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Relation	

Research Report

Geographic Distribution of Regional Quota Program Graduates of Japanese Medical Schools: A Nationwide Cohort Study

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Supplemental digital content for this article is available at [LWW INSERT LINK].

Abstract

Purpose

To show practice location of graduates from two Japanese programs to recruit physicians to rural areas: a regional quota program of medical schools and a prefecture scholarship program (a prefecture is an administrative geographic division). Graduates of each program must work in a designated rural prefecture for a fixed period.

Method

A nationwide cohort study was conducted for three groups of subjects graduating between 2014 and 2016: quota graduates without scholarship (quota alone), non-quota graduates with scholarship (scholarship alone), and quota graduates with scholarship. A questionnaire was sent via a medical school or prefecture office to each potential subject to collect baseline individual data, including home prefecture and year of graduation. The data were connected through physician identification number to the Physician Census 2016 of Ministry of Health, Labour and Welfare to identify the subjects' practice location and compared to data for other physicians in the Census. Comparisons were conducted with Mann-Whitney and chi-square tests.

Results

The proportion of physicians working in nonmetropolitan municipalities for quota alone (185/244; 75.8%), scholarship alone (305/363; 84.0%), and quota with scholarship (341/384; 88.8%) was significantly higher than for other physicians (13,299/22,906; 58.1%). Median population density of the municipalities where subjects worked for quota alone (1,042.4 persons per square kilometer), scholarship alone (613.5), and quota with scholarship (547.4) was significantly lower than that for other physicians (3,214.0). These disparities increased

with number of years since graduation.

Conclusions

The regional quota and prefecture scholarship programs succeeded in producing physicians who practiced in rural areas of Japan.

The skewed geographic distribution of physicians and their subsequent shortage in rural areas is a serious socio-medical problem all over the world. In Japan, recruiting and retaining physicians in rural areas has long been a key theme of national and prefectural health policies. A prefecture is an administrative geographic division, similar to a state in the United States; Japan has 47 prefectures. Examples of the polices are *1-ken-1-idai-seisaku,* the policy of one medical school in each prefecture in the 1970s and 1980s, and the creation of Jichi Medical University, a special medical school dedicated to producing rural physicians, founded in 1972.[1] Each of these approaches had some effect,[2,3] but the maldistribution of physicians has largely remained unchanged.[4,5] If anything, it has worsened since 2004 when a new training system for postgraduate year 1 and year 2 physicians was implemented.[6–8] Responding to the surge of social demand for physicians, particularly in rural areas, in cooperation with prefecture governments and medical schools, the national government created a *chiikiwaku,* or regional quota program, at some medical schools in 2008. The quota program had spread to 67 of Japan's 80 medical schools by the end of 2016.[9] The number of entrants to the quota programs has risen to 1,521 per year nationally, accounting for 16.2% of all medical students in Japan (Figure 1).[10,11] The regional quota program is one of the largest and most ambitious ever conducted in Japan to rectify the maldistribution of physicians. [12]

“”“”

In Japan, medical schools admit high school graduates, and it takes six years for them to complete their undergraduate medical education. All schools provide a curriculum that conforms to the “model core curriculum” created by the Ministry of Education, Culture, Sports, Science and Technology. On graduation, the students take the National License Examination for Physicians, and if they pass, receive the Physician License from the Ministry of Health, Labour and Welfare. For two years after obtaining the license, they have

to undergo postgraduate clinical training at a training hospital designated by the Ministry of Health. Then they proceed to three to five years of specialist training approved by the Japanese Board of Medical Specialties to obtain a board certification for that specialty.

The size and design of regional quota programs varies among medical schools, but most have at least one (and usually all) of the following elements: applicants are limited to those with a geographic background in the prefecture in which the medical school is located; they undergo a special admission process with emphasis on activity records in the high school, interview and personal statement (usual admission process is heavily based on test score); they have more exposure to rural practice in their undergraduate medical education; and upon graduation they are obliged or expected to work in the prefecture for a certain length of time.[12,13] Most of the regional quotas are bundled with a scholarship program provided by the prefecture government, and all entrants receive, as a requirement on admission, the scholarship for all or part of their six-year undergraduate education. In exchange, they must work in the prefecture for about 1.5 times the length of the term of the scholarship; usually one-third to one-half of the obligatory period is for working in rural municipalities in the prefecture.[9,14] All prefectures have training hospitals for postgraduate clinical and specialty training, so theoretically, scholarship recipients can complete their necessary training and do their obligatory service concurrently. In some quota programs, graduates can practice in rural areas or in specialties such as obstetrics where physicians are in short supply. In all quota programs with scholarship, the graduates do not need to pay back the scholarship they received by completing the obligatory service. Some quota program students are admitted under separate terms from the prefecture scholarship, and these graduates are expected as a condition on admission, but not required, to work in the prefecture, including its rural municipalities.[13,15] If the quota graduates without the scholarship do not choose to work in the designated prefecture, they have no payment or penalty.

