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Results of physician license examination and scholarship contract compliance by the graduates of regional subquotas in Japanese medical schools

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Keywords: physicians; geography; medical education; health policy; Japan

Word count: 2732

ABSTRACT

Objectives:

Responding to the serious shortage of physicians in rural areas, the Japanese government has aggressively increased the number of entrants to medical schools since 2008, mostly as a *chiikiwaku*, a regional subquota. The subquota has spread to most medical schools, and these entrants occupied 16% of all medical school seats in 2016. Most of these entrants were admitted to medical school with a scholarship with the understanding that after graduation they will practice in designated areas of their home prefectures for several years. The subquota and scholarship systems will be revised by the government starting in 2018. This study evaluates the intermediate outcomes of the subquota system and prefecture scholarship programmes.

Design: Cross-sectional survey to all prefectural governments and medical schools every year from 2014 to 2017

Settings: Nationwide

Participants: All subquota and non-subquota graduates with prefecture scholarship in each prefecture, and all the subquota graduates without scholarship in each medical school.

Primary outcome measures: Passing rate of the National License Examination for Physicians, and the percentage of graduates who have not bought out the scholarship contract after graduation.

Results: Almost all of Japan's prefectures and medical schools participated in this study

(97.8-100%). Subquota graduates with scholarship were significantly more likely to pass the National License Examination for Physicians than all medical graduates in all the years (97.9, 96.7, 97.4 and 94.7% versus 93.9, 94.5, 94.3 and 91.8%, respectively). The percentage of subquota graduates with scholarship who remained in the scholarship contract 3.25 years after graduation was 92.2% , and 89.9% for non-subquota graduates with scholarship.

Conclusions: Subquota entrants showed better academic performance than their peers. Most of the subquota graduates remained in the contractual workforce. The imminent revision of the national policies regarding subquota and scholarship systems need to be based on this evidence.

Strengths and limitations of this study

- This study shows intermediate outcomes of subquota admission system of medical schools and prefecture scholarship programmes, one of the largest national policies enacted to improve Japan's geographic maldistribution of physicians.
- With support from concerned ministries and the representative body of medical schools, almost all of Japan's prefectural governments and medical schools participated in this study, which enabled the collection of reliable information on study subjects every year.
- The passing rates of the National License Examination for Physicians of the subquota graduates with scholarship, subquota graduates without scholarship, and non-subquota graduates with scholarship were compared to that of all medical graduates in Japan.
- The percentages of subquota and non-subquota graduates with scholarship who have not bought out the scholarship contract were calculated and compared.
- Geographic location of the subquota graduates and scholarship recipients are unknown, and will be shown based on the data from the ongoing nationwide cohort study, a part of which is this study.

INTRODUCTION

Geographic distribution of physicians in Japan

The geographic inequity of physician distribution has long been a social problem in Japan and in many other countries. Japan's national and local governments have attempted to solve this problem by establishing public hospitals and clinics in rural areas since 1950s, creating at least one medical school in each prefecture in 1960s and 1970s, including Jichi Medical University in 1972 which is exclusively responsible for producing rural physicians.[1,2]

Over the long term, these policies have increased the number of physicians in rural areas,[3] but many studies revealed that the disparity in the number of urban and rural physicians has been persisting.[3-8] This maldistribution of physicians has worsened since 2004 when the new residency training system for the physicians within the first two years after graduation was introduced nationwide.[4,8] Furthermore, the new specialty training system for physicians after the residency training is schedule to start in 2018, which has caused a great concern among health professionals and policy makers that young physicians will be even more likely to cluster in large cities.[9-12]

Chiikiwaku (regional subquota) and prefecture scholarship as a national policy

In response to such a situation, the national government has aggressively increased the number of entrants to medical schools since 2008. Most of these entrants were admitted as a *chiikiwaku*, a regional subquota of a medical school. The subquota has spread to most of the medical schools in Japan. The subquota is a special admission quota of a medical school in which entrants were

admitted under the condition that they practice in designated areas of their home prefectures, usually in rural areas in exchange for a scholarship by the prefectural government.[13] The scholarship is given for the all six years of undergraduate medical education, and the graduate is required to work in the prefecture for nine years after graduation including four years in rural areas of the prefecture. Some medical schools have a regional subquota without the scholarship. Entrants under this form of subquota thus are not contractually required to work in designated areas though they are expected to do so.[14] The number of entrants to any form of regional subquota is now 1504, accounting for 16% of all medical school students in Japan.[15,16] The model of these subquotas was Jichi Medical University.

Apart from the scholarship given in couple with the subquota admission, there are scholarship programmes of prefectural governments for non-*chiikiwaku* students. These scholarships are also based in national policy. The scholarship is given to a medical student who has been admitted to a medical school and then applies to the scholarship programme. The recipients of these scholarships are also required to work in the designated areas of the prefecture for a certain amount of time, usually 1.5 times the length of the term of the scholarship. Half of that contractual period is to be spent practicing in rural areas of the prefecture.[14]

Academic performance and compliance of scholarship contract

Admission to medical schools in Japan is highly competitive. In 2016, one in four applicants of public medical schools and one in 16 applicants of private medical schools were accepted.[17,18] Medical schools have not traditionally imposed restrictions on the geographic background of applicants, so each medical school, even rural ones, attracts applicants from all over Japan. Most the medical schools require several days of tests and an interview of all the applicants, so given the lack of time for interviews, admission decisions are largely based on scores of written test.

Entrance examination for regional subquota is different. Most medical schools admit students only from the prefecture in which they live and/or where the scholarship is given. In addition, many medical schools consider only applicants who have been recommended by their high schools. Thus there are far fewer applicants to the subquotas. The application process for subquota applicants is usually a combination of written test, academic records in the high school, a personal statement, and an interview. The academic test thus carries less weight as compared with the conventional admission process. Because of these differences, the academic performance of subquota entrants have been concerned about among general population and medical educators since the start of this special admission system.[14] However, so far, no researchers seem to have compared the academic outcomes of subquota and non-subquota students.

There has also been a concern that many subquota entrants may buy out the scholarship contract to avoid practicing in the prefecture and/or in rural areas. However, no researchers have investigated

how many subquota entrants have actually done this.

Objectives of this study

In this study we compared the results of the National License Examination for Physicians among graduates of subquota with scholarship, subquota without scholarship, non-subquota with scholarship and all new medical graduates in Japan. We also showed the percentages of those graduates who have not bought out the scholarship and thus completed their contractual work. We assessed the intermediate outcomes of subquota and scholarship systems, and attempted to offer scientific evidence to inform political decision makers for future revision of the subquota and scholarship systems.

METHODS

The method of this study has already been reported,[14] thus is described briefly.

Design and settings

This study is a part of the nationwide cohort study conducted by the Japanese Council for Community-based Medical Education (JCCME). Yearly cross-sectional outcomes of the cohort study are reported in this study. The study period is from 2014 to 2017. The study include the following

three groups of subjects: subquota graduates with scholarship, non-subquota graduates with scholarship (scholarship alone), and subquota graduates without scholarship. Data of the former two groups were collected from prefectures and that of the last group were from medical schools (Figure 1).

Figure 1 here

Every November, the cohort study office of JCCME sent a pre-survey questionnaire to all the 47 prefectures and all the 77 medical schools except for Jichi Medical University, National Defence Medical College, and University of Occupational and Environmental Health to know which prefectures and medical schools have eligible subjects. Every year all the prefectures and medical schools responded to this. In June of the survey year, the study office sends a survey questionnaire to each prefectural government to obtain information on the number of new graduates who had received scholarship, the number who passed the National License Examination for Physicians, and the number who have bought out the scholarship. The cohort office sends a questionnaire to each medical school to obtain information on the number of subquota students without scholarship and number who passed the National License Examination for Physicians. 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 prefectures and/or medical schools to participate.

Definitions of subquota and scholarship

In this study, a subquota of medical school 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."

Statistical analyses

Based on the data obtained from the prefectures and medical schools, passing rates of the National License Examination for Physicians were calculated for the subjects in subquota with scholarship, subquota without scholarship, and non-subquota with scholarship (scholarship alone). The rates in 2014 and 2015 have been reported previously,[14] and in this study, results in 2015 and 2016 were added. These rates were compared with the passing rate of all medical school graduates in Japan reported every year by the Ministry of Health, Labour and Welfare.[19,20] The comparisons were conducted with the Fisher's exact test.

Also based on the data from the prefectures, retention rates for contractual workforce of subjects

in subquota with scholarship and subjects with scholarship alone were calculated. The retention rate is the percentage of graduates who are complying with the terms of being admitted to a subquota and/or receiving scholarship. The retention rate of each group each year was calculated with Kaplan-Meier survival analysis. The retention rates were compared between the two groups with the log-rank test.

Statistical analyses were done using SPSS version 24 (IBM-SPSS Japan, Tokyo) and R version 3.3.2 (R Foundation for Statistical Computing, Vienna, Austria). P values less than 0.05 (two-sided test) were regarded as statistically significant.

RESULTS

Response rates

The response rates of prefectures and medical schools in each year are shown in Table 1. The response rate is the percentage of those who returned a completed questionnaire to the study office among all the prefectures or medical schools which have eligible subjects. The number of subjects in all the responding prefectures or medical schools in each year is shown in Table 1. Almost all prefectures and medical schools with eligible subjects participated (response rates 97.8-100%).

