries, medical systems that permit general physicians and midwives to take Pap smears for cervical cancer screening are now seeing the benefit [27–31]. These systems can help improve access to cancer screening programs, although they can also serve as a barrier to referring abnormal results to gynecologists. In Sweden, midwives have the responsibility of taking Pap smears during cervical cancer screening and of simultaneously conducting consultations on health problems [29]. In the U.S., most primary care physicians provide Pap tests to their patients following the specified guidelines [27]. However, although family and general physicians were more likely to follow the specified guidelines used by gynecologists [26], some nonexpert physicians feel that there are some barriers in accurately taking Pap smears, such as the lack of a training system [30]. Similar problems have been suggested in studies conducted in European countries [28, 29, 31]. On the other hand, even if general physicians have no constraint in taking Pap smears, they often hesitate to perform them because they believe that women are better served if Pap smears are taken by gynecologists [30, 31]. Although sharing the screening work with general physicians in rural areas might be one of the solutions to improve accessibility to cervical cancer screening in Japan, training programs and management guidelines are crucially needed.

Interestingly, recent studies have reported that self-sampling HPV testing is a useful approach to increasing the participation rate [32]. Also, the sensitivity and specificity of self-sampling HPV testing are nearly equal to those of a clinician performing the HPV testing [32–34]. Some countries have already introduced self-sampling HPV testing for non-attenders [35, 37]. It is also used in low-resource areas with poor access to screening services [38]. The introduction of self-sampling HPV testing can be a viable option for reducing the workload of gynecologists in taking Pap smears. Besides, self-sampling HPV testing can also be adopted in rural areas without gynecologists and obstetricians in Japan.

There are some limitations to this study. First, the literature search was limited to English and Japanese literature. Second, the information regarding human resources for cervical cancer screening is insufficient. We selected the articles only, and there is publication bias. This information might be included in the conference abstracts or other reports. Finally, the analysis of human resources based on the national survey was a descriptive study. To clarify the appropriate supply of cervical cancer screening, the demands in local areas should be investigated.

Conclusions

To date, there has been a huge deficiently and disparity in human resources for taking Pap smears for cervical cancer screening in Japan. Enabling general physicians to take Pap smears and introduction of self-sampling HPV testing are viable options that can be considered to augment the limited access to cervical cancer screening in rural areas. In the series of medical procedures from screening to diagnosis and treatment, division of roles and collaboration with general physicians should be considered for the efficient use of limited resources for cervical cancer screening. To improve disparity in the accessibility to cervical cancer screening, a further study including capacity estimation based on the local demand is warranted.

Abbreviations

HPV:human papillomavirus, Pap smear:Papanicolaou smear, JSGO:Japan Society of Gynecologic Oncology, WHO:World Health Organization,

Declarations

Ethics approval and consent to participate

This information was not included personal information. Based on the Japanese guidelines for epidemiological studies developed by the national government, in the present study, secondary data from the national database were used, thus informed consent was waived.

Consent publication

Not applicable.

Availability of data and materials

Not applicable.

This study used national databases which are indicated below.

Ministry of Health, Labour and Welfare. Survey of Physicians, Dentists, and Pharmacists [https://www.e-stat.go.jp/]. Accessed 1 Apr 2019.

Competing interests

The authors declare that they have no competing interests.

Funding

This study was supported by the National Cancer Center, Tokyo, Japan (Grant numbers: 29-A-16). This study is a part of a systematic review of cervical cancer screening guidelines published by the National Cancer Center. The funder had no role in the conceptualization of the study design, data collection, and analysis, decision to publish, or preparation of the manuscript.

Authors' contributions

CH designed the study. KH performed literature searches and summarized the search terms. CH, SS, KH, SH, TK, and TT performed a systematic review. CH conducted a statistical analysis of the data. CH and SS wrote and made critical revisions to the article. All authors read and approved the final manuscript.

Acknowledgments

We appreciate Dr. Tomio Nakayama, National Cancer Center for giving helpful comments and support for the systematic review.

We are grateful to Dr. Edward F. Barroga (http://orcid.org/0000-0002-8920-2607), Medical Editor and Professor of Academic Writing at St. Luke's International University for the editorial review of the manuscript.