Apart from scholarship bundled with the regional quotas, many prefectures have their own scholarship programs. These scholarships are available to students who entered medical schools through the usual admission process and hope to work somewhere in the prefecture. The scholarship amount is usually the same as the one offered to quota students with scholarship, as are the length and obligatory service requirement.[13,15]

Intermediate outcomes of regional quota and prefecture scholarship programs have been reported. The straight graduation rate (the percentage of students who have finished their six-year medical program on schedule) of quota students was 89.6% for the class of 2008 and 89.0% for the class of 2009 nationwide, higher than the rate of all the medical school entrants in those years (85.4% and 84.2%, respectively).[9] Quota graduates with scholarships were significantly more likely to pass the National License Examination for Physicians than other medical graduates in Japan in 2014, 2015, 2016, and 2017 (97.9%, 96.7%, 97.4%, and 94.7% versus 93.9%, 94.5%, 94.3%, and 91.8%, respectively).[15] The percentage of quota graduates with scholarships who remained in the scholarship contract three years after graduation was 92.2%; the percentage was 89.9% for non-quota graduates with scholarship.[15]

Despite these intermediate outcomes, the main outcome of quota and scholarship programs—whether the graduates are truly working in rural areas—has, to our knowledge, not yet been reported. We thus have conducted a cohort study following practice location of quota graduates and scholarship recipients beginning in 2014 when the first class of the quota entrants (class of 2008) graduated from medical schools. We report their geographic distribution as of 2016 and compare it to the distribution of other physicians.

Method

Definitions of quota and scholarship students

In this study, a quota student is one whose “geographic background or location of graduated high schools of applicants are restricted and/or working place or specialty after graduation is clearly specified.” A scholarship is “given by a prefecture to a medical student which needs not to be paid back if the student works in designated areas by the prefecture for a certain period.”

Design and settings

Supplemental Digital Appendix 1, available at [LWW INSERT LINK], presents the design for the nationwide cohort study conducted by the Japanese Council for Community-based Medical Education (JCCME)[13] from 2014 to 2017. The study consists of three groups of subjects: quota graduates with scholarship, non-quota graduates with scholarship (scholarship alone), and quota graduates without scholarship (quota alone). All subjects were physicians licensed in 2014–2016. All other physicians graduating during the same time period registered in the Physician Census 2016, Ministry of Health, constitute the comparison group. Details of this study protocol were previously reported[13,15]; we offer a summary here.

Every year before the full survey, a pre-survey was conducted. The cohort study office of JCCME sent a pre-survey questionnaire to all 47 prefectures and all 77 medical schools to ask which prefectures and medical schools have eligible subjects. The only schools that were not consulted were Jichi Medical University, National Defence Medical College, and University of Occupational and Environmental Health because of their unique missions. All the prefectures and medical schools responded to this pre-survey. Each June, the main survey

was conducted. The cohort office asked each prefecture and medical school to forward a questionnaire to all prospective study participants. The prefecture then sent the questionnaire to all quota and non-quota graduates with scholarship from the prefecture; the medical school sent the questionnaire to all of its quota graduates without scholarship. Each participant then returned the completed questionnaire to the cohort office, which was registered as the baseline data at the office. All subjects were newly licensed physicians.[13]

The questionnaire for the quota with scholarship group and the scholarship alone group (Supplemental Digital Appendix 2, available at [LWW INSERT LINK]) asks whether the participant was admitted to a quota program, physician identification number, name of the medical school (including identification as public or private), year of graduation, home prefecture, term of scholarship, length of postgraduate obligation period, and length of rural service or service in a designated specialty. The questionnaire for the quota without scholarship group (Supplemental Digital Appendix 3, available at [LWW INSERT LINK]) requests the participant's physician identification number, medical school (including identification as public or private), graduation year, home prefecture, and conditions for admission to the quota program. A pilot questionnaire was administered to quota students at select medical schools before the study started. The faculty members of the select schools evaluated the precision of their answers.

The Ministry of Health, Labour and Welfare; the Ministry of Education Culture, Sports, Science and Technology; and the Association of Japan Medical Colleges supported this study by requesting the participation of prefectures and/or medical schools.

Follow-up of individual participants

We connected the baseline individual data, through physician identification number, to the

national census data for the Survey of Physicians, Dentists and Pharmacists 2016 (Physician Census), which is conducted biennially by the Ministry of Health. Under Japanese law, all licensed physicians must register in the Physician Census, which gathers information on practice location, type of medical facility, work contents, specialty, and board certification status. In 2017 we asked the Ministry of Health for individualized data from the Physician Census of 2016. In 2018 the Ministry forwarded the data with special permission to use the data for the research.

Among the 319,481 physicians registered in the census, 23,897 who were licensed in 2014–2016 were extracted and connected to the baseline data. By connecting study participants to the census data, it was possible to identify the location in which they practiced. In addition, practice location of non-subjects in the census, i.e., physicians who are neither quota graduates nor scholarship recipients, were also identified. By doing so we could compare the geographic distribution between study participants and other physicians in the same postgraduate years.

Municipality data

Japan has three levels of government: municipal, prefectural, and national. We extracted data on municipal (city, town, village) populations and land areas in 2015, as the closest years to the Physician Census, from the National Population Census, published as the Statistical Observations of Shi, Ku, Machi, Mura 2017 by the Statistics Bureau, Ministry of Internal Affairs and Communications.[16] The physician data was connected to this municipality-based population data through the municipality code.