Table 1 here

Passing rates of the National Physician License Examination

Passing rates of subquota with scholarship, subquota without scholarship, scholarship alone, and all new graduates of Japanese medical schools (control group) each year are shown in Figure 2A-D. Throughout the study period, the passing rates of subquota graduates with scholarship, subquota graduates without scholarship, and non-subquota with scholarship were higher than the passing rate of all the new medical graduates in Japan. The percentage of subquota with scholarship was significantly higher than the percentage of all new graduates in all the years (97.9, 96.7, 97.4 and 94.7% v.s. 93.9, 94.5, 94.3 and 91.8%, respectively). The passing rate of subquota with scholarship was the highest among all the groups except for 2017 in which the percentage of scholarship alone was the highest.

Figure 2A-D here

Retention rates for contractual work (non-buying-out rates)

The retention rate, the 100% - scholarship buying-out rate, of subjects in subquota with scholarship and that of those in non-subquota with scholarship is shown in Figure 3A-D. Figure 3A-C shows the retention rates of the two groups who graduated in 2014, 2015 and 2016. Figure 3D

shows the rates of all the graduates between 2014 and 2017. The retention rate varied by graduation year and at intervals after graduation. In all graduation years, the retention rate of subquota with scholarship was higher than that of scholarship alone at the end of follow-up, but the difference was not statistically significant (Figure 3A-C). The survival analysis including all the subjects who obtained physician license between 2014 and 2017 showed that the retention rate 3.25 years after graduation was 92.2% for those in subquota with scholarship and 89.9% for those with scholarship alone (statistically not significant: Figure 3D).

Figure 3A-D here

DISCUSSION

The results of this study showed that the graduates of regional subquota with scholarship were more likely to pass the National License Examination for Physicians than the other new graduates of medical schools. The passing rates of those in non-subquota with scholarship and those in subquota without scholarship were the highest. The percentage of those who remained in the contractual workforce accompanied with scholarship 3.25 years after graduation was 92.2% among those of subquota with scholarship, and 89.9% among those with scholarship alone.

There has been a concern about the academic level of subquota entrants because they are admitted to medical school under different criteria.[14] The results of this study, however, show that the concern is invalid. In Japan the length of undergraduate medical education is six years, which is long enough to obscure the correlation between academic performance at entrance and that at graduation.[21] Also in the usual admission process, many applicants are examined over the course of a few days, which forces medical schools to choose entrants solely based on their test scores. Elements other than the written test score, such as the personal statement and interview result, are not as valued. In contrast, the admission process in many of the regional subquotas is a combined evaluation of the applicant's high school activities, a recommendation letter from the high school, an interview, an academic test, and a personal statement. The variety of elements valued in the process may have contributed to the better performance on the physician license examination. Whether in a subquota or not, students with scholarship may be under socioeconomic pressure to become a physician immediately. The results of this study offer a warning to Japan's conventional medical school admission system. In the scheduled revision by the government for the new university entrance system in 2021, the selection of medical school applicants needs to be more effective.

There is a room for argument whether the contract retention rates shown in this study are high or low. The results shown are the representative value of all the subjects in all prefectures

of Japan. In reality, however, there is a substantial difference among prefectures. It is thus necessary to evaluate the result in each prefecture or in each medical school. The retention rate of graduates from Jichi Medical University, founded in 1972 solely to produce rural physicians and became the model when making regional subquota systems all over the country, is 97%.[22] The percentage is obviously higher than that of subquota graduates shown in this study. However the total amount of prefecture scholarship given to a Jichi student for six years is 23 million yen (equivalent to USD 209,090), which is double the average amount of scholarship for a subquota student: 12.2 million yen (USD 110,909).[23,24] In other words, we need to consider both the financial burden of the country/prefecture and the risk of losing workers, in order to make the subquota system both sustainable.

Internationally there are many financial incentive programmes to recruit physicians to practice in rural areas.[25,26] The estimated retention rate of the pooled subjects of these programmes was reportedly 71%.[26] The retention rate of subjects in state scholarship programmes for medical students in the United States was 66.5%.[27] It is not so meaningful, however, to compare the contract retention rate among programmes with different social and cultural contexts. In Japan it is important to prolong the observation period of this study and accumulate Japan's original data on its own unique subquota and scholarship system.

This study has the following limitations. First, as this study gathered information about

graduates, their academic performance and scholarship buy-out rate before graduation are unknown. According to the Association of Japan Medical Colleges, the straight graduation rate, which is the proportion of students who have finished their six-year medical program without repeating a school year, of subquota students who entered in 2008 was 89.6% nationwide, which was higher than the rate of all the medical school entrants in the year (85.4%). The rate of subquota entrants in 2009, which was 89.0%, was also higher than that of all medical students (84.2%).[24] The report also mentioned that 0.7% of undergraduate subquota students bought out their prefectural scholarship each year.[24] This information should be added to the results of this study when assessing the effectiveness of subquota and scholarship systems. The geographic location of the subquota graduates and scholarship recipients are not shown in this study. Their location, particularly after their contractual periods, is the most important outcome of these systems, and will be shown in the near future based on the data from the ongoing cohort study.

Regional subquotas and prefecture scholarships are based on temporary legislation by the national government, and thus the systems will be revised starting in 2018. In most of the prefectures, however, the first generation of the subquota entrants is still undergoing its clinical training or have just started their practice in rural areas. So, as of this writing (summer 2017), we cannot assess the final outcomes of these systems. All we can do is to collect intermediate outcomes like those shown in this study, analyse them in a variety of dimensions, and engage in

evidence-based decision making for the future national policies while accumulating data for the next assessment.

CONCLUSION

The passing rate of the entrants to the *chiikiwaku*, regional subquota of medical schools, for the National License Examination for Physicians was higher than the rate of non-subquota medical graduates. The passing rate of prefecture scholarship recipients was also higher than non-recipients. More than 90% of subquota physicians with scholarship were complying with the terms of their contract more than three years after obtaining the physician license. The imminent revision of the national policy regarding the subquota and scholarship systems should be based on these intermediate outcomes.

Contributors

MM contributed to the study design, tools, study administration, data collection, analysis, interpretation of data, and writing the draft. KT and TM contributed to the study design, tools, study administration, data interpretation, and writing the draft. ST and KI contributed to the study design, interpretation of data, and writing the draft. SK contributed to the analysis and writing the draft, TO and SI contributed to the study administration, data collection.

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Competing interests

None

Ethics approval

Ethical approval was granted by the Ethics Committee for epidemiological research of Hiroshima University (ref. no. 778) and the Research Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences (ref. no. 13091342).

Data sharing statement

Conditions of the ethical approvals permit the cohort office (Department of Community-Based Medical System, Graduate School of Biomedical and Health Sciences, Hiroshima University) and the sub-office (Department of Community Medicine, Nagasaki University Graduate School of Biomedical Science) to share the cohort data. Aggregated data are shared with stakeholders or other researchers.

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Table 1. Response rates of prefectures and medical schools

Year	Prefectures			Medical Schools		
	N*	Response rate	Subjects**	N*	Response rate	Subjects***
2014	36/36	100%	466	19/19	100%	166
2015	45/46	97.8%	696	22/22	100%	253
2016	46/47	97.8%	838	29/29	100%	308
2017	47/47	100%	985	31/31	100%	382

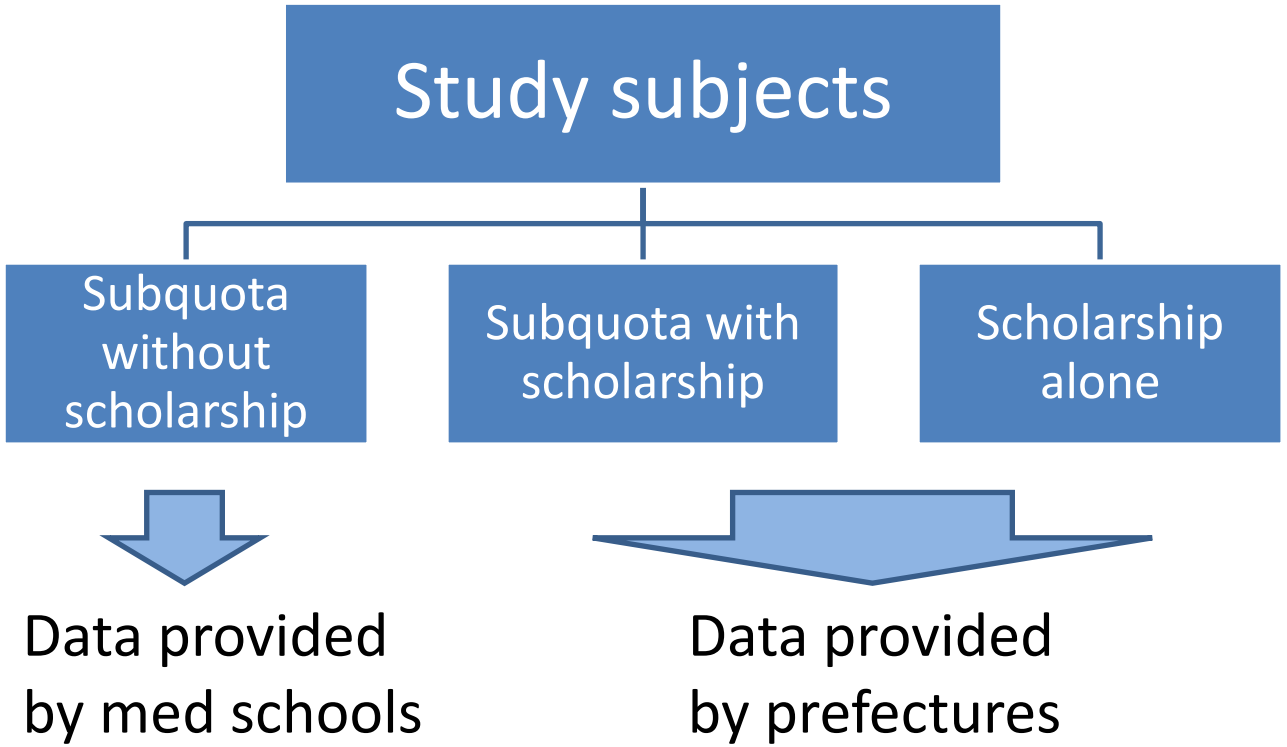
*Both the number of eligible prefectures (medical schools) and that of responded prefectures (medical schools) are shown.
**Subjects in prefectures are those in subquota with scholarship or those with scholarship alone.
***Subjects in medical schools are in subquota without scholarship.