We also thank Ms. Kanoko Matsushima, Ms. Yumiko Nakagawa and Ms. Junko Asai for research assistant work.

References

1. National Cancer Center: Center for Cancer Control and Information Services. https://ganjoho.jp/public/index.html (2019). Accessed 7 May 2019.
2. GLOBOCAN 2012, Estimated Cancer Incidence, Mortality and Prevalence Worldwide in 2012. International Agency for Research on Cancer, Lyon. 2012. http://gco.iarc.fr/. Accessed 1 Apr 2019.
3. Elfström KM, Arnheim-Dahlström L, von Karsa L, Dillner J. Cervical cancer screening in Europe: Quality assurance and organisation of programmes. Eur J Cancer. 2015; 51: 950-68.
4. Hamashima C. Cancer screening guidelines and policy making: 15 years of experience in cancer screening guideline development in Japan. Jpn J Clin Oncol. 2018; 48: 278-
5. OECD and European Union: II.6. Effectiveness: Quality of care and patient experience. Screening, survival and mortality for cervical cancer. Health at a Glance: Europe 2018, State of Health in the EU cycle. Paris: OECD Publishing; 2018. p.158-9.
6. Monden M. The basic plan to promote cancer control in Japan. Gan To Kagaku Ryoho. 2013; 40: 559-64.
7. Report on Regional Public Health Services and Health Promotion Services. Ministry of Health, Labour and Welfare, Tokyo. 2017. https://www.mhlw.go.jp/toukei/saikin/hw/c-hoken/16/dl/kekka2.pdf. Accessed 1 Apr 2019.
8. International Agency for Research on Cancer: Chapter 3, Use of screening for cervical cancer, IARC Handbooks of Cancer Prevention, Volume10, Cervix Cancer Screening. Lyon: IARC Press; 2005. p. 117-29.
9. Sano H, Goto R, Hamashima C. What is the most effective strategy for improving the cancer screening rate in Japan? Asian Pac J Cancer Prev. 2014; 15: 2607-
10. Nakagi Y, Saijo Y, Itoh T, Sugioka Y, Endo H, Sengoku K, et al. Association of infant mortality and decrease of gynecologists and pediatricians Hokkaido. J Health & Welfare Statistics. 2010; 57: 24-30.
11. Andermann A, Blancquaert I, Beauchamp S, Déry V. Revisiting Wilson and Jungner in the genomic age: a review of screening criteria over the past 40 years. Bull World Health Organ. 2008; 86: 317-