To show their rurality, we classified municipalities as “metropolis,” “center city,” “other city,” and “town/village.” “Metropolis” includes all of the wards (ku) of the ordinance-

designated cities (seirei-shitei-toshi) and 23 special wards of Tokyo (n = 198). “Center city” includes non-metropolis large cities (chukaku-shi) (n = 54). “Other city” includes non-metropolis and non-center cities (shi) (n = 716). “Town/village” includes towns (cho) and villages (son) (n = 928). This classification of municipalities is usually used administratively based on the Local Autonomy Act.

As another indicator of rurality of municipalities, we classified all municipalities into equal-size quintiles (from 1 to 5) according to the population density; the cut-off value of population density was set so that each quintile has 20% of physicians in the Physician Census. Quintile 1 was the group of municipalities with the lowest population density (most rural), and quintile 5 was that with highest (most urban). The cut-off value between quintiles 1 and 2 was 612.25 persons per square kilometer, between 2 and 3 was 1,327.45, between 3 and 4 was 4,848.32, and between 4 and 5 was 11,384.65 persons per square kilometer. Population density, defined as the number of residents divided by land area including both habitable and non-habitable lands, is a well-established indicator of the rurality or urbanity of an area.[30,34,35]

Statistical analysis

We calculated the proportion of physicians working in each administrative category of municipalities (metropolis, center city, other city and town/village), among all physicians in each category. Then the median population density of municipalities in which physicians in each category (quota with scholarship, quota without scholarship, scholarship alone, and others) were working was calculated and its interquartile range was evaluated. We also calculated the proportion of physicians working in each quintile group of municipalities among all physicians in each category. We conducted all analyses by subdividing physicians according to their class year.

Comparison of the results between study subjects and “other physicians” was conducted with Mann-Whitney test for the median population density and with chi-square test for the proportion of physicians. We regarded *P* values less than .05 (two-sided test) as statistically significant. We conducted all statistical analyses using SPSS statistical software, version 21 (IBM-SPSS Japan, Tokyo).

Results

Between 2014 and 2016, all prefectures (n = 47) and medical schools (n = 77) responded to the pre-survey. Based on the results of the pre-survey for the three years, there were a cumulative total of 129 prefectures and 70 medical schools with eligible subjects. Among them, 127 prefectures (98.4%) and 70 medical schools (100%) sent questionnaires to potential subjects. The number of potential quota alone subjects was 727, of scholarship alone 1,033, and quota with scholarship 947. Among them, 261 (35.9%), 389 (37.7%), and 402 (42.4%) responded, respectively. Responders whose physician identification numbers were missing or could not be connected to those in the 2016 Physician Census were excluded. Therefore, data for 244 (33.6%), 363 (35.1%), and 384 (40.5%) participants were subject to longitudinal analysis.

START HERE The basic characteristics of respondents are shown in Table 1. Males outnumbered females, and graduates of public medical schools outnumbered graduates of private ones. Those in quota programs with scholarship were most and those in quota programs alone were least represented. Respondents with scholarship alone were slightly older than those in other categories. The average length of receiving scholarship was 4.9 years for those in scholarship alone, but 5.9 years for those in quota with scholarship.

Consequently the average length of in-prefecture obligatory service was shorter for those in scholarship alone (6.5 years) than those in quota with scholarship (8.2 years). Within the obligation period, those in scholarship alone need to serve 2.2 years in rural municipalities of the prefecture, compared with 3.1 years for those in quota with scholarship. The range of percentages of those in scholarship alone who served in the prefecture that offered the scholarship was 78.4%–89.6% (87/111–121/135), while that for those in quota with scholarship was 90.4%–97.0% (161/178–130/134).

Table 2 shows the percentage of respondents working in each administrative category of municipalities. The percentages of those working in municipalities other than metropolis for quota alone (185/244; 75.8%), scholarship alone (305/363; 84.0%) and quota with scholarship (341/384; 88.8%) were significantly higher than for other physicians (13,299/22,906; 58.1%). The gaps tended to be larger as the number of years since graduation increases. Particularly in postgraduate year 3, the proportion in non-metropolitan municipalities was quite high for quota with scholarship (70/72; 97.2%) compared with quota alone (36/50; 72.0%), scholarship alone (89/111; 80.2%), and other physicians (3,930/7,233; 54.3%).

Table 3 shows the median population density of the municipalities in which physicians in each category worked. The values for those in quota alone (1,042.4), scholarship alone (613.5), and quota with scholarship (547.4) were significantly lower than for other physicians (3,214.0). This tendency was unchanged across class years, and the value was lowest for quota with scholarship participants in any class year. Especially three years after graduation, that is, the year immediately after postgraduate clinical training, the median population density of quota with scholarship (366.1) was remarkably lower than the values of other categories.

The percentages of participants working in each quintile of municipalities sorted according to population density is shown in Table 4. The percentage of those working in the lowest population density quintile was 35.7% (87/244) for quota alone, 49.3% (179/363) for scholarship alone, and 51.6% (198/384) for quota with scholarship, all of which were significantly higher than for other physicians: 18.8% (4,309/22,906). The greater the time since graduate, the more remarkable the gaps were. For example in postgraduate year 3, the percentage those working in the least population-dense municipalities was 65.3% (47/72) for quota with scholarship and 18.0% (1,299/7,233) for other physicians.