Figure legends

Figure 1. Study subjects and data collection.

Figure 2. Passing rates of the National Licence Examination for Physicians (A: 2014, B: 2015, C: 2016, D: 2017). Control data were from the Ministry of Health, Labour and Welfare.[19,20] Rates in 2014 and 2015 have been reported previously.[14]

Figure 3. Retention rates of subjects in subquota with scholarship and those in non-subquota with scholarship (scholarship alone). (A: graduates in 2014, B: 2015, C: 2016, D: 2014-2017)


Study subjects
Subquota without scholarship
Subquota with scholarship
Scholarship alone
Data provided by med schools
Data provided by prefectures

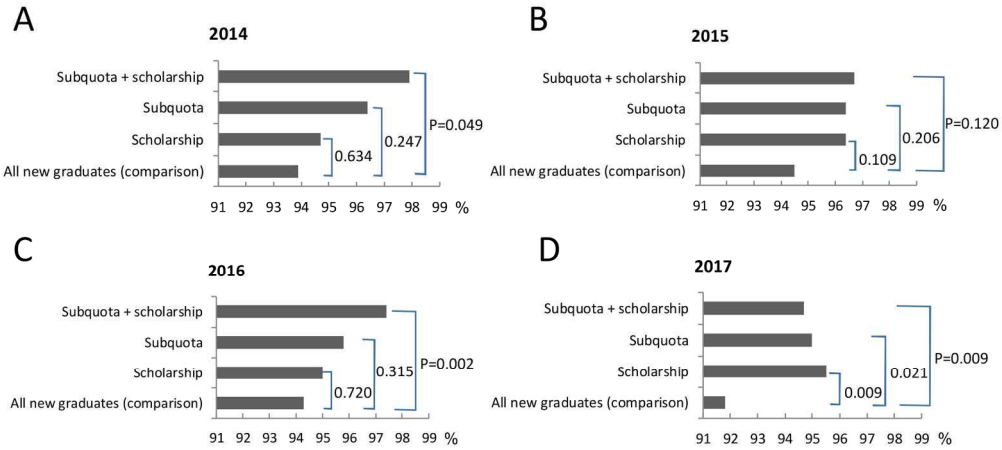


Figure 2. Passing rates of the National Licence Examination for Physicians (A: 2014, B: 2015, C: 2016, D: 2017). Control data were from the Ministry of Health, Labour and Welfare. Rates in 2014 and 2015 have been reported previously.

170x80mm (300 x 300 DPI)

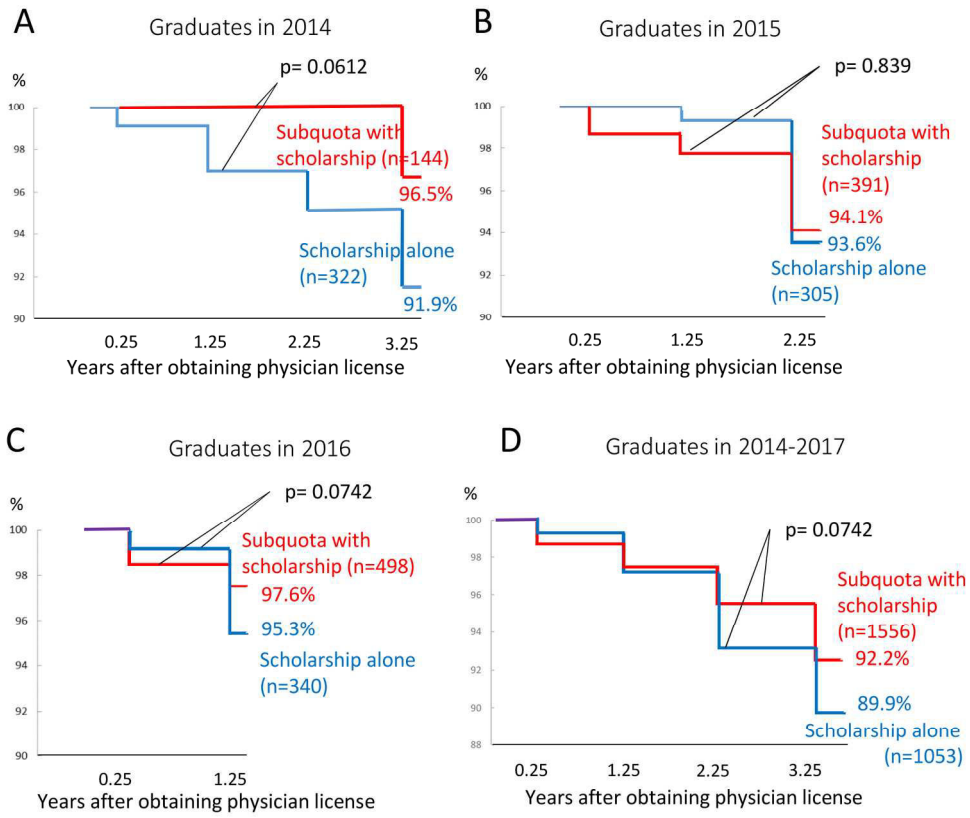


Figure 3. Retention rates of subjects in subquota with scholarship and those in non-subquota with scholarship (scholarship alone). (A: graduates in 2014, B: 2015, C: 2016, D: 2014-2017)

170x140mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-8
Objectives	3	State specific objectives, including any prespecified hypotheses	8
Methods			
Study design	4	Present key elements of study design early in the paper	8-9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8-9
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	9-10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9-11
Bias	9	Describe any efforts to address potential sources of bias	8-9
Study size	10	Explain how the study size was arrived at	Not needed. This study is a nationwide census.
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10-11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	10-11
		(*b*) Describe any methods used to examine subgroups and interactions	10-11
		(*c*) Explain how missing data were addressed	11
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	11

		(*e*) Describe any sensitivity analyses	Not needed.
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11
		(b) Give reasons for non-participation at each stage	11
		(c) Consider use of a flow diagram	9
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11
		(b) Indicate number of participants with missing data for each variable of interest	11
Outcome data	15*	Report numbers of outcome events or summary measures	11-13
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-13
		(*b*) Report category boundaries when continuous variables were categorized	11-13
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not relevent
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-13
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15-16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Results of physician license examination and scholarship contract compliance by the graduates of regional quotas in Japanese medical schools

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Results of physician license examination and scholarship contract compliance by the graduates of regional quotas in Japanese medical schools

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ABSTRACT

Objectives:

Responding to the serious shortage of physicians in rural areas, the Japanese government has aggressively increased the number of entrants to medical schools since 2008, mostly as a *chiikiwaku*, entrants filling a regional quota. The quota has spread to most medical schools, and these entrants occupied 16% of all medical school seats in 2016. Most of these entrants were admitted to medical school with a scholarship with the understanding that after graduation they will practice in designated areas of their home prefectures for several years. The quota and scholarship programmes will be revised by the government starting in 2018. This study evaluates the intermediate outcomes of these programmes.

Design: Cross-sectional survey to all prefectural governments and medical schools every year from 2014 to 2017 to obtain data on medical graduates.

Settings: Nationwide

Participants: All quota and non-quota graduates with prefecture scholarship in each prefecture, and all the quota graduates without scholarship in each medical school.

Primary outcome measures: Passing rate of the National License Examination for Physicians, and the percentage of graduates who have not bought out the scholarship contract after graduation.

Results: Most Japan's prefectures and medical schools participated in this study (97.8%-100%).

Quota graduates with scholarship were significantly more likely to pass the National License Examination than the other medical graduates in Japan at all the years (97.9, 96.7, 97.4 and 94.7% versus 93.9, 94.5, 94.3 and 91.8%, respectively). The percentage of quota graduates with scholarship who remained in the scholarship contract 3 years after graduation was 92.2%, and 89.9% for non-quota graduates with scholarship.

Conclusions: Quota entrants showed better academic performance than their peers. Most of the quota graduates remained in the contractual workforce. The imminent revision of the national policy regarding quota and scholarship programmes need to be based on this evidence.

Strengths and limitations of this study

- This study shows intermediate outcomes of quota admission programmes of medical schools and prefecture scholarship programmes, one of the largest national policies enacted to improve Japan's geographic maldistribution of physicians.
- With support from concerned ministries and the representative body of medical schools, almost all of Japan's prefectural governments and medical schools participated in this study, which enabled the collection of reliable information on study subjects every year.
- The passing rates of the National License Examination for Physicians of the quota graduates with scholarship, quota graduates without scholarship, and non-quota graduates with scholarship were compared with that of the other medical graduates in Japan. The percentages of quota and non-quota graduates with scholarship who have not bought out the scholarship contract were calculated and compared.
- This study is part of an ongoing nationwide cohort study, which will also examine the geographic location of quota graduates and scholarship recipients in the long run.

