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Complete List of Authors:	Matsumoto, Masatoshi; Institute of Biomedical and Health Sciences, Hiroshima University, Department of Community-Based Medical System Takeuchi, keisuke; Institute of Biomedical and Health Sciences, Hiroshima University, Department of Community-Based Medical System Tanaka, Junko; Institute of Biomedical and Health Sciences, Hiroshima University, Department of Epidemiology, Infectious Disease Control and Prevention Tazuma, Susumu; Hiroshima University Hospital and Graduate School of Biomedical & Health Sciences, Department of General Internal Medicine Inoue, Kazuo; Chiba Medical Center, Teikyo University School of Medicine, Department of Community Medicine Owaki, Tetsuhiro; Graduate School of Medical Sciences, Kagoshima University, Education Center for Doctors in Remote Islands and Rural Areas Iguchi, Seitaro; Niigata University Graduate School of Medical & Dental Sciences, Department of Community Medicine Maeda, Takahiro; Nagasaki University Graduate School of Biomedical Science, Department of Community Medicine
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Outcomes of the subquota system of Japanese medical schools for physician shortage areas and prefecture scholarship programmes for medical students: a cohort protocol

Masatoshi Matsumoto[1], Keisuke Takeuchi[1], Junko Tanaka[2], Susumu Tazuma[3], Kazuo Inoue[4], Tetsuhiro Owaki[5], Seitaro Iguchi[6], Takahiro Maeda[7]

1 Department of Community-Based Medical System, Institute of Biomedical and Health Sciences, Hiroshima University, Hiroshima, Japan

2 Department of Epidemiology, Infectious Disease Control and Prevention, Institute of Biomedical and Health Sciences, Hiroshima University, Hiroshima, Japan

3 Department of General Internal Medicine, Hiroshima University Hospital and Graduate School of Biomedical & Health Sciences, Hiroshima, Japan

4 Department of Community Medicine, Chiba Medical Center, Teikyo University School of Medicine, Chiba, Japan

5 Education Center for Doctors in Remote Islands and Rural Areas, Graduate School of Medical Sciences, Kagoshima University, Kagoshima, Japan

6 Department of Community Medicine, Niigata University Graduate School of Medical & Dental Sciences, Niigata, Japan

7 Department of Community Medicine, Nagasaki University Graduate School of Biomedical Science, Nagasaki, Japan

Corresponding author: Masatoshi Matsumoto

Department of Community Based Medical System, Institute of Biomedical and Health Sciences, Hiroshima University

1-2-3 Kasumi, Minami-ku, Hiroshima, 734-8551 JAPAN

Phone: +81-82-257-5894 Fax: +81-82 257-5895 Email: matmo10@jb3.so-net.ne.jp

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ABSTRACT

Introduction: Given the shortage of physicians, particularly in rural areas, the Japanese government has rapidly expanded the number of medical school students by adding *chiikiwaku*, subquotas, since 2008. Subquota entrants now account for 17% of all medical school entrants. Subquota entrants are usually local high school graduates who receive a scholarship from the prefecture government. In exchange, they temporarily practice in that prefecture, including its rural areas, after graduation. Many prefectures have also scholarship programmes for non-subquota students in exchange for postgraduate in-prefecture practice. The objective of this cohort study, conducted by the Japanese Council for Community-based Medical Education, is to evaluate the outcomes of the subquota admission system and prefecture scholarship programmes nationwide.

Methods and analysis: There are three groups of study subjects: subquota without scholarship, subquota with scholarship, and non-subquota with scholarship. Under the support of government ministries and the Association of Japan Medical Colleges, and participation of all prefectures and medical schools, passing rate of the National Physician License Examination, scholarship buying-out rate, geographic distribution and specialties distribution of each group are analysed. Subjects are followed by linking their baseline information to data in the government's biennial Physician Census. Results to date showed that, despite medical schools' concerns about academic quality, the passing rate of the National Physician License Examination in each group was higher than that of all medical school graduates.

Ethics and dissemination: The Ethics Committee for epidemiological research of Hiroshima University and the Research Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences permitted this study. No individually identifiable results will be presented in conferences or published in journals. The results will be reported to concerned government ministries, associations, prefectures and medical schools as data for future policy planning.