12. Ministry of Health, Labour and Welfare. e-Stat, Survey of Physicians, Dentists and Pharmacists. Ministry of Health, Labour and Welfare, Tokyo. 2019. https://www.e-stat.go.jp/. Accessed 1 Apr 2019.
13. Ministry of Health, Labour and Welfare. Report of resident registered population. Ministry of Health, Labour and Welfare, Tokyo. e-Stat, https://www.e-stat.go.jp/. Accessed 1 Apr 2019.
14. Morimura Y, Soeda S, Toraiwa R, Sato M, Ito M, Takahashi K, et al. Problems with mass screening for cervical cancer at medical facilities. Fukushima Medical Journal. 2007; 57: 1-7.
15. Sano H, Goto R, Hamashima C. Does lack of resources impair access to breast and cervical cancer screening in Japan? PLoS One. 2017; 12: e0180819.
16. Fujii T. Changing state of gynecologic oncologist specialty in Japan. J Obstet Gynaecol Res. 2016; 42: 481-
17. Mikami M, Shida M, Shibata T, Katabuchi H, Kigawa J, Aoki D, et al. Impact of institutional accreditation by the Japan Society of Gynecologic Oncology on the treatment and survival of women with cervical cancer. J Gynecol Oncol. 2018; 29: e23.
18. YagiA, Ueda Y, Nakagawa S, Morimoto A, Matsuzaki S, Kobayashi E, et al. Relation between the number of board-certified gynecologic oncologists per hospital and survival of cervical cancer. J Obstet Gynaecol Res. 2019; 45: 1160-6
19. Hirai K, Ishikawa Y, Fukuyoshi J, Yonekura A, Harada K, Shibuya D, et al. Tailored message interventions versus typical messages for increasing participation in colorectal cancer screening among a non-adherent population: A randomized controlled trial. BMC Public Health. 2016; 16: 431.
20. Hamashima C, Goto R: Potential capacity of endoscopic screening for gastric cancer in Japan. Cancer Sci. 2017; 108: 101-
21. Seeff LC, Richards TB, Shapiro JA, Nadel MR, Manninen DL, Given LS, et al. How many endoscopies are performed for colorectal cancer screening? Results from CDC's survey of endoscopic capacity. Gastroenterology. 2004; 127: 1670-
22. Seeff LC, Manninen DL, Dong FB, Chattopadhyay SK, Nadel MR, Tangka FKL. Is there endoscopic capacity to provide colorectal cancer screening to the unscreened population in the United States? Gastroenterology. 2004; 127: 1661-
23. Lau A, Gregor JC. Resource implications for a population-based colorectal cancer screening program in Canada: a study of the impact on colonoscopy capacity and costs in London, Ontario. Can J Gastroenterol. 2007; 21: 371-
24. van Turenhout ST, Terhaar sive Droste JS, Meijer GA, Masclée AA, Mulder CJJ. Anticipating implementation of colorectal cancer screening in The Netherlands: a nationwide survey on endoscopic supply and demand. BMC Cancer. 2012; 12: 46.
25. Joseph DA, Meester RG, Zauber AG, Manninen DL, Winges L, Dong FB, et al. Colorectal cancer screening: Estimated future colonoscopy need and current volume and capacity. Cancer. 2016; 122: 2479-86.
26. Comas M, Mendivil J, Andreu M, Hernández C, Castells X. Long-term prediction of the demand of colonoscopies generated by a population-based colorectal cancer screening program. PLoS One. 2016; 11: e0164666.