INTRODUCTION

Geographic distribution of physicians in Japan

The geographic inequity of physician distribution has long been a social problem in Japan and in

many other countries. Japan's national and local governments have attempted to solve this problem by establishing public hospitals and clinics in rural areas since 1950s, creating at least one medical school in each prefecture in 1960s and 1970s, including Jichi Medical University in 1972 which is exclusively responsible for producing rural physicians.[1,2]

Over the long term, these policies have increased the number of physicians in rural areas,[3] but many studies revealed that the disparity in proportional representation of urban and rural physicians has persisted.[3-8] This maldistribution of physicians has worsened since 2004 when the new residency training programme for the physicians within the first two years after graduation was introduced nationwide.[4,8] Furthermore, additional specialty training for physicians after residency training, scheduled to start in 2018, has caused concern among health care professionals and policy makers that young physicians will be even more likely to cluster in large cities.[9-12]

Chiikiwaku (regional quota) and prefecture scholarship as a national policy

In response to such a situation, the national government has aggressively increased the number of entrants to medical schools since 2008. Most of these entrants were admitted as a *chiikiwaku*, a regional quota of a medical school. The model of these quotas was Jichi Medical University. The quota had spread to 67 of the 80 medical schools by the end of 2016.[13] The quota is a special admission quota of a medical school in which entrants were admitted under the condition that they

practice in designated areas of their home prefectures, usually in rural areas in exchange for a scholarship by the prefectural government.[14] The scholarship is given for the all six years of undergraduate medical education, and the graduate is required to work in the prefecture for nine years after graduation including four years in rural areas of the prefecture. The prefecture governments allocate a budget for the scholarship according to the national policy. Some medical schools have a regional quota without the scholarship. Entrants under this form of quota thus are not contractually required to work in designated areas though they are expected to do so.[15] The number of entrants to any form of regional quota is now 1504, accounting for 16% of all medical school students in Japan.[16,17]

Apart from the scholarship coupled with the quota admission, there are scholarship programmes of prefectural governments for non-*chiikiwaku* students. These scholarships are also based in the national policy. The scholarship is given to a medical student who has been admitted to a medical school through a conventional admission process and then applies to the scholarship programme. The recipients of these scholarships are also required to work in the designated areas of the prefecture for a certain amount of time, usually 1.5 times the length of the term of the scholarship. Half of that contractual period is to be spent practicing in rural areas of the prefecture.[15]

Academic performance and compliance of scholarship contract

Admission to medical schools in Japan has been highly competitive. In 2016, one in four applicants of public medical schools and one in 16 applicants of private medical schools were accepted.[18,19] Medical schools have not traditionally imposed restrictions on the geographic background of applicants, so each medical school, even rural ones, attracts applicants from all over Japan. Most the medical schools require a few days of written tests coupled with a short interview of all the applicants, so given the lack of time for interviews, admission decisions are largely based on scores of written test.

Entrance examination for regional quota is different. Most medical schools admit students only from the prefecture in which the students live and/or from which the scholarship is given. In addition, many medical schools consider only applicants who have been recommended by their high schools. Thus there are far fewer applicants to the quotas. The application process for quota applicants is usually a combination of written test, academic records in the high school, a personal statement, and an interview. The academic test thus carries less weight as compared with the conventional admission process. Because of these differences, the general population and medical educators are concerned about the academic performance of quota entrants. In addition, there is a concern that many quota entrants may buy out their contract to avoid practising in the prefecture and/or in rural areas.[15] However, so far, no researchers seem to have compared the academic and contractual outcomes of quota and non-quota students in Japan.

Objectives of this study

In this study we compared the results of the National License Examination for Physicians among graduates of quota with scholarship, quota without scholarship, non-quota with scholarship and all the other new medical graduates in Japan. We also examined the percentages of those graduates who have not bought out the scholarship. We assessed the intermediate outcomes of quota and scholarship programmes, so that the results can be used to inform political decision-makers for future revision of the quota and scholarship programs.

METHODS

Design and settings

This study is a part of the nationwide cohort study conducted by the Japanese Council for Community-based Medical Education (JCCME).[15] Yearly cross-sectional outcomes of the cohort study are reported in this study. The study period is from 2014 to 2017. The study includes three groups of subjects: quota graduates with scholarship, non-quota graduates with scholarship (scholarship alone), and quota graduates without scholarship (quota alone). Data on the former two groups were collected from prefectures and that on the last group were collected from medical schools (Figure 1).

Figure 1 here

Every November, the cohort study office of JCCME sent a pre-survey questionnaire to all the 47 prefectures and all the 77 medical schools except for Jichi Medical University, National Defence Medical College, and University of Occupational and Environmental Health to ask which prefectures and medical schools have eligible subjects. Every year all the prefectures and medical schools responded to this. In June of the survey year, the study office sends a survey questionnaire to each prefectural government to obtain information on the number of new graduates who had received scholarship, the number who passed the National License Examination for Physicians, and the number who have bought out the scholarship. The cohort office sends a questionnaire to each medical school to obtain information on the number of quota students without scholarship and number who passed the National License Examination for Physicians. 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 prefectures and/or medical schools to participate.

Definitions of quota and scholarship

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."

Statistical analyses

Based on the data obtained from the prefectures and medical schools, passing rates of the National License Examination for Physicians were calculated for the subjects in quota with scholarship, quota without scholarship (quota alone), and non-quota with scholarship (scholarship alone). The rates in 2014 and 2015 have been reported previously,[15] and in this study, results in 2016 and 2017 were added. These rates were compared with the passing rate of all the other medical graduates in Japan. The passing rate of the other graduates was calculated by subtracting the numbers of passed and failed subjects in quota with scholarship, quota alone and scholarship alone from those of all new graduates in Japan reported every year by the Ministry of Health, Labour and Welfare.[20,21] The comparisons were conducted with the Fisher's exact test for a part of 2014 analysis because there were fewer than 5 failed subjects in quota with scholarship. All the other comparisons were conducted with the chi-square test of independence.

Also based on the data from the prefectures, retention rates for contractual workforce of subjects

in quota with scholarship and subjects with scholarship alone were calculated. The retention rate is the percentage of graduates who are complying with the terms of being admitted to a quota and/or receiving scholarship. The retention rate of each group was calculated in each cohort of graduation year. The retention rate of all those who graduated between 2014 and 2017 was also calculated with Kaplan-Meier survival analysis in which subjects with various observation periods were analysed. The retention rates were compared between the two groups with the log-rank test.

Statistical analyses were done using SPSS version 24 (IBM-SPSS Japan, Tokyo) and R version 3.3.2 (R Foundation for Statistical Computing, Vienna, Austria). P values less than 0.05 (two-sided test) were regarded as statistically significant.

All the data were provided and analysed anonymously.

RESULTS

Response rates

Almost all prefectures and medical schools with eligible subjects participated in this study (response rates 97.8-100%) (Table 1). The response rate is the percentage of those who returned a completed questionnaire to the study office among all the prefectures or medical schools which have eligible subjects.

Table 1 here

Passing rates of the National Physician License Examination

Throughout the study period, the passing rates of quota graduates with scholarship, quota graduates without scholarship, and non-quota with scholarship were higher than the passing rate of all the other new medical graduates in Japan (Figure 2A-D). The percentage of quota with scholarship was substantially higher than the percentage of all the other graduates in all the years (97.9, 96.7, 97.4 and 94.7% v.s. 93.9, 94.5, 94.3 and 91.8%, respectively), and the difference was statistically significant in all years except for 2015 (P= 0.034, 0.090, 0.002, and 0.003, respectively). The passing rate of quota with scholarship was the highest among all the groups except for 2017 in which the percentage of scholarship alone was the highest.

The passing rate of quota with scholarship was still higher than that of the comparison group except for 2017 even when the comparison group was limited to the graduates of public (i.e., national or prefectural) medical schools (93.6%, 94.8%, 95.3%, and 95.1% respectively). The difference was however significant only in 2016 (p=0.16, 0.31, 0.02, and 0.31 respectively) (data not shown in the figure).

Figure 2A-D here

Retention rates for contractual work (non-buying-out rates)

Figure 3A-C shows the retention rates of subjects in quota with scholarship and those in non-quota with scholarship. Figure 3D shows the rates of all the graduates between 2014 and 2017. The retention rate varied by graduation year and at intervals after graduation. In all graduation years, the retention rate of quota with scholarship was higher than that of scholarship alone at the end of follow-up, but the difference was not statistically significant (Figure 3A-C). The survival analysis including all the subjects who obtained physician license between 2014 and 2017 showed that the retention rate 3.25 years after graduation was 92.2% for those in quota with scholarship and 89.9% for those with scholarship alone (statistically not significant: Figure 3D).

The 2014-2017 retention rate of quota with scholarship varied substantially among prefectures (78.4%-100%). The rate of scholarship alone likewise varied among prefectures (70.8%-100%) (data not shown in the figure).

Figure 3A-D here

DISCUSSION

The results of this study showed that the graduates of regional quota with scholarship were

more likely to pass the National License Examination for Physicians than the other new graduates of medical schools. The percentage of those who remained in the contractual workforce accompanied with scholarship 3.25 years after graduation was 92.2% among those of quota with scholarship, and 89.9% among those with scholarship alone.