Discussion

Our findings demonstrate that graduates of regional quota and recipients of prefecture scholarship were more likely to practice in rural areas than graduates of conventional medical programs in Japan. In particular the rural practice rate for physicians from the quota with scholarship group was notably higher. These tendencies were most remarkable for physicians in postgraduate year 3. This is probably because those in postgraduate year 1 and 2 were completing their clinical training. Postgraduate clinical training in Japan must be conducted at hospitals that have the approval of the national government. Most of the training hospitals are large general hospitals located in urban or suburban municipalities. Thus the rural placement for quota graduates and scholarship recipients actually begins from postgraduate year 3. But still the rural practice rate in postgraduate years 1 and 2 was higher for quota or scholarship graduates than for other physicians. So despite the urban-biased clinical training system, quota or scholarship physicians tended to choose training hospitals in rural areas.

These findings also demonstrate a portion of physicians from quota with scholarship and

those with scholarship alone worked in urban areas. Some were probably under obligatory in-prefecture service but were not in rural municipalities. As shown in Table 1, the prefectures permit scholarship recipients to work outside of rural municipalities within their prefectures for about three years, mainly because some specialty training cannot be completed within rural hospitals. Others would have temporarily interrupted their obligatory service, which is also permitted by prefectures for a certain years, or bought out the scholarship contract to avoid the obligatory work.

Internationally there are many undergraduate medical education programs to produce rural physicians. For example, the Physician Shortage Area Program (PSAP) at Jefferson Medical College in the United States, as well as programs at Northern Ontario School of Medicine in Canada and Flinders University School of Medicine in Australia have their own idiosyncratic rural medical education schemes.[17–19] These programs have increased the probability of their graduates to practice in rural areas by admitting students with a rural background, exposing participating students to rural practice during undergraduate education, and encouraging them to choose family practice. The retention rate in rural locations of graduates of PSAP is reportedly 79% after 11–16 years in practice.[20] Moreover the Australian government is now implementing the Integrated Rural Training Pipeline for Medicine (IRTP) initiative in which training for medical students, junior doctors, and specialists are seamlessly provided within rural areas.[21] These initiatives are different from the Japanese regional quota program in that they are not combined with scholarship and thus rural service of their graduates is not mandatory.

Financial incentive programs by a government or by other administrative bodies in exchange for practicing in rural areas have been reported outside of Japan.[22–25] The National Health Service Corps (NHSC) managed by the federal government is one of the largest financial

incentive programs in the United States. Medical students who received a scholarship from the NHSC are required, after becoming a licensed physician, to work at rural health facilities designated by the NHSC for a timespan equal to that of the scholarship.[26] State governments also manage return-of-service scholarship and/or loan forgiveness programs for medical students. In addition, both the NHSC and individual states have loan repayment programs for licensed physicians which require them to work in designated rural areas.[23] There are many such initiatives in the world, and the estimated retention rate of the pooled subjects of these was reported to be 71% as of 2009.[27] However, the regional quota programs in Japan are different from these other initiatives in that the regional quota combines medical school admission, undergraduate rural-oriented education, scholarship, and obligatory rural service. Outcomes of this regional quota program thus may be worth noting by educators and policy makers in countries where such a comprehensive education-scholarship initiative is planned.[15]

We urge future Japanese policies regarding physician supply to be based on the results of this study. The regional quota program is based on temporary national legislation, and thus will be substantially revised starting in 2020.[13,15] Whether the quota should be maintained or not is under discussion by a special committee of the Ministry of Health, Labour and Welfare for supply of health care professionals.[28] Concentration of physicians in urban areas and the subsequent shortage in rural areas are serious social problems recognized by the population, health professional bodies, and policy makers.[29] There are as yet no ways of ensuring placement of rural physicians in Japan aside from the regional quota program and Jichi Medical University. Ending the regional quota will exacerbate the existing maldistribution of physicians and disrupt not only the health care facilities and population health in rural areas but also Japanese society as a whole. It should be noted, however, that the overall population in rural areas is decreasing faster than in urban areas.[30] The size of regional quotas should be

modified based on this demographic change.

Jichi Medical University is the model of regional quotas. It is the only medical school in Japan whose mission is specifically to produce rural doctors. It was established in 1972 by the Ministry of Home Affairs and all 47 prefectures. It takes 2–3 students from each of 47 prefectures (100–110 students in total) every year and fully funds them for all six years of their undergraduate medical education. In exchange, the graduates are required to work for medical institutions in their home prefectures for nine years after graduation, including offering services in rural municipalities for about six years.[31–34] The proportion of Jichi Medical University graduates working in rural areas was 13 times higher in under-obligation period and four times higher in post-obligation period than other physicians.[3] We cannot directly compare the rural practice rate between Jichi Medical University and quota graduates because different studies have different definitions of "rural."[35] We must also keep in mind that the total amount of prefecture scholarship given to a Jichi Medical University student for six years is 23 million yen (USD 209,090), which is double the average scholarship amount for a quota student, at 12.2 million yen (USD 110,909).[9,36]