Strengths and limitations of this study

- Subquota admission system of medical schools is one of the largest national policies ever conducted to redress maldistribution of physicians, and these entrants now constitute 17% of all medical school entrants in Japan.
- This study evaluates the outcomes of the subquota admission system and prefecture scholarship programmes for medical students by cross-sectional survey to prefectures and medical schools, and analysing cohort of subquota and scholarship subjects.
- Started in 2013, this is the first comprehensive and longitudinal study of this sort, with support from concerned ministries and the representative body of medical schools.
- All of Japan's prefecture governments and medical schools participate in this study, which yields precise information on the passing rate of the National License Examination for Physicians and scholarship buying-out rate of study subjects every year.
- Geographic and specialty distributions of all the study subjects registered in the cohort can be followed until they retire as we link the baseline data to the government's national biennial census data, though increasing the recruitment rate of subjects is a challenge.

INTRODUCTION

Geographic maldistribution of physicians in Japan

Geographic maldistribution of physicians has long been recognised as a chronic social problem in Japan. No public agencies have a legal right to decide the allocation of physicians, and thus physicians are given unrestricted freedom to practice wherever they like. There is no

allocation system in which local governments or professional bodies place a cap on the number of physicians in each area as seen in other countries such as United Kingdom. In this context the concentration of physicians in urban areas and a corresponding shortage in rural areas is inevitable.[1-3] Article 25 of the Japanese Constitution guarantees healthy living of all citizens and obliges the government to improve public health. So redressing the geographic maldistribution is usually recognised a responsibility of the national and local governments.

The national and prefectural governments have attempted to resolve this issue in several ways. First the government constructed one medical school in each prefecture between the 1960s and 1970s, founding new public medical schools in mainly rural prefectures where none had existed. Under this policy, the number of medical schools in Japan increased from 46 to 79 and the number of medical school entrants doubled.[4] Second, in 1972, the national and prefectural governments cooperated to found a special medical school, Jichi Medical School, solely to train rural physicians.[2 5 6] These policies increased both the number of practicing physicians nationwide and the number of rural physicians.[7 8] It is likely that the increase in the number of rural physicians contributed to the decrease in number of country's designated *muichiku* (non-physician communities).[2]

However, the equity of distribution of physicians has been almost unchanged; in other words the disparity between the number of urban and rural physicians has not diminished.[7 9 10] To make matters worse, a new residency training system started in 2004. In this new system, like the residency matching system of the United States, new graduates are matched to training hospitals nationwide in order of their preferences, which changed the distribution of young physicians who previously tended to concentrate in university hospitals.[11] This change decreased the physician-assigning capability of university hospitals which has traditionally dispatched physicians in rural hospitals.[3] Since the implementation of this new residency scheme, the geographic distribution of physicians has reportedly worsened.[12-15] Then the

shortage of physicians in rural areas and collapse of healthcare provision in such communities has resurfaced as a social concern.

Emergence of subquota as a national policy

The government responded by rapidly expanding the number of medical school entrants by adding *chiikiwaku*, a subquota, in 2008.[16] Under the subquota, applicants to a medical school, in most cases, must have graduated from a high school in that prefecture. An expressed intention to practice in that prefecture, preferably in one of its rural areas, is valued in the admission interview. Upon admission, entrants are usually offered six-year scholarships from the prefectural government in exchange for working in the prefecture, including its rural areas, for a designated obligation period after graduation (Figure 1).[16] The design of the subquota varies substantially among medical schools. Some medical schools have subquotas without scholarship, in which case the intention to practice in certain areas is valued in admission but the entrants have no obligation period. Some subquotas require their students to work in rural areas or in a specialty which is recognised in severe shortage in the prefecture.

Currently 70 out of Japan's 80 medical schools have such subquotas. The number of entrants to subquota exceeded 1500 per year, amounting to 17% of all medical school entrants (Figure 2).[17] Historically this is one of the largest and most ambitious policies to rectify the maldistribution of physicians in Japan. Evaluation of outcomes of this policy thus is needed. However, the subquota has only just started to graduate students, so there is as yet no comprehensive and longitudinal study to assess its effectiveness.