There has been a concern about the academic level of quota entrants because they are admitted to medical school under different criteria.[15] The results of this study, however, show that the concern is invalid at least for the observed period. In Japan the length of undergraduate medical education is six years, which is long enough to obscure the correlation between academic performance at entrance and that at graduation.[22] Also in the usual admission process, many applicants are examined over the course of a few days, which forces medical schools to choose entrants solely based on their test scores. Elements other than the written test score, such as the personal statement and interview result, are not as valued. In contrast, the admission process in many of the regional quotas is a combined evaluation of the applicant's high school activities, a recommendation letter from the high school, an interview, an academic test, and a personal statement. The variety of elements valued in the process may have contributed to a better academic performance of quota students, and subsequently the better outcome on the physician license examination. The results of this study thus offer a warning to Japan's conventional medical school admission process. The government of Japan is scheduled to revise,

on a nationwide basis, the process of university entrance in 2021. This revision should make the selection of medical school applicants more effective.

There is a room for argument whether the contract retention rates shown in this study are high or low. The results shown are the overall value of all the subjects in all prefectures of Japan. In reality, however, there is a substantial difference among prefectures. It is thus necessary to evaluate the result in each prefecture or in each medical school. The retention rate of graduates from Jichi Medical University, founded in 1972 solely to produce rural physicians and became the model when making regional quota programmes all over the country, is 97%.[23] The percentage is obviously higher than that of quota graduates shown in this study. However the total amount of prefecture scholarship given to a Jichi student for six years is 23 million yen (equivalent to USD 209,090), which is double the average amount of scholarship for a quota student: 12.2 million yen (USD 110,909).[13,24] In order to make the quota programme sustainable, we need to consider the balance between the financial burden of the country/prefecture and the certainty to secure physicians in needed areas. Also the differences in the training offered to students, in the focus of the school, and in postgraduate training programmes may have contributed to the gap in retention rates between Jichi and quotas.

Internationally there are many financial incentive programmes to recruit physicians to practice in rural areas.[25,26] The estimated retention rate of the pooled subjects of these

programmes was reported to be 71%.[26] The retention rate of subjects in state scholarship programmes for medical students in the United States was 66.5%.[27] While international data are favourable, it is not known if the relationships would hold for Japan. Thus further study is needed in Japan.

This study has the following limitations. First, as this study gathered information about graduates, their academic performance and scholarship buy-out rate before graduation are unknown. According to the Association of Japan Medical Colleges, the straight graduation rate, which is the proportion of students who have finished their six-year medical program without repeating a school year, of quota students who entered in 2008 was 89.6% nationwide, which was higher than the rate of all the medical school entrants in the year (85.4%). The rate of quota entrants in 2009, which was 89.0%, was also higher than that of all medical students (84.2%).[13] The report also mentioned that 0.7% of undergraduate quota students bought out their prefectural scholarship each year.[13] This information should be added to the results of this study when assessing the effectiveness of quota and scholarship programmes. The geographic location of the quota graduates and scholarship recipients are not shown in this study. Their location, particularly after their contractual periods, is the most important outcome of these programs, and will be assessed in the near future, based on the data from the ongoing cohort study.

Regional quotas and prefecture scholarships are based on temporary legislation by the

national government, and thus the programmes will be revised starting in 2018. In most of the prefectures, however, the first generation of the quota entrants is still undergoing its clinical training or have just started their practice in rural areas. So, as of this writing (summer 2017), we cannot assess the final outcomes of these programmes. All we can do is to collect intermediate outcomes like those shown in this study, analyse them in a variety of dimensions, and engage in evidence-based decision making for the future national policies while accumulating data for the next assessment.

CONCLUSION

The passing rate of the entrants to the *chiikiwaku*, regional quota of entrants to medical schools, for the National License Examination for Physicians was higher than the rate of non-quota medical graduates. The passing rate of prefecture scholarship recipients was also higher than non-recipients. More than 90% of quota physicians with scholarship were complying with the terms of their contract for more than three years after obtaining the physician license during which we observed. The imminent revision of the national policy regarding the quota and scholarship programmes should be based on these intermediate outcomes.

Contributors

MM contributed to the study design, tools, study administration, data collection, analysis, interpretation of data, and writing the draft. KT and TM contributed to the study design, tools, study administration, data interpretation, and writing the draft. ST and KI contributed to the study design, interpretation of data, and writing the draft. SK contributed to the analysis and writing the draft, TO and SI contributed to the study administration, data collection.

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Competing interests

None

Ethics approval

Ethical approval was granted by the Ethics Committee for epidemiological research of Hiroshima University (ref. no. 778) and the Research Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences (ref. no. 13091342).

Data sharing statement

Conditions of the ethical approvals permit the cohort office (Department of Community-Based Medical System, Graduate School of Biomedical and Health Sciences, Hiroshima University) and the sub-office (Department of Community Medicine, Nagasaki University Graduate School of

Biomedical Science) to share the aggregated data with stakeholders or researchers.

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Table 1. Response rates of prefectures and medical schools

Table 1. Response rates of prefectures and medical schools

Year	Prefectures				Medical Schools		
	N*	Response rate	Subjects		N*	Response rate	Subjects
			Quota with scholarship	Scholarship alone			Quota alone
2014	36/36	100%	144	322	19/19	100%	166
2015	45/46	97.8%	305	391	22/22	100%	253
2016	46/47	97.8%	498	340	29/29	100%	308
2017	47/47	100%	609	376	31/31	100%	382

*Both the number of eligible prefectures (medical schools) and that of responded prefectures (medical schools) are shown.

Figure legends

Figure 1. Study subjects and data collection.

Figure 1 footnote. “Quota with scholarship” are students who entered a regional quota and received a prefecture scholarship, “quota alone” are students who entered the quota but did not receive the scholarship, “scholarship alone” are students who received the scholarship but did not enter the quota, and others are all medical students excluding quota and scholarship ones.

Figure 2. Passing rates of the National Licence Examination for Physicians (A: 2014, B: 2015, C: 2016, D: 2017).

Figure 2 footnote. Control data were from the Ministry of Health, Labour and Welfare.[20,21] Rates in 2014 and 2015 have been reported previously.[15] *Fisher’s exact test.

Figure 3. Retention rates of subjects in quota with scholarship and those in non-quota with scholarship (scholarship alone). (A: graduates in 2014, B: 2015, C: 2016, D: 2014-2017)

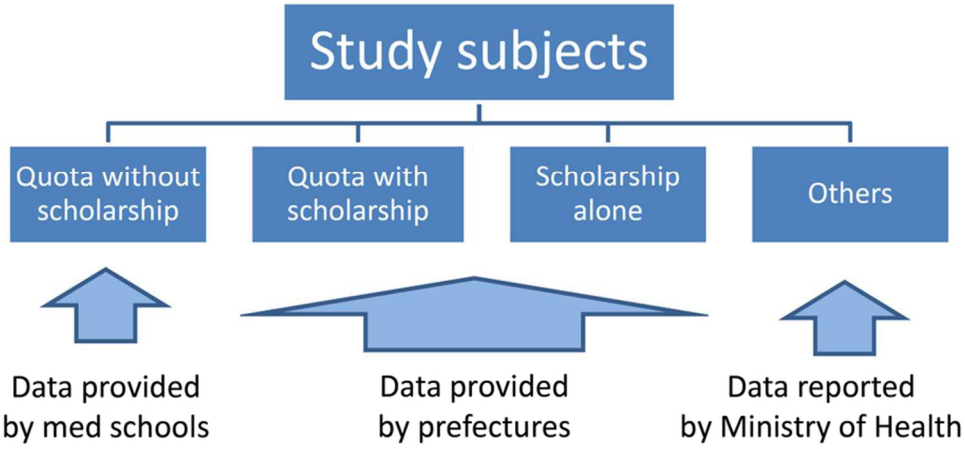

Figure 1

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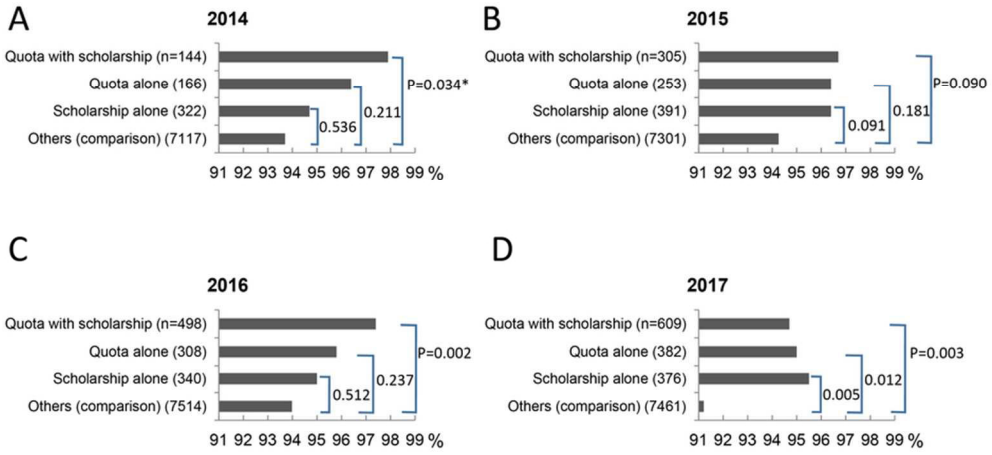