This study has several limitations. First, the follow-up period is three years, which is too short to judge the long-term effectiveness of regional quota and prefecture scholarship programs. We evaluated recruitment outcomes in this study, but retention outcomes should be assessed in future studies with a longer observation period. Second participants in this study are only a portion of quota graduates and scholarship recipients. If the subject selection is biased, their geographic distribution would not be the same as the distribution of all potential subjects. But we have sent the questionnaire to almost all the quota graduates and scholarship recipients. Also the average response rate of potential subjects graduating from private medical schools (36.0%) didn't differ significantly from that from public schools (42.3%; $P = .571$,

independent t-test). The response rate of each prefecture was not significantly correlated with its population density (Spearman's correlation coefficient 0.132, $P = .378$). Accordingly, the selection bias should be minimal. We also followed up with all the enrolled subjects including those who bought out the scholarship contract and dropped out from obligatory service, so bias due to dropping out is negligible. Third, we did not analyze specialty choice of subjects; this will be done in a future study.

Conclusions

Regional quota and prefecture scholarship programs, particularly the combination of both, have succeeded in producing physicians who practice in rural areas of Japan. Based on this finding, we believe that imminent revision of this policy by the national government is warranted.

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References

1. Matsumoto M, Inoue K, Kajii E, Takeuchi K. Retention of physicians in rural Japan: Concerted efforts of the government, prefectures, municipalities and medical schools. Rural Remote Health. 2010;10:1432.
2. Matsumoto M, Inoue K, Bowman R, Noguchi S, Kajii E. Physician scarcity is a predictor of further scarcity in U.S., and a predictor of concentration in Japan. Health Policy. 2010;95:129–36.
3. Matsumoto M, Inoue K, Kajii E. Contract-based training system for rural physicians: Follow-up of Jichi Medical University graduates (1978–2006). J Rural Health. 2008;24:360–368.
4. Kobayashi Y, Takaki H. Geographic distribution of physicians in Japan. Lancet. 1992;340:1391–1393.
5. Matsumoto M, Inoue K, Bowman R, Noguchi S, Toyokawa S, Kajii E. Geographical distributions of physicians in Japan and US: Impact of healthcare system on physician dispersal pattern. Health Policy. 2010;96:255–261.
6. Toyabe S. Trend in geographic distribution of physicians in Japan. Int J Equity Health. 2009;8:5.
7. Tanihara S, Kobayashi Y, Une H, Kawachi I. Urbanization and physician maldistribution: A longitudinal study in Japan. BMC Health Serv Res. 2011;11:260.
8. Sakai R, Tamura H, Goto R, Kawachi I. Evaluating the effect of Japan’s 2004 postgraduate training programme on the spatial distribution of physicians. Hum Resour Health. 2015;13:5.
9. Association of Japan Medical Colleges. Heisei 28 nendo chiikiwaku-nyugaku-seido to chiiki-iryo-shien-senta no jitsujou ni kansuru chousahoukoku. [Survey report on

regional subquota admission and community health support centers in 2016.] Tokyo: Association of Japan Medical Colleges; 2017.

10. Ministry of Education, Culture, Sports, Science and Technology. Heisei 28 nendo igakubu nyugakuteiinnzou ni tuite. [Increase in the number of entrants to medical schools in 2016]. 2016. http://www.mext.go.jp/b_menu/houdou/27/10/__icsFiles/afieldfile/2015/10/23/1363060_4_1.pdf. Accessed January 31, 2019.
11. Ministry of Education, Culture, Sports, Science and Technology. Heisei 30 nendo igakubu nyugakuteiinnzou ni tuite. [Increase in the number of entrants to medical schools in 2018]. 2018. http://www.mext.go.jp/component/b_menu/shingi/toushin/__icsFiles/afieldfile/2016/10/31/1378462_02.pdf. Accessed January 31, 2019.
12. Matsumoto M, Inoue K, Takeuchi K. Quality of care in Japan: An additional strategy. Lancet. 2011;378:e17.
13. Matsumoto M, Takeuchi K, Tanaka J, et al. Follow-up study of the regional quota system of Japanese medical schools and prefecture scholarship programmes: A study protocol. BMJ Open. 2016;6:e011165.
14. Association of Japan Medical Colleges. Heisei 27 nendo chiikiwaku-nyugaku-seido to chiiki-iryo-shien-senta no jitsujou ni kansuru chousahoukoku. [Survey report on regional subquota admission and community health support centers in 2015.] Tokyo: Association of Japan Medical Colleges; 2016.
15. Matsumoto M, Takeuchi K, Owaki T, et al. Results of physician licence examination and scholarship contract compliance by the graduates of regional quotas in Japanese medical schools: A nationwide cross-sectional survey. BMJ Open. 2017;7:e019418.
16. Statistic Bureau, Ministry of Internal Affairs and Communications. Toukei de miru shikuchouson no sugata 2017. [Statistical Observations of Shi, Ku, Machi, Mura

2017.] 2017. https://www.e-stat.go.jp/stat-search/files?page=1&layout=datalist&toukei=00200502&tstat=000001102475&cycle=0. Accessed January 31, 2019.