27. Yabroff KR, Saraiya M, Meissner HI, Haggstrom DA, Wideroff L, Yuan G, et al. Specialty differences in primary care physician reports of Papanicolaou test screening practices: a national survey, 2006 to 2007. Ann Intern Med. 2009; 151: 602-
28. McDonald P, Herity B, Johnson Z, O'Kelly F. Views of Irish general practitioners on screening for cervical cancer. Ir J Med Sci. 2001; 170: 186-8.
29. Ideström M, Milsom I, Andersson-Ellström A. The cervical cancer screening program from a midwife's perspective. Acta Obstet Gynecol Scand. 2007; 86: 742-8.
30. Cooper CP, Saraiya M. Opting out of cervical cancer screening: physicians who do not perform pap tests. Am J Prev Med. 2014; 47: 315-9.
31. Poncet L, Rigal L, Panjo H, Gautier A, Chauvin P, Menvielle G, et al. Disengagement of general practitioners in cervical cancer screening. Eur J Cancer Prev. 2016; 25: 547-55.
32. Arbyn M, Smith SB, Temin S, Sultana F, Castle P, Collaboration on Self-Sampling and HPV Testing. Detecting cervical precancer and reaching underscreened women by using HPV testing on self samples: updated meta-analyses. BMJ. 2018;3 63: k4823.
33. Polman NJ, Ebisch RMF, Heideman DAM, Melchers WJG, Bekkers RLM, Molijn AC, et al. Performance of human papillomavirus testing on self-collected versus clinician-collected samples for the detection of cervical intraepithelial neoplasia of grade 2 or worse: a randomised, paired screen-positive, non-inferiority trial. Lancet Oncol. 2019; 20: 229-38.
34. Gustavsson I, Aarnio R, Berggrund M, Hedlund-Lindberg J, Sanner K, Wikström I, et al. Randomised study of HPV prevalence and detection of CIN2+ in vaginal self-sampling compared to cervical specimens collected by medical personnel. Int J Cancer. 2019; 144: 89-97.
35. The Health Council of the Netherlands. Dutch Health Council **Law on population-based screening: renewal of national population-based screening programme for cervical cancer, 2016.** https://www.gezondheidsraad.nl/documenten/adviezen/2016/06/20/wet-op-het-bevolkingsonderzoek-vernieuwing-landelijk-bevolkingsonderzoek-baarmoederhalskanker(2016). Accessed 1 Apr 2019.
36. Medical Services Advisory Committee**. Effectiveness modelling and economics evaluation in the Australian setting**. In: National cervical screening program renewal, Executive summary. Medical Services Advisory Committee, Canberra. 2013. http://www.cancerscreening.gov.au/internet/screening/publishing.nsf/Content/E6A211A6FFC29E2CCA257CED007FB678/$File/Executive%20Summary% Accessed 23 Sep 2018.
37. Danish Health Authority. Danish Health Council **Screening for cervical cancer-recommendations 2017,** https://prodstoragehoeringspo.blob.core.windows.net/fdaf8cf3-e83f-4c62-87ea-611ade1dd743/SST%20Anbefalinger%20livmoderhalskr%C3%A6ftscreening%20-%20H%C3%B8ring%20nov%202017.pdf(2017). Accessed 23 Sep 2018.
38. Zhao FH, Lewkowitz AK, Chen F, Lin MJ, Hu SY, Zhang X, et al. Pooled analysis of a self-sampling HPV DNA Test as a cervical cancer primary screening method. J Natl Cancer Inst. 2012; 104: 178-88.