Figure 2

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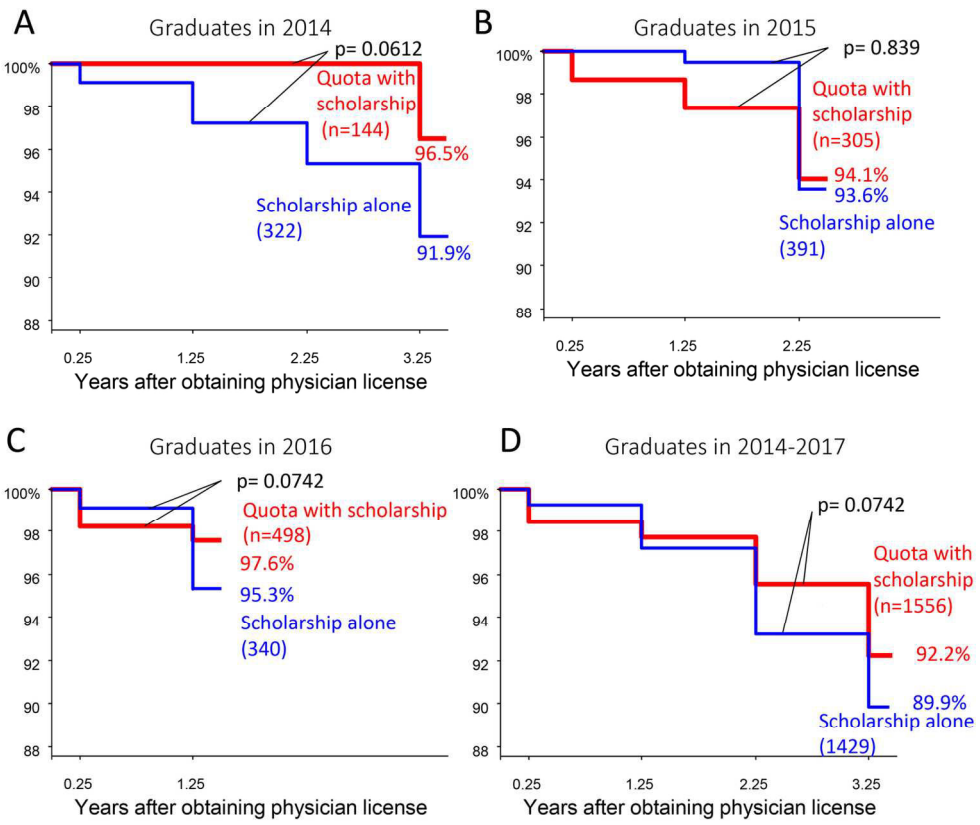

Figure 3

140x116mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-8
Objectives	3	State specific objectives, including any prespecified hypotheses	8
Methods			
Study design	4	Present key elements of study design early in the paper	8-9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8-9
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	9-10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9-11
Bias	9	Describe any efforts to address potential sources of bias	8-9
Study size	10	Explain how the study size was arrived at	Not needed. This study is a nationwide census.
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10-11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	10-11
		(*b*) Describe any methods used to examine subgroups and interactions	Not applicable
		(*c*) Explain how missing data were addressed	11
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	11

		(*e*) Describe any sensitivity analyses	Not needed.
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11
		(b) Give reasons for non-participation at each stage	11
		(c) Consider use of a flow diagram	9
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	No data
		(b) Indicate number of participants with missing data for each variable of interest	11 (no data on missing subjects)
Outcome data	15*	Report numbers of outcome events or summary measures	11-13
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-13
		(*b*) Report category boundaries when continuous variables were categorized	11-13
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not relevent
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Not applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15-16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Results of physician license examination and scholarship contract compliance by the graduates of regional quotas in Japanese medical schools: a nationwide cross-sectional survey

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Results of physician license examination and scholarship contract compliance by the graduates of regional quotas in Japanese medical schools: a nationwide cross-sectional survey

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Keywords: physicians; geography; medical education; health policy; Japan

Word count: 2856

ABSTRACT

Objectives:

Responding to the serious shortage of physicians in rural areas, the Japanese government has aggressively increased the number of entrants to medical schools since 2008, mostly as a *chiikiwaku*, entrants filling a regional quota. The quota has spread to most medical schools, and these entrants occupied 16% of all medical school seats in 2016. Most of these entrants were admitted to medical school with a scholarship with the understanding that after graduation they will practice in designated areas of their home prefectures for several years. The quota and scholarship programmes will be revised by the government starting in 2018. This study evaluates the intermediate outcomes of these programmes.

Design: Cross-sectional survey to all prefectural governments and medical schools every year from 2014 to 2017 to obtain data on medical graduates.

Settings: Nationwide

Participants: All quota and non-quota graduates with prefecture scholarship in each prefecture, and all the quota graduates without scholarship in each medical school.

Primary outcome measures: Passing rate of the National License Examination for Physicians, and the percentage of graduates who have not bought out the scholarship contract after graduation.

Results: Most Japan's prefectures and medical schools participated in this study (97.8%-100%).

Quota graduates with scholarship were significantly more likely to pass the National License Examination than the other medical graduates in Japan at all the years (97.9, 96.7, 97.4 and 94.7% versus 93.9, 94.5, 94.3 and 91.8%, respectively). The percentage of quota graduates with scholarship who remained in the scholarship contract 3 years after graduation was 92.2%, and 89.9% for non-quota graduates with scholarship.

Conclusions: Quota entrants showed better academic performance than their peers. Most of the quota graduates remained in the contractual workforce. The imminent revision of the national policy regarding quota and scholarship programmes need to be based on this evidence.

Strengths and limitations of this study

- This study shows intermediate outcomes of quota admission programmes of medical schools and prefecture scholarship programmes, one of the largest national policies enacted to improve Japan's geographic maldistribution of physicians.
- With support from concerned ministries and the representative body of medical schools, almost all of Japan's prefectural governments and medical schools participated in this study, which enabled the collection of reliable information on study subjects every year.
- The passing rates of the National License Examination for Physicians of the quota graduates with scholarship, quota graduates without scholarship, and non-quota graduates with scholarship were compared with that of the other medical graduates in Japan.
- The percentages of quota and non-quota graduates with scholarship who have not bought out the scholarship contract were calculated and compared with each other.
- The geographic location of the quota graduates and scholarship recipients are not shown in this study, which will be assessed in the ongoing cohort study of which this study is a part.

INTRODUCTION

Geographic distribution of physicians in Japan

The geographic inequity of physician distribution has long been a social problem in Japan and in many other countries. Japan's national and local governments have attempted to solve this problem by establishing public hospitals and clinics in rural areas since 1950s, creating at least one medical school in each prefecture in 1960s and 1970s, including Jichi Medical University in 1972 which is exclusively responsible for producing rural physicians.[1,2]

Over the long term, these policies have increased the number of physicians in rural areas,[3] but many studies revealed that the disparity in proportional representation of urban and rural physicians has persisted.[3-8] This maldistribution of physicians has worsened since 2004 when the new residency training programme for the physicians within the first two years after graduation was introduced nationwide.[4,8] Furthermore, additional specialty training for physicians after residency training, scheduled to start in 2018, has caused concern among health care professionals and policy makers that young physicians will be even more likely to cluster in large cities.[9-12]

***Chiikiwaku* (regional quota) and prefecture scholarship as a national policy**

In response to such a situation, the national government has aggressively increased the number of entrants to medical schools since 2008. Most of these entrants were admitted as a *chiikiwaku*, a regional quota of a medical school. The model of these quotas was Jichi Medical University. The

quota had spread to 67 of the 80 medical schools by the end of 2016.[13] The quota is a special admission quota of a medical school in which entrants were admitted under the condition that they practice in designated areas of their home prefectures, usually in rural areas in exchange for a scholarship by the prefectural government.[14] The scholarship is given for the all six years of undergraduate medical education, and the graduate is required to work in the prefecture for nine years after graduation including four years in rural areas of the prefecture. The prefecture governments allocate a budget for the scholarship according to the national policy. Some medical schools have a regional quota without the scholarship. Entrants under this form of quota thus are not contractually required to work in designated areas though they are expected to do so.[15] The number of entrants to any form of regional quota is now 1504, accounting for 16% of all medical school students in Japan.[16,17]

Apart from the scholarship coupled with the quota admission, there are scholarship programmes of prefectural governments for non-*chiikiwaku* students. These scholarships are also based in the national policy. The scholarship is given to a medical student who has been admitted to a medical school through a conventional admission process and then applies to the scholarship programme. The recipients of these scholarships are also required to work in the designated areas of the prefecture for a certain amount of time, usually 1.5 times the length of the term of the scholarship. Half of that contractual period is to be spent practicing in rural areas of the prefecture.[15]

Academic performance and compliance of scholarship contract

Admission to medical schools in Japan has been highly competitive. In 2016, one in four applicants of public medical schools and one in 16 applicants of private medical schools were accepted.[18,19] Medical schools have not traditionally imposed restrictions on the geographic background of applicants, so each medical school, even rural ones, attracts applicants from all over Japan. Most the medical schools require a few days of written tests coupled with a short interview of all the applicants, so given the lack of time for interviews, admission decisions are largely based on scores of written test.

Entrance examination for regional quota is different. Most medical schools admit students only from the prefecture in which the students live and/or from which the scholarship is given. In addition, many medical schools consider only applicants who have been recommended by their high schools. Thus there are far fewer applicants to the quotas. The application process for quota applicants is usually a combination of written test, academic records in the high school, a personal statement, and an interview. The academic test thus carries less weight as compared with the conventional admission process. Because of these differences, the general population and medical educators are concerned about the academic performance of quota entrants. In addition, there is a concern that many quota entrants may buy out their contract to avoid practising in the prefecture and/or in rural

areas.[15] However, so far, no researchers seem to have compared the academic and contractual outcomes of quota and non-quota students in Japan.