Prefecture scholarship for medical students independent of subquota

Aside from the subquota, many prefectures have independent scholarship programmes for medical students. This scholarship is also given in exchange for postgraduate practice within the prefecture, usually including rural areas. The scholarship recipients are students who entered

medical schools in a usual way (non-subquota admission) or those who entered subquotas without scholarship. Similar to the subquota system, these scholarship programmes have recently expanded. Similar programmes are seen in other countries, but their outcomes are open to debate.[18-23] The outcomes of the prefecture scholarship programmes in Japan are not yet known.

Objectives of this study

This cohort study investigates the outcome of subquota admission system of medical schools and that of prefecture scholarship programmes for non-subquota students. The cohort consists of three groups of physicians: subquota without scholarship, subquota with scholarship, and scholarship without subquota admission (Figure 3). Passing rate of the National Physician License Examination, scholarship buying-out rate, geographic distribution, and specialty distribution of each group of subjects are evaluated and compared with those of all Japanese physicians in the same generation.

Methods and analysis

Study design

This study is conducted by the Japanese Council for Community-based Medical Education (JCCME). The JCCME is the network of medical school departments related with community health or rural health with its mission being promotion of community-based medical education. Many of the departments in JCCME educate and train subquota students.

The outline of study design is shown in Figure 4. The study consists of three steps. In the first step, the cohort office of JCCME contacts all prefectural governments and medical schools and obtains data for the yearly cross-sectional outcomes (lower part of figure 4). In the second step,

the cohort office contacts individual subjects via prefectural governments or medical schools and obtains baseline data for follow-up (upper part). Finally, in the third step the each individual subject is followed up by obtaining the corresponding individual's data in the biennial national physician census and linking it to the baseline data.

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

Definitions of subquota and scholarship

According to 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."

In the subquota admission system, receiving the scholarship is often a condition for admission to the medical school. However, some medical schools have subquotas without scholarships, so entrants are not obligated to practice in certain areas of Japan. In addition, some medical students who did not enter subquotas (but did enter medical schools by passing the traditional written examination) but still hope for a prefecture scholarship. This study includes subjects of all the three groups (Figure 3).

Information on scholarship recipients with or without subquota admission are obtained from each prefecture government. Information on subjects of subquota without scholarship are obtained from each medical school.

Yearly cross-sectional outcomes

Every year the cohort office of JCCME begins this study by sending a questionnaire to each prefecture government to obtain information on the number of newly graduated subjects who received scholarship, number of the subjects who passed the National License Examination for Physicians, and number of subjects who bought out the scholarship to refuse the obligatory work. The cohort office sends a questionnaire also to each medical school to obtain information on the number of subjects in subquotas without scholarship and number of the subjects who passed the National License Examination for Physicians (arrows 1 and 2 in Figure 4). The results are yearly cross-sectional outcomes. Some results to-date are shown later in this paper.

This step of survey started in 2014 and will be conducted every year at least until 2025.

Individual baseline data

In the second step, the cohort office requests each prefecture and medical school to forward a questionnaire (arrow 3 in Figure 4) and the prefecture and medical school forward the questionnaire to each potential study subject (arrow 4). Each subject then sends back the answered questionnaire to the cohort office (arrow 5). Then the cohort office obtains the baseline data on each subject. The subjects consist of either of the three groups shown in Figure 3 and are all newly licensed physicians.

The questionnaire for each subject in the group of subquota with scholarship and in the group of scholarship alone includes information on whether the subject was admitted to a subquota, physician identification number, name of the graduated medical school, graduation year, home prefecture, term of scholarship, length of postgraduate obligation period required by the scholarship, and length of rural service or service in a designated specialty during the obligation period. The questionnaire for each subject in the group of subquota without scholarship includes information on physician identification number, name of the graduated medical school, graduation year, home prefecture, and conditions for admission to the subquota. The validity

and easiness to answer the questions were pre-checked using sample subjects (subquota students) in selected medical schools before the study started.

This step in the survey also started in 2014 and will be conducted every year at least until 2025.

Follow-up of individual subjects

The third step is to follow up the subjects. The baseline individual data obtained in the second step is connected, through physician identification number, to the national census data of the "Survey of Physicians, Dentists and Pharmacists" (Physician Census) conducted by Ministry of Health, Labour and Welfare every two years (Figure 5). All licensed physicians in Japan are obligated to register in the Physician Census. The Physician Census includes information on practice location, type of medical facility, work contents, specialty, and board certification status. The connection between the baseline data and the data in Physician Census enables comparison of geographic distribution among the three subject groups and between each subject group and a control group of all physicians in the same generation in Japan. The cohort office will request the Ministry of Health, Labour and Welfare to provide individualised data of Physician Census every two years since 2016 in which data of 2014 Census will be available.