Tables

Due to technical limitations, all tables are only available for download from the Supplementary Files section.

Supplementary Files Legend

List of supporting information

Doc. S1. Database search strategy: strategy 1 for Ovid-MEDLINE in English and strategy 2 for Ichushi-Web (the Japan Medical Abstracts Society) in Japanese.

Figures

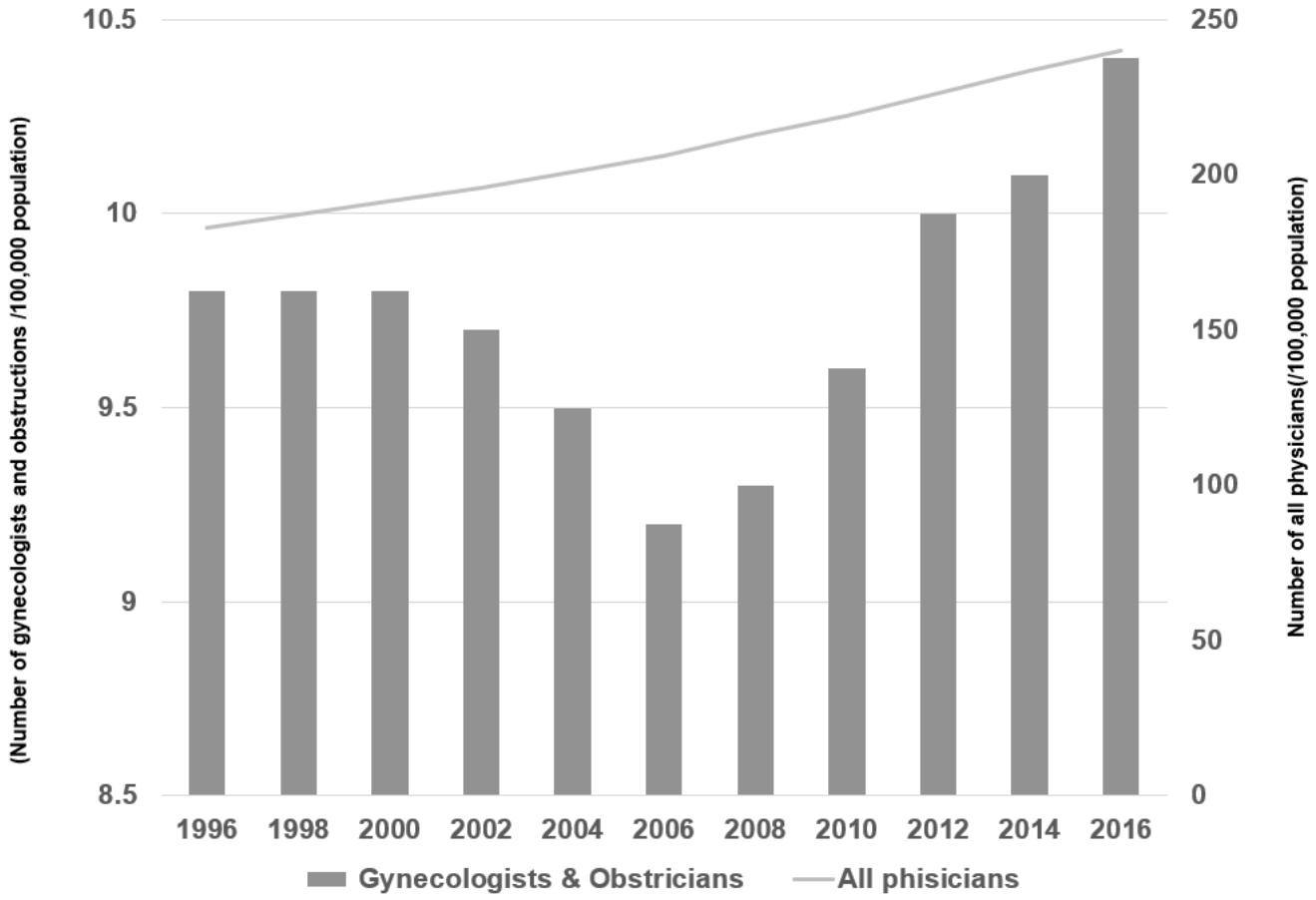

Figure 1

Trends of the number of physicians From 1996 to 2016, the total number of all physicians were increased. However, for two decades, the proportion of gynecologists and obstetricians has remained at approximately 5%.