Objectives of this study

In this study we compared the results of the National License Examination for Physicians among graduates of quota with scholarship, quota without scholarship, non-quota with scholarship and all the other new medical graduates in Japan. We also examined the percentages of those graduates who have not bought out the scholarship. We assessed the intermediate outcomes of quota and scholarship programmes, so that the results can be used to inform political decision-makers for future revision of the quota and scholarship programs.

METHODS

Design and settings

This study is a part of the nationwide cohort study conducted by the Japanese Council for Community-based Medical Education (JCCME).[15] Yearly cross-sectional outcomes of the cohort study are reported in this study. The study period is from 2014 to 2017. The study includes three groups of subjects: quota graduates with scholarship, non-quota graduates with scholarship (scholarship alone), and quota graduates without scholarship (quota alone). Data on the former two

groups were collected from prefectures and that on the last group were collected from medical schools (Figure 1).

Figure 1 here

Every November, the cohort study office of JCCME sent a pre-survey questionnaire to all the 47 prefectures and all the 77 medical schools except for Jichi Medical University, National Defence Medical College, and University of Occupational and Environmental Health to ask which prefectures and medical schools have eligible subjects. Every year all the prefectures and medical schools responded to this. In June of the survey year, the study office sends a survey questionnaire to each prefectural government to obtain information on the number of new graduates who had received scholarship, the number who passed the National License Examination for Physicians, and the number who have bought out the scholarship. The cohort office sends a questionnaire to each medical school to obtain information on the number of quota students without scholarship and number who passed the National License Examination for Physicians. 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 prefectures and/or medical schools to participate.

Definitions of quota and scholarship

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."

Statistical analyses

Based on the data obtained from the prefectures and medical schools, passing rates of the National License Examination for Physicians were calculated for the subjects in quota with scholarship, quota without scholarship (quota alone), and non-quota with scholarship (scholarship alone). The rates in 2014 and 2015 have been reported previously,[15] and in this study, results in 2016 and 2017 were added. These rates were compared with the passing rate of all the other medical graduates in Japan. The passing rate of the other graduates was calculated by subtracting the numbers of passed and failed subjects in quota with scholarship, quota alone and scholarship alone from those of all new graduates in Japan reported every year by the Ministry of Health, Labour and Welfare.[20,21] The comparisons were conducted with the Fisher's exact test for a part of 2014 analysis because there were fewer than 5 failed subjects in quota with scholarship. All the other comparisons

were conducted with the chi-square test of independence.

Also based on the data from the prefectures, retention rates for contractual workforce of subjects in quota with scholarship and subjects with scholarship alone were calculated. The retention rate is the percentage of graduates who are complying with the terms of being admitted to a quota and/or receiving scholarship. The retention rate of each group was calculated in each cohort of graduation year. The retention rate of all those who graduated between 2014 and 2017 was also calculated with Kaplan-Meier survival analysis in which subjects with various observation periods were analysed. The retention rates were compared between the two groups with the log-rank test.

Statistical analyses were done using SPSS version 24 (IBM-SPSS Japan, Tokyo) and R version 3.3.2 (R Foundation for Statistical Computing, Vienna, Austria). P values less than 0.05 (two-sided test) were regarded as statistically significant.

All the data were provided and analysed anonymously.

RESULTS

Response rates

Almost all prefectures and medical schools with eligible subjects participated in this study (response rates 97.8-100%) (Table 1). The response rate is the percentage of those who returned a completed questionnaire to the study office among all the prefectures or medical schools which have

eligible subjects.

Table 1 here

Passing rates of the National Physician License Examination

Throughout the study period, the passing rates of quota graduates with scholarship, quota graduates without scholarship, and non-quota with scholarship were higher than the passing rate of all the other new medical graduates in Japan (Figure 2A-D). The percentage of quota with scholarship was substantially higher than the percentage of all the other graduates in all the years (97.9, 96.7, 97.4 and 94.7% v.s. 93.9, 94.5, 94.3 and 91.8%, respectively), and the difference was statistically significant in all years except for 2015 (P= 0.034, 0.090, 0.002, and 0.003, respectively). The passing rate of quota with scholarship was the highest among all the groups except for 2017 in which the percentage of scholarship alone was the highest.

The passing rate of quota with scholarship was still higher than that of the comparison group except for 2017 even when the comparison group was limited to the graduates of public (i.e., national or prefectural) medical schools (93.6%, 94.8%, 95.3%, and 95.1% respectively). The difference was however significant only in 2016 (p=0.16, 0.31, 0.02, and 0.31 respectively) (data not shown in the figure).

Figure 2A-D here

Retention rates for contractual work (non-buying-out rates)

Figure 3A-C shows the retention rates of subjects in quota with scholarship and those in non-quota with scholarship. Figure 3D shows the rates of all the graduates between 2014 and 2017. The retention rate varied by graduation year and at intervals after graduation. In all graduation years, the retention rate of quota with scholarship was higher than that of scholarship alone at the end of follow-up, but the difference was not statistically significant (Figure 3A-C). The survival analysis including all the subjects who obtained physician license between 2014 and 2017 showed that the retention rate 3.25 years after graduation was 92.2% for those in quota with scholarship and 89.9% for those with scholarship alone (statistically not significant: Figure 3D).

The 2014-2017 retention rate of quota with scholarship varied substantially among prefectures (78.4%-100%). The rate of scholarship alone likewise varied among prefectures (70.8%-100%) (data not shown in the figure).

Figure 3A-D here

DISCUSSION

The results of this study showed that the graduates of regional quota with scholarship were more likely to pass the National License Examination for Physicians than the other new graduates of medical schools. The percentage of those who remained in the contractual workforce accompanied with scholarship 3.25 years after graduation was 92.2% among those of quota with scholarship, and 89.9% among those with scholarship alone.

There has been a concern about the academic level of quota entrants because they are admitted to medical school under different criteria.[15] The results of this study, however, show that the concern is invalid at least for the observed period. In Japan the length of undergraduate medical education is six years, which is long enough to obscure the correlation between academic performance at entrance and that at graduation.[22] Also in the usual admission process, many applicants are examined over the course of a few days, which forces medical schools to choose entrants solely based on their test scores. Elements other than the written test score, such as the personal statement and interview result, are not as valued. In contrast, the admission process in many of the regional quotas is a combined evaluation of the applicant's high school activities, a recommendation letter from the high school, an interview, an academic test, and a personal statement. The variety of elements valued in the process may have contributed to a better academic performance of quota students, and subsequently the better outcome on the

physician license examination. The results of this study thus offer a warning to Japan's conventional medical school admission process. The government of Japan is scheduled to revise, on a nationwide basis, the process of university entrance in 2021. This revision should make the selection of medical school applicants more effective.

There is a room for argument whether the contract retention rates shown in this study are high or low. The results shown are the overall value of all the subjects in all prefectures of Japan. In reality, however, there is a substantial difference among prefectures. It is thus necessary to evaluate the result in each prefecture or in each medical school. The retention rate of graduates from Jichi Medical University, founded in 1972 solely to produce rural physicians and became the model when making regional quota programmes all over the country, is 97%.[23] The percentage is obviously higher than that of quota graduates shown in this study. However the total amount of prefecture scholarship given to a Jichi student for six years is 23 million yen (equivalent to USD 209,090), which is double the average amount of scholarship for a quota student: 12.2 million yen (USD 110,909).[13,24] In order to make the quota programme sustainable, we need to consider the balance between the financial burden of the country/prefecture and the certainty to secure physicians in needed areas. Also the differences in the training offered to students, in the focus of the school, and in postgraduate training programmes may have contributed to the gap in retention rates between Jichi and quotas.

Internationally there are many financial incentive programmes to recruit physicians to practice in rural areas.[25,26] The estimated retention rate of the pooled subjects of these programmes was reported to be 71%.[26] The retention rate of subjects in state scholarship programmes for medical students in the United States was 66.5%.[27] While international data are favourable, it is not known if the relationships would hold for Japan. Thus further study is needed in Japan.

This study has the following limitations. First, as this study gathered information about graduates, their academic performance and scholarship buy-out rate before graduation are unknown. According to the Association of Japan Medical Colleges, the straight graduation rate, which is the proportion of students who have finished their six-year medical program without repeating a school year, of quota students who entered in 2008 was 89.6% nationwide, which was higher than the rate of all the medical school entrants in the year (85.4%). The rate of quota entrants in 2009, which was 89.0%, was also higher than that of all medical students (84.2%).[13] The report also mentioned that 0.7% of undergraduate quota students bought out their prefectural scholarship each year.[13] This information should be added to the results of this study when assessing the effectiveness of quota and scholarship programmes. The geographic location of the quota graduates and scholarship recipients are not shown in this study. Their location, particularly after their contractual periods, is the most important outcome of these programs,

and will be assessed in the near future, based on the data from the ongoing cohort study.

Regional quotas and prefecture scholarships are based on temporary legislation by the national government, and thus the programmes will be revised starting in 2018. In most of the prefectures, however, the first generation of the quota entrants is still undergoing its clinical training or have just started their practice in rural areas. So, as of this writing (summer 2017), we cannot assess the final outcomes of these programmes. All we can do is to collect intermediate outcomes like those shown in this study, analyse them in a variety of dimensions, and engage in evidence-based decision making for the future national policies while accumulating data for the next assessment.