In this way, once the physician identification numbers are stored, the subjects can be followed up almost permanently (until the subjects retire or stop practicing in Japan). The end of the follow-up is thus not determined.

Analysis

Based on the data obtained directly from the prefectures and medical schools (arrow 2 in Figure 4), passing rates of the National License Examination for Physicians in the three groups of subjects are calculated. These rates are compared with the passing rate of the entire medical school graduates in Japan reported every year by the Ministry of Health, Labour and Welfare.

Also based on the data from the prefectures, scholarship buying-out rates of subjects in the groups of subquota with scholarship and scholarship alone are calculated. The buying-out rate is, in other words, the number of subjects who refuse to comply with the conditions accompanied by receiving scholarship and thus pay back the awarded money.

Based on the data obtained from individual subjects (arrow 5 in Figure 4) and its linkage to Physician Census data, municipality (city, town, and village)-level distribution, Gini coefficients, proportion of those in rural areas, proportion of those in specialties that are reportedly in shortage nationwide (such as obstetrics and paediatrics) among the subjects in each group are evaluated. These values are compared with those of all the physicians in the same generation in the Census (control). Proportion of those who are retained in their home prefectures in each group is also calculated and will be compared with the proportion of other newly licensed physicians that has been or will be reported elsewhere.[17 24] Also the associations between baseline characteristics of subjects (such as sex and length of obligation period) and their geographic distribution are analysed using multivariate models. These results are longitudinally compared among different postgraduate years in the same cohort generation.

Obtained results to date

Although follow-up data has yet to be obtained as data of 2014 Physician Census is still unavailable, cross-sectional outcomes in 2014 and 2015 have already been obtained.

In 2014, 38 of Japan's 47 prefectures had study subjects who met the subject definitions. All of the 38 prefectures responded to our questionnaire (response rate 100%). The number of new medical graduates who are from subquota with scholarship was 144, and among them, 141 passed the National License Examination for Physicians (passing rate 97.9%). The number of those with scholarship alone was 322, of whom 305 (94.7%) passed the License Examination. Among all 80 medical schools in Japan, the number of those which had study subjects was 21.

All of the 21 medical schools (100%) responded to our questionnaire. The number of new graduates who are from subquota without scholarship was 166; among them, 160 (96.4%) passed the License Examination. These passing rates of the three groups of subjects were higher than the passing rate of all new medical graduates in Japan: 93.9%.

In 2015, 45 prefectures had study subjects, and all (100%) responded to the questionnaire. The number of new graduates who are from subquota with scholarship was 305, and 295 (96.7%) passed the License Examination. The number of those with scholarship alone was 391, of whom 377 (96.4%) passed the License Examination. Twenty-two medical schools had study subjects, and all of the schools (100%) responded to our questionnaire. The number of new graduates who are from subquota without scholarship was 253, and 244 (96.4%) passed the License Examination. This year again the passing rates of the all groups were higher than that of all new medical graduates in Japan: 94.5%.[25]

The passing rates in the two years are shown in Figure 6. These results are rather unexpected, taking into account the concern about academic capability of subquota students which was and still remains among both the general population and medical school faculty members.

The number of 2014 licensed subjects who bought out their scholarship as of June 2015 was 9 (2.0%) out of all 446 scholarship awardee subjects. The comparable figure of 2015-lincensed subjects was 4 (0.6%) out of 672.

As for recruitment of individual subjects, in 2014 the cohort office sent a questionnaire, via prefecture or medical school to 603 subjects. Among them 241 (response rate 40.0%) responded. In 2015 the questionnaire was sent to 929 subjects and 398 (42.8%) responded to it. These respondents were registered as the cohort subjects.