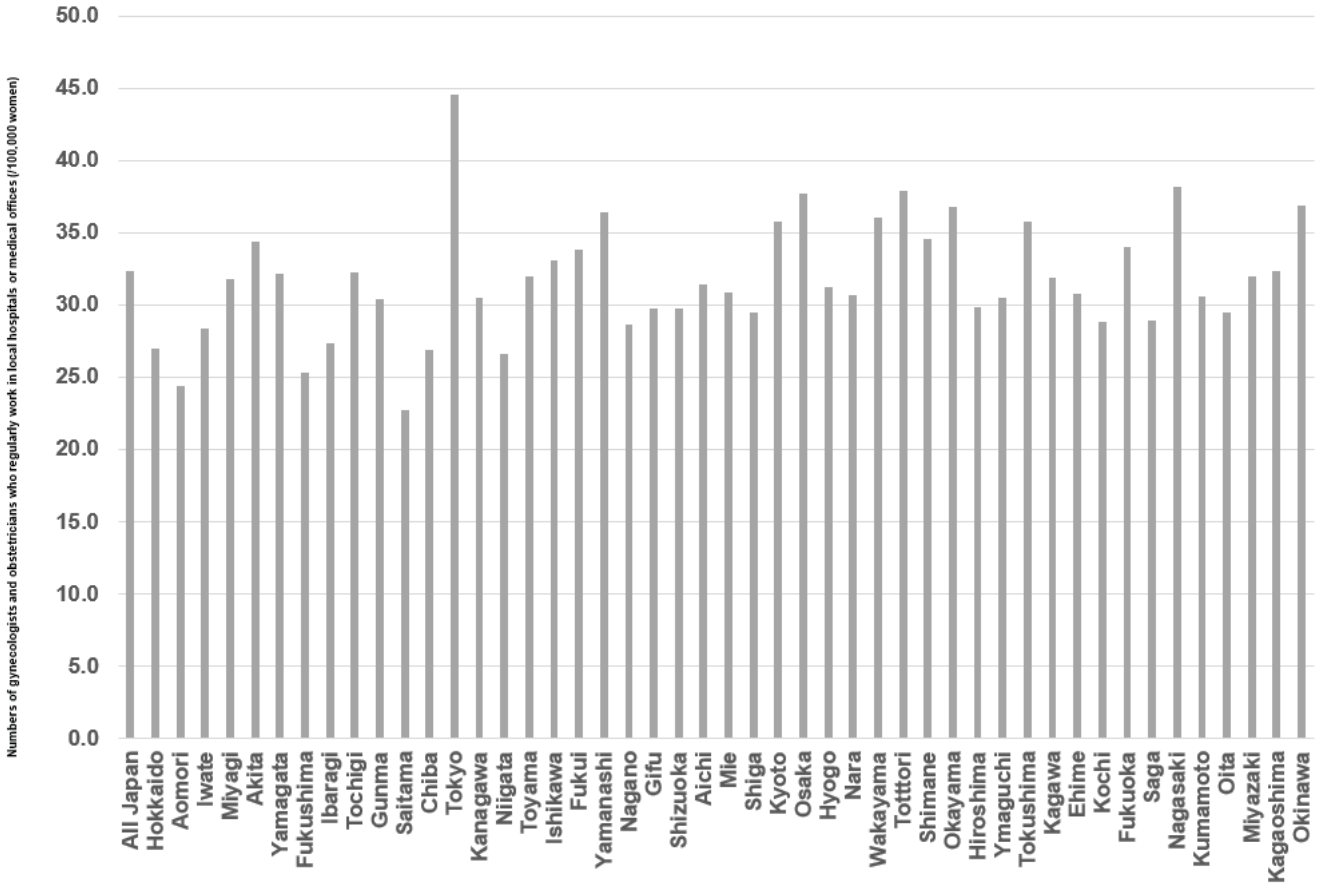

Figure 2

Comparison of the number of obstetricians and gynecologists among 47 prefectures The national average of the number of gynecologists and obstetricians was 32.3 (/100,000 women aged 20-69 years). In most prefectures, the number was below the national average. The numbers were cited from the Survey of Physicians, Dentists and Pharmacists 2016.