17. Rabinowitz HK. Recruitment, retention, and follow-up of graduates of a program to increase the number of family physicians in rural and underserved areas. N Engl J Med. 1993;328:934–939.

18. Worley P, Esterman A, Prideaux D. Cohort study of examination performance of undergraduate medical students learning in community settings. BMJ 2004;328:207–209.

19. Hogenbirk JC, French MG, Timony PE, Strasser RP, Hunt D, Pong RW. Outcomes of the Northern Ontario School of Medicine's distributed medical education programmes: Protocol for a longitudinal comparative multicohort study. BMJ Open. 2015;5:e008246.

20. Philadelphia University and Thomas Jefferson University. Physician Shortage Area Program. https://www.jefferson.edu/university/skmc/programs/physician-shortage-area-program.html. Accessed January 31, 2019.

21. Department of Health. Australian Government. Integrated Rural Training Pipeline for Medicine (IRTP). 2017; http://www.health.gov.au/internet/main/publishing.nsf/content/integrated-rural-training-pipeline-medicine. Accessed January 31, 2019.

22. Pathman DE, Fryer GE, Jr., Phillips RL, Smucny J, Miyoshi T, Green LA. National Health Service Corps staffing and the growth of the local rural non-NHSC primary care physician workforce. J Rural Health. 2006;22:285–293.

23. Pathman DE, Taylor DH, Jr., Konrad TR, et al. State scholarship, loan forgiveness, and related programs: The unheralded safety net. JAMA. 2000;284:2084–2092.

24. Frehywot S, Mullan F, Payne PW, Ross H. Compulsory service programmes for recruiting

health workers in remote and rural areas: Do they work? Bull World Health Organ. 2010;88:364–370.

25. Barnighausen T, Bloom DE. Designing financial-incentive programmes for return of medical service in underserved areas: Seven management functions. Hum Resour Health. 2009;7:52.

26. Health Resources & Services Administration. National Health Service Corps. 2018; https://bhw.hrsa.gov/loansscholarships/nhsc. Accessed January 31, 2019.

27. Barnighausen T, Bloom DE. Financial incentives for return of service in underserved areas: A systematic review. BMC Health Serv Res. 2009;9:86.

28. Working Group on Demand-Supply of Health Professionals Ministry of Health, Labour and Welfare. Iryoujujisya no jukyu ni kansuru kentoukai ishijukyubunkakai dai3ji tyukantorimatome. [3rd midterm report from the Working Group on Demand-supply of Health Professionals.] Tokyo: Ministry of Health, Labour and Welfare; 2018.

29. Japan Association of City Mayors. Kokumin-fuzai no shinsenmoni-seido wo kigushi sessoku ni susumeru kotoni hantaisuru kinkyu youbou. [Objecting the new programs for producing specialist doctors.] 2017. http://www.mayors.or.jp/p_opinion/documents/290412shinsenmoni_kinkyuyoubou.pdf. Accessed January 31, 2019.

30. Matsumoto M, Kimura K, Inoue K, Kashima S, Koike S, Tazuma S. Aging of hospital physicians in rural Japan: A longitudinal study based on national census data. PloS one. 2018;13:e0198317.

31. Inoue K, Matsumoto M, Sawada T. Evaluation of a medical school for rural doctors. J Rural Health. 2007;23:183–187.

32. Inoue K, Hirayama Y, Igarashi M. A medical school for rural areas. Medical Education. 1997;31:430-434.

33. Matsumoto M, Inoue K, Kajii E. Long-term effect of the home prefecture recruiting

scheme of Jichi Medical University. Rural Remote Health. 2008;8:930.

34. Matsumoto M, Inoue K, Kajii E. Policy implications of a financial incentive programme to retain a physician workforce in underserved Japanese rural areas. Soc Sci Med. 2010;71:667–671.

35. Matsumoto M, Inoue K, Kajii E. Definition of “rural” determines the placement outcomes of a rural medical education program: Analysis of Jichi Medical University graduates. J Rural Health. 2010;26:234–239.

36. Jichi Medical University. Syugaku-shikin, shogakushikin. [Scholarship system.] 2017. https://www.jichi.ac.jp/exam/medicine/campus/backup.html. Accessed January 31, 2019.

Figure Legends

Figure 1

Number of medical school entrants in Japan, from a study of rural physician placement programs, 2014–2016. A part of this figure was published previously.[13] Data are from Ministry of Education, Culture, Sports, Science and Technology.[11] “Quota” indicates students from regional quota programs and “others” indicates all other, non-quota students.