Strengths and limits of the study

The first strength of this study is that this is the first nationwide and comprehensive longitudinal study on the subquota admission system and the prefecture scholarship programme. The second is that, with the help of two related ministries and the national representative body of medical schools, all the prefecture governments and medical schools did and will participate in this study, which enables us to obtain precise information on the number of potential subjects, passing rate of the License Examination, and scholarship buying-out rate every year. In addition, with the full cooperation of prefectures and medical schools, the cohort office can send the questionnaire to all the potential individual subjects. The third strength of this study is that almost 100% of subjects registered in the cohort can be followed up until they either retire or stop practicing in Japan and drop out of the Physician Census. Using the national census data as a way of follow-up costs less money, time, and effort than usual follow-up in which the cohort office contacts each subject numerous times in the future.

One limitation of this study is that the participation of an individual subject is voluntary and thus recruiting all the potential subjects is quite difficult. This is particularly so because the questionnaire includes personal information such as physician identification number. The participation rate of subjects in 2014 was 40.0% and that in 2015 was 43%. We thus cannot exclude a selection bias of the registered cohort subjects, which might create a biased result on the geographic and specialities distribution of these subjects shown in the future.

Impact on global, national, and local policies

The special admission systems of medical schools aiming to improve the shortage of physicians in rural areas are conducted worldwide.[26-28] Also financial incentive programmes for return of service in underserved areas exist in many countries.[22 23] The results of this study will add evidence to show the effectiveness of these systems and programmes.

The expansion of medical school entrants by adding subquota is continued, under a national law, until 2019. But after 2019, the future of the subquota system is unknown. The government, prefectures, and medical schools have four options: expanding the system, continuing it as it is, restricting its scale, and abolishing it entirely. The results of this study, such as geographic distribution, specialty distribution, buying-out rate, and national examination passing rate of subquota graduates, will enable the stakeholders to make the most informed choice. Moreover, the results of this study in each prefecture will enable the prefecture to consider what to do with its scholarship programme.

ETHICS AND DISSEMINATION

The Ethics Committee for epidemiological research of Hiroshima University and the Research Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences gave permission for this study. The cohort office explains in a document to all the prefectures, medical schools, and individual subjects that all the information in the questionnaire is used only for the research purpose and the data provided by an individual can be deleted any time when the individual requests the cohort office to do so. The response to the sent questionnaire is voluntary.

The cohort data is collected and stored in the cohort office (Department of Community-based Medical System, Hiroshima University) without personal name of each individual subject (completely anonymous data). Individually unidentifiable results will be presented in conferences or published in journals. The results also will be reported to concerned government ministries, associations, and prefectures.

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. JT, ST and KI contributed to the study design, interpretation of data, and writing the draft. TO and SI contributed to the study administration, data collection, and draft writing.

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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, Institute 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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Figure legends

Figure 1. Example of rural subquota system of a Japanese medical school (Hiroshima University School of Medicine and Hiroshima Prefecture). Each school designs its own subquota system (yr, year; med, medical).

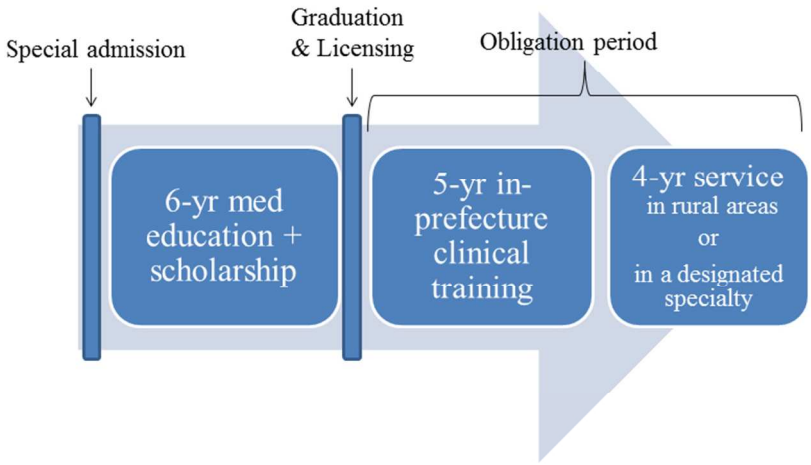
Figure 2. Number of entrants to Japanese medical schools (data from Ministry of Education, Culture, Sports, Science and Technology).[17]

Figure 3. Study subjects

Figure 4. Overview of study design (QE, questionnaire; JCCME, Japanese Council for Community-based Medical Education; yrs, years; exam, examination).