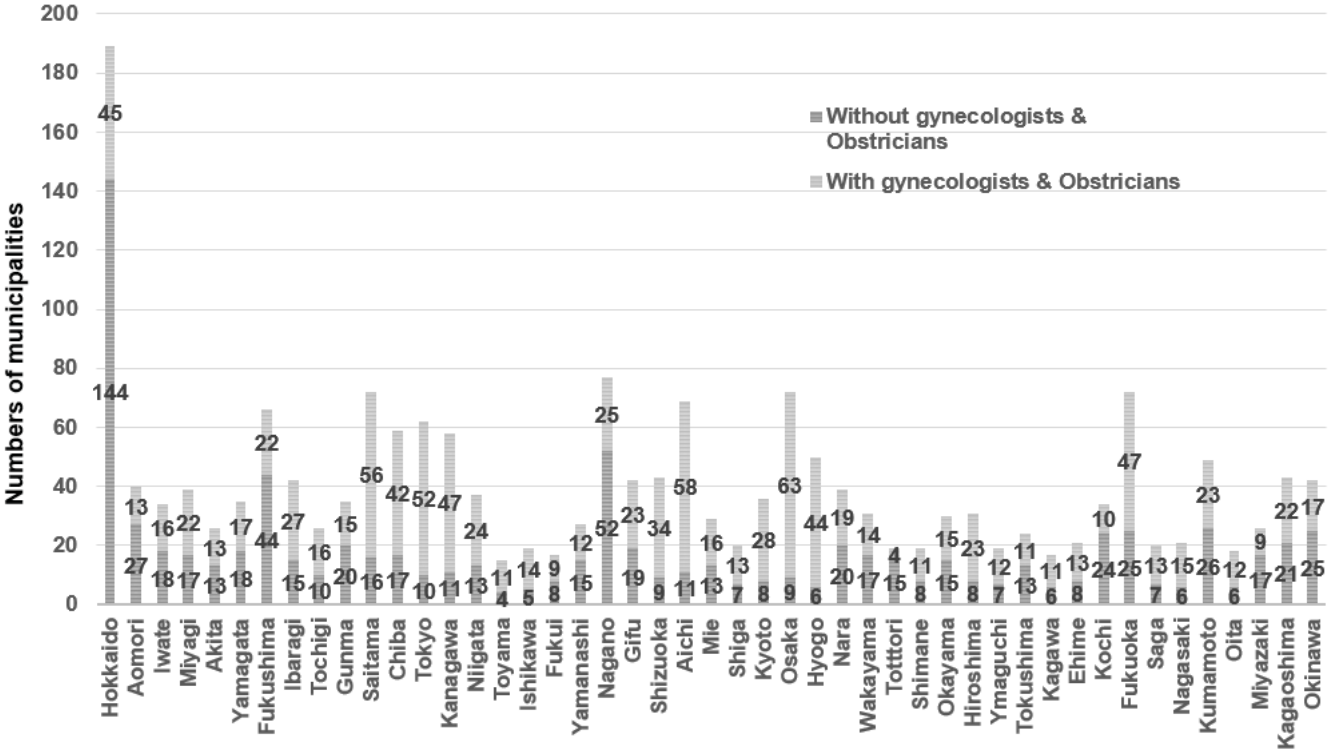

Figure 3

Numbers of municipalities without gynecologists and obstetricians who regularly work in local hospitals or medical offices There were 43.6% of municipalities without gynecologists' obstetricians who regularly work in local hospitals or medical offices. The numbers were cited from the Survey of Physicians, Dentists and Pharmacists 2016.

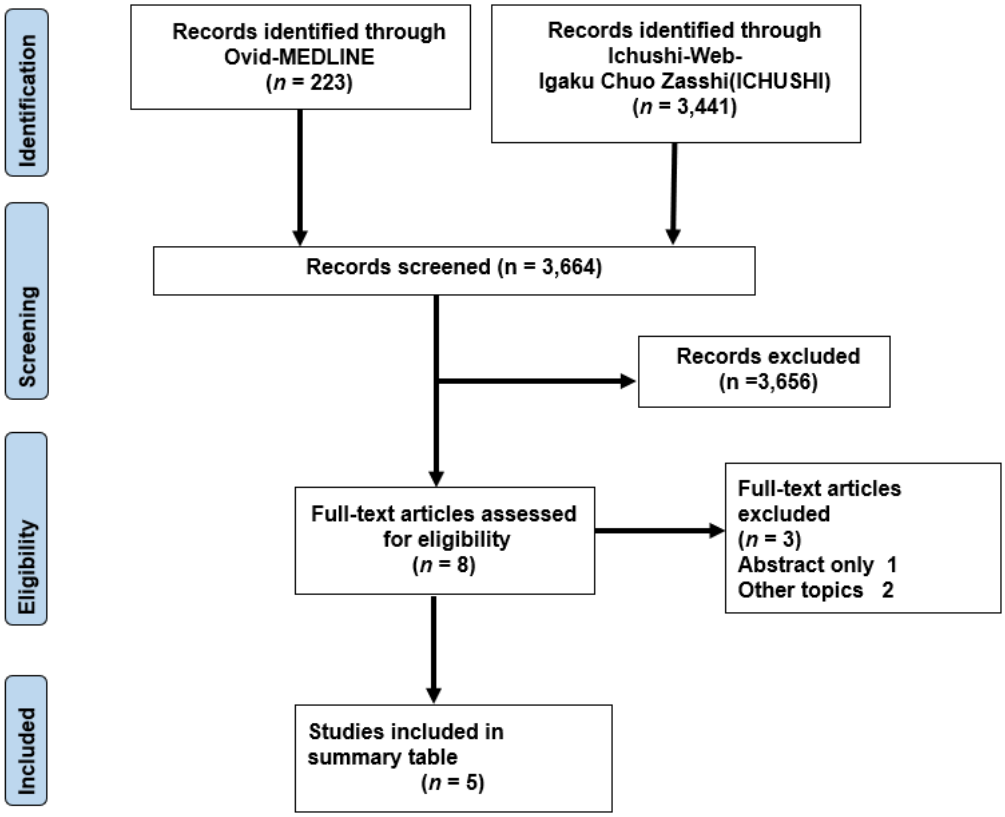

Figure 4

The selection process of articles in the literature search using the PRISMA 2009 flow diagram The number of articles identified from the literature search using Ovid-MEDLINE and Ichushi-Web was 3,664 articles after a two-stage review, 4 English articles and 1 Japanese article were selected.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- PRISMA2009checklist200220.doc
- Tables.docx
- SupplCH200222.docx