Table 1

Basic Characteristics of Study Participants, From a Study of Rural Physician Placement Programs in Japan, 2014–2016

Characteristic	Others[a]	Quota alone	Scholarship alone	Quota with scholarship	Total
Sex, no. (%)					
Male	15,666 (68.4)	126 (51.6)	246 (67.8)	214 (55.7)	16,252 (68.0)
Female	7,240 (31.6)	118 (48.4)	117 (32.2)	170 (44.3)	7,645 (32.0)
Postgraduate year, no. (%)					
1	8,026 (35.0)	92 (37.7)	117 (32.2)	178 (46.4)	8,413 (35.2)
2	7,647 (33.4)	102 (41.8)	135 (37.2)	134 (34.9)	8,018 (33.6)
3	7,233 (31.6)	50 (20.5)	111 (30.6)	72 (18.8)	7,466 (31.2)
Age, average (SD)	27.8 (3.3)	26.7 (2.5)	28.6 (5.0)	26.3 (2.3)	27.8 (3.3)
Medical school, no (%)[b]					
Public	--	213 (87.3)	309 (85.6)	350 (91.4)	872 (88.3)
Private	--	31 (12.7)	52 (14.4)	33 (8.6)	116 (11.7)
Funded years, average (SD)[c]	--	--	4.9 (1.6)	5.9 (0.5)	4.1 (2.6)
Obligation years including permitted interruption, average (SD)[c]	--	--	9.0 (3.3)	10.7 (2.7)	9.9 (3.2)
Obligation years, average (SD)[c]	--	--	6.5 (2.6)	8.2 (1.9)	7.3 (2.4)
Years of rural service, average (SD)[c]	--	--	2.2 (2.7)	3.1 (2.9)	2.7 (2.8)
Those working in contracted prefecture, no. (%)[c]					
PGY1	--	--	102 (87.2)	161 (90.4)	264 (89.2)
PGY2	--	--	121 (89.6)	130 (97.0)	251 (93.3)
PGY3	--	--	87 (78.4)	67 (93.1)	154 (84.2)

Abbreviations: SD indicates standard deviation; PGY, postgraduate year.

[a]Data on “others” were derived from Physician Census, Ministry of Health Labour and Welfare.

[b]Information on medical school were unavailable for “others.”

[c]Scholarship-related information did not exist for “quota alone” and “others.”

Table 2

Percentage of Participants Working in Each Administrative Category of Municipalities, From a Study of Rural Physician Placement Programs in Japan, 2014–2016

Category	Administrative category of municipalities, no. (%)[a]					*P* value[b]
	Town/village	Other city	Center city	Metropolis	Total	
PGY1						
Others	256 (3.2)	3,024 (37.7)	1,595 (19.9%)	3,151 (39.3)	8,026 (100.0)	--
Quota alone	2 (2.2)	34 (37.0)	31 (33.7)	25 (27.2)	92 (100.0)	.006
Scholarship alone	6 (5.1)	71 (60.7)	24 (20.5)	16 (13.7)	117 (100.0)	< .001
Quota with scholarship	12 (6.7)	101 (56.7)	45 (25.3)	20 (11.2)	178 (100.0)	< .001
Total	276 (3.3)	3,230 (38.4)	1,695 (20.1)	3,212 (38.2)	8,413 (100.0)	--
PGY2						
Others	227 (3.0)	2,808 (36.7)	1,459 (19.1)	3,153 (41.2)	7,647 (100.0)	--
Quota alone	7 (6.9)	31 (30.4)	44 (43.1)	20 (19.6)	102 (100.0)	< .001
Scholarship alone	8 (5.9)	87 (64.4)	20 (14.8)	20 (14.8)	135 (100.0)	< .001
Quota with scholarship	4 (3.0)	84 (62.7)	25 (18.7)	21 (15.7)	134 (100.0)	< .001
Total	246 (3.1)	3,010 (37.5)	1,548 (19.3)	3,214 (40.1)	8,018 (100.0)	--
PGY3						
Others	284 (3.9)	2,356 (32.6)	1,290 (17.8)	3,303 (45.7)	7,233 (100.0)	--
Quota alone	1 (2.0)	19 (38.0)	16 (32.0)	14 (28.0)	50 (100.0)	.02
Scholarship alone	6 (5.4)	62 (55.9)	21 (18.9)	22 (19.8)	111 (100.0)	< .001
Quota with scholarship	3 (4.2)	48 (66.7)	19 (26.4)	2 (2.8)	72 (100.0)	< .001
Total	294 (3.9)	2,485 (33.3)	1,346 (18.0)	3,341 (44.7)	7,466 (100.0)	--
Total						
Others	767 (3.3)	8,188 (35.7)	4,344 (19.0)	9,607 (41.9)	22,906 (100.0)	--

Quota alone	10 (4.1)	84 (34.4)	91 (37.3)	59 (24.2)	244 (100.0)	< .001
Scholarship alone	20 (5.5)	220 (60.6)	65 (17.9)	58 (16.0)	363 (100.0)	< .001
Quota with scholarship	19 (4.9)	233 (60.7)	89 (23.2)	43 (11.2)	384 (100.0)	< .001
Total	816 (3.4)	8,725 (36.5)	4,589 (19.2)	9,767 (40.9)	23,897 (100.0)	--

Abbreviation: PGY indicates postgraduate year.

[a]Metropolis: wards of the ordinance-designated cities and 23 special wards of Tokyo (n = 198); Center city: non-metropolis large cities (n = 54); Other city: non-metropolis and non-center cities (n = 716); Town/village: towns and villages (n = 928).

[b]Chi-square test comparing with “others.”