Figure 5. Creation of follow-up data (MHLW, Ministry of Health, Labour and Welfare; ID, identification number)

Figure 6. Passing rates of the National Licence Examination for Physicians. Control data were from the Ministry of Health, Labour and Welfare. [25]



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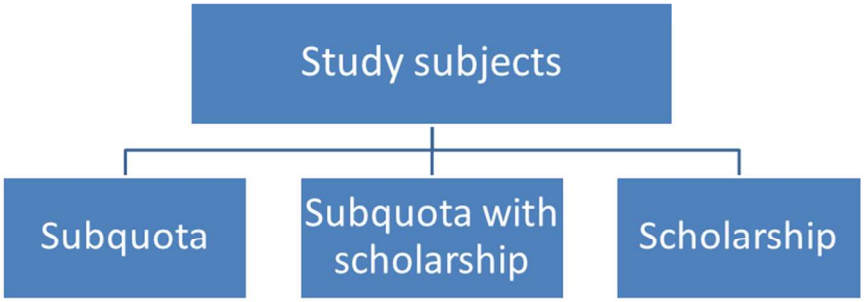

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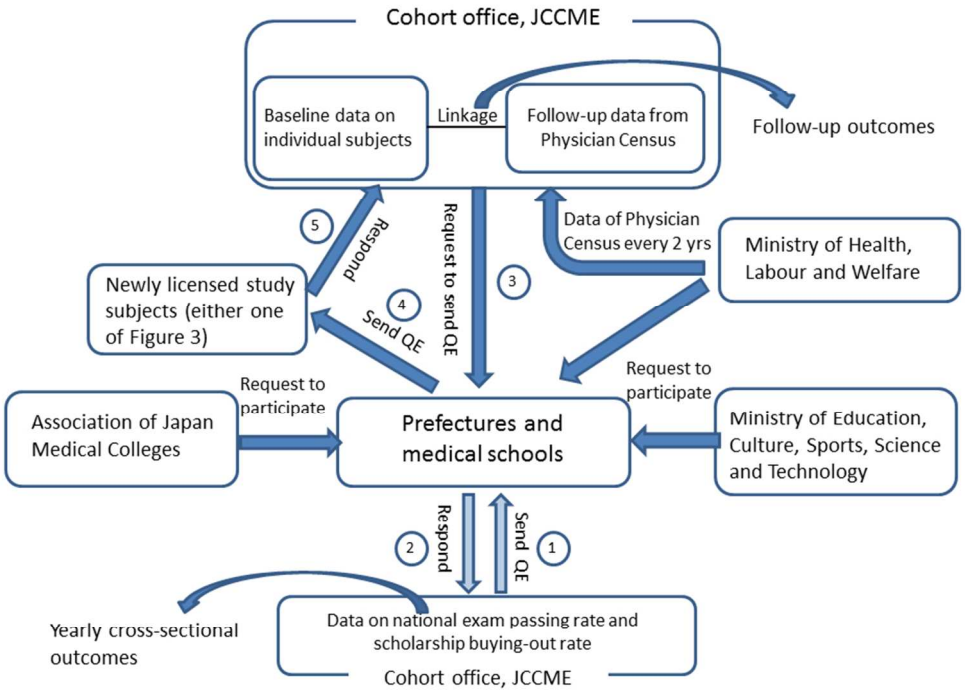

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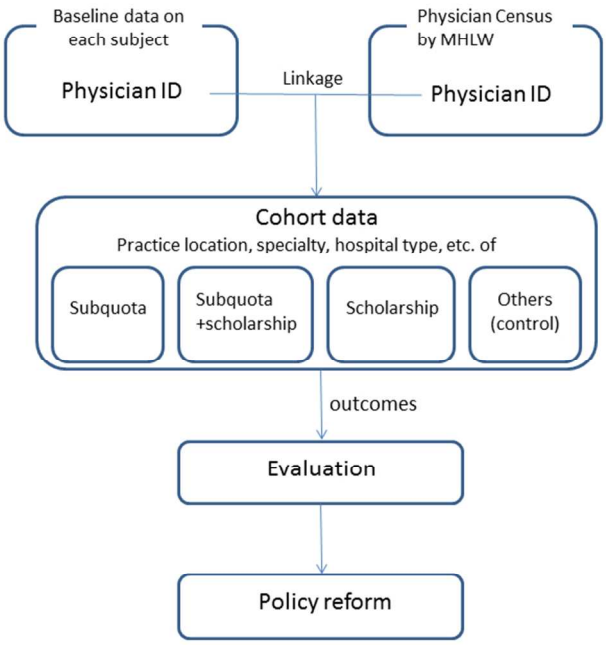