CONCLUSION

The passing rate of the entrants to the *chiikiwaku*, regional quota of entrants to medical schools, for the National License Examination for Physicians was higher than the rate of non-quota medical graduates. The passing rate of prefecture scholarship recipients was also higher than non-recipients. More than 90% of quota physicians with scholarship were complying with the terms of their contract for more than three years after obtaining the physician license during which we observed. The imminent revision of the national policy regarding the quota and scholarship programmes should be based on these intermediate outcomes.

Contributors

MM contributed to the study design, tools, study administration, data collection, analysis, interpretation of data, and writing the draft. KT and TM contributed to the study design, tools, study administration, data interpretation, and writing the draft. ST and KI contributed to the study design, interpretation of data, and writing the draft. SK contributed to the analysis and writing the draft, TO and SI contributed to the study administration, data collection.

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Competing interests

None

Ethics approval

Ethical approval was granted by the Ethics Committee for epidemiological research of Hiroshima University (ref. no. 778) and the Research Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences (ref. no. 13091342).

Data sharing statement

Conditions of the ethical approvals permit the cohort office (Department of Community-Based

Medical System, Graduate School of Biomedical and Health Sciences, Hiroshima University) and the sub-office (Department of Community Medicine, Nagasaki University Graduate School of Biomedical Science) to share the aggregated data with stakeholders or researchers.

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Table 1. Response rates of prefectures and medical schools

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Year	Prefectures				Medical Schools		
	N*	Response rate	Subjects		N*	Response rate	Subjects
			Quota with scholarship	Scholarship alone			Quota alone
2014	36/36	100%	144	322	19/19	100%	166
2015	45/46	97.8%	305	391	22/22	100%	253
2016	46/47	97.8%	498	340	29/29	100%	308
2017	47/47	100%	609	376	31/31	100%	382

*Both the number of eligible prefectures (medical schools) and that of responded prefectures (medical

schools) are shown.

Figure legends

Figure 1. Study subjects and data collection.

Figure 1 footnote. "Quota with scholarship" are students who entered a regional quota and received a prefecture scholarship, "quota alone" are students who entered the quota but did not receive the scholarship, "scholarship alone" are students who received the scholarship but did not enter the quota, and others are all medical students excluding quota and scholarship ones.

Figure 2. Passing rates of the National Licence Examination for Physicians (A: 2014, B: 2015, C: 2016, D: 2017).

Figure 2 footnote. Control data were from the Ministry of Health, Labour and Welfare.[20,21] Rates in 2014 and 2015 have been reported previously.[15] *Fisher's exact test.

Figure 3. Retention rates of subjects in quota with scholarship and those in non-quota with scholarship (scholarship alone). (A: graduates in 2014, B: 2015, C: 2016, D: 2014-2017)

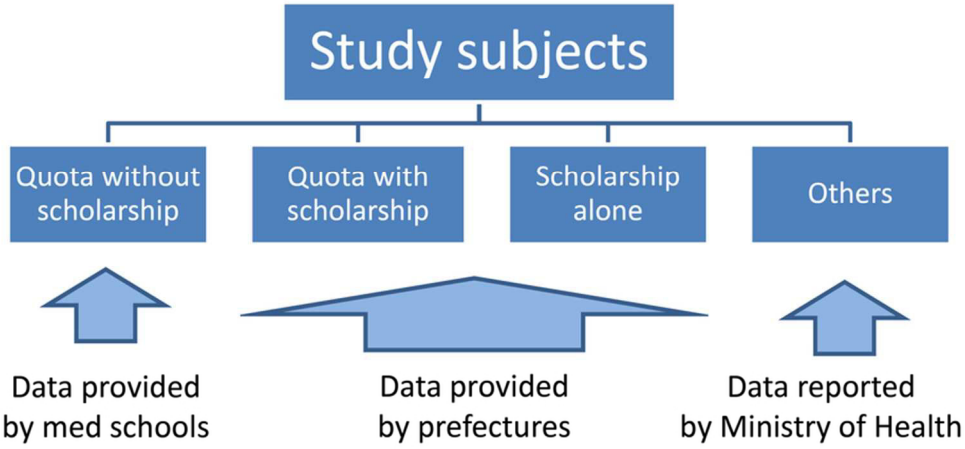

Figure 1

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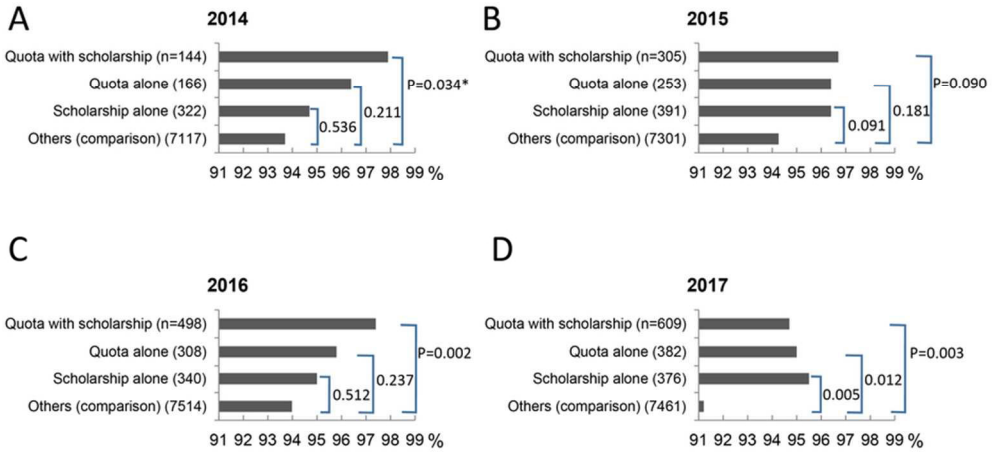

Figure 2

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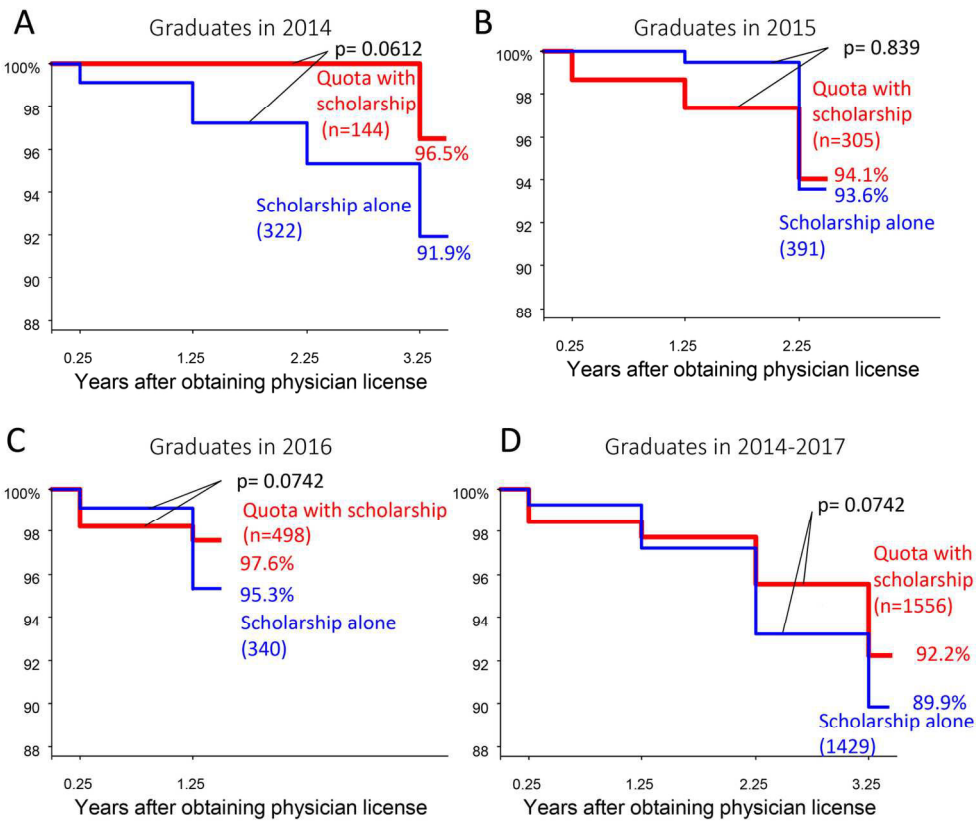

Figure 3

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-8
Objectives	3	State specific objectives, including any prespecified hypotheses	8
Methods			
Study design	4	Present key elements of study design early in the paper	8-9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8-9
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	9-10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9-11
Bias	9	Describe any efforts to address potential sources of bias	8-9
Study size	10	Explain how the study size was arrived at	Not needed. This study is a nationwide census.
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10-11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	10-11
		(*b*) Describe any methods used to examine subgroups and interactions	Not applicable
		(*c*) Explain how missing data were addressed	11
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	11

		(*e*) Describe any sensitivity analyses	Not needed.
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11
		(b) Give reasons for non-participation at each stage	11
		(c) Consider use of a flow diagram	9
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	No data
		(b) Indicate number of participants with missing data for each variable of interest	11 (no data on missing subjects)
Outcome data	15*	Report numbers of outcome events or summary measures	11-13
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-13
		(*b*) Report category boundaries when continuous variables were categorized	11-13
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not relevent
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Not applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15-16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.