Table 3

Median Population Density of Municipalities in Which Each Group of Participants Worked, From a Study of Rural Physician Placement Programs in Japan, 2014–2016

Category	No.	Median	IQR	*P* value[a]
PGY1				
Others	8,026	2,949.1	734.0 – 8,587.3	
Quota alone	92	1,074.8	454.2 – 4,668.4	< .001
Scholarship alone	117	613.5	335.7 – 1,159.0	< .001
Quota with scholarship	178	693.4	306.6 – 1,450.0	< .001
PGY2				
Others	7,647	3,214.0	796.8 – 8,922.8	
Quota alone	102	928.2	437.3 – 3,854.0	< .001
Scholarship alone	135	665.7	308.8 – 1,091.3	< .001
Quota with scholarship	134	500.8	265.2 – 1,182.6	< .001
PGY3				
Others	7,233	3,462.6	855.6 – 9,796.2	
Quota alone	50	863.9	346.2 – 4,868.0	< .001
Scholarship alone	111	443.0	275.4 – 1,127.6	< .001
Quota with scholarship	72	366.1	273.9 – 951.7	< .001
Total				
Others	22,906	3,214.0	796.8 – 8,922.8	

Quota alone	244	1,042.4	452.3 – 4,032.4	< .001
Scholarship alone	363	613.5	316.6 – 1,127.6	< .001
Quota with scholarship	384	547.4	275.4 – 1,189.7	< .001

Abbreviations: IQR indicates interquartile range; PGY, postgraduate year.

[a]Mann-Whitney test comparing with "others."

Table 4

Percentage of Participants Working in Each Quintile of Municipalities, According to Population Density, From a Study of Rural Physician Placement Programs in Japan, 2014–2016

Category	Quintile of municipalities sorted by population density, no. (%)[a]					Total	*P* value[b]
	1	2	3	4	5		
PGY1							
Others	1,585 (19.7)	1,685 (21.0)	1,577 (19.6)	1,691 (21.1)	1,488 (18.5)	8,026 (100.0)	
Quota alone	27 (29.3)	26 (28.3)	16 (17.4)	14 (15.2)	9 (9.8)	92 (100.0)	.017
Scholarship alone	56 (47.9)	39 (33.3)	10 (8.5)	8 (6.8)	4 (3.4)	117 (100.0)	< .001
Quota with scholarship	83 (46.6)	48 (27.0)	28 (15.7)	15 (8.4)	4 (2.2)	178 (100.0)	< .001
Total	1,751 (20.8)	1,798 (21.4)	1,631 (19.4)	1,728 (20.5)	1,505 (17.9)	8,413 (100.0)	
PGY2							
Others	1,425 (18.6)	1,530 (20.0)	1,598 (20.9)	1,577 (20.6)	1,517 (19.8)	7,647 (100.0)	
Quota alone	39 (38.2)	22 (21.6)	19 (18.6)	18 (17.6)	4 (3.9)	102 (100.0)	< .001
Scholarship alone	63 (46.7)	45 (33.3)	19 (14.1)	6 (4.4)	2 (1.5)	135 (100.0)	< .001
Quota with scholarship	68 (50.7)	36 (26.9)	16 (11.9)	6 (4.5)	8 (6.0)	134 (100.0)	< .001
Total	1,595 (19.9)	1,633 (20.4)	1,652 (20.6)	1,607 (20.0)	1,531 (19.1)	8,018 (100.0)	
PGY3							
Others	1,299 (18.0)	1,326 (18.3)	1,511 (20.9)	1,518 (21.0)	1,579 (21.8)	7,233 (100.0)	
Quota alone	21 (42.0)	7 (14.0)	9 (18.0)	11 (22.0)	2 (4.0)	50 (100.0)	< .001
Scholarship alone	60 (54.1)	24 (21.6)	6 (5.4)	8 (7.2)	13 (11.7)	111 (100.0)	< .001
Quota with scholarship	47 (65.3)	19 (26.4)	4 (5.6)	1 (1.4)	1 (1.4)	72 (100.0)	< .001
Total	1,427 (19.1)	1,376 (18.4)	1,530 (20.5)	1,538 (20.6)	1,595 (21.4)	7,466 (100.0)	
Total							
Others	4,309 (18.8)	4,541 (19.8)	4,686 (20.5)	4,786 (20.9)	4,584 (20.0)	22,906 (100.0)	
Quota alone	87 (35.7)	55 (22.5)	44 (18.0)	43 (17.6)	15 (6.1)	244 (100.0)	< .001

Scholarship alone	179 (49.3)	108 (29.8)	35 (9.6)	22 (6.1)	19 (5.2)	363 (100.0)	< .001
Quota with scholarship	198 (51.6)	103 (26.8)	48 (12.5)	22 (5.7)	13 (3.4)%	384 (100.0)	< .001
Total	4,773 (20.0)	4,807 (20.1)	4,813 (20.1)	4,873 (20.4)	4,631 (19.4)	23,897 (100.0)	

Abbreviation: PGY indicates postgraduate year.

[a]Quintile 1 ≤ 612.25; Quintile 2 ≤ 1,326.45; Quintile 3 ≤ 4,848.32; Quintile 4 ≤ 11,384.65; Quintile 5 ≥ 11,384.66 people per square kilometer.

[b]Chi-square test comparing with “others.”