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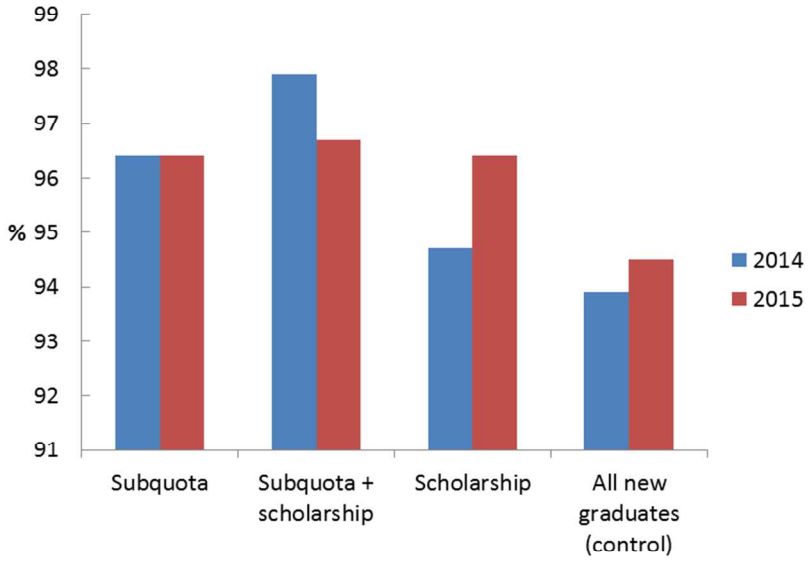

Figure 6. Passing rates of the National Licence Examination for Physicians. Control data were from the Ministry of Health, Labour and Welfare.
254x190mm (96 x 96 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort 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	✓
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	✓
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	✓
Objectives	3	State specific objectives, including any prespecified hypotheses	✓
Methods			
Study design	4	Present key elements of study design early in the paper	✓
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	✓
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	✓
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	✓
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	✓
Bias	9	Describe any efforts to address potential sources of bias	✓
Study size	10	Explain how the study size was arrived at	not needed
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	✓
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	✓
		(*b*) Describe any methods used to examine subgroups and interactions	✓
		(*c*) Explain how missing data were addressed	✓
		(*d*) If applicable, explain how loss to follow-up was addressed	✓
		(*e*) Describe any sensitivity analyses	
Results			not needed

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	✓
		(b) Give reasons for non-participation at each stage	unknown
		(c) Consider use of a flow diagram	✓
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	no obtained yet as this is a protocol paper
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	
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	
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	✓
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	✓

*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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Follow-up study of the regional quota system of Japanese medical schools and prefecture scholarship programmes: a study protocol

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Complete List of Authors:	Matsumoto, Masatoshi; Institute of Biomedical and Health Sciences, Hiroshima University, Department of Community-Based Medical System Takeuchi, keisuke; Institute of Biomedical and Health Sciences, Hiroshima University, Department of Community-Based Medical System Tanaka, Junko; Institute of Biomedical and Health Sciences, Hiroshima University, Department of Epidemiology, Infectious Disease Control and Prevention Tazuma, Susumu; Hiroshima University Hospital and Graduate School of Biomedical & Health Sciences, Department of General Internal Medicine Inoue, Kazuo; Chiba Medical Center, Teikyo University School of Medicine, Department of Community Medicine Owaki, Tetsuhiro; Graduate School of Medical Sciences, Kagoshima University, Education Center for Doctors in Remote Islands and Rural Areas Iguchi, Seitaro; Niigata University Graduate School of Medical & Dental Sciences, Department of Community Medicine Maeda, Takahiro; Nagasaki University Graduate School of Biomedical Science, Department of Community Medicine
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Follow-up study of the regional quota system of Japanese medical schools and prefecture scholarship programmes: a study protocol

Masatoshi Matsumoto[1], Keisuke Takeuchi[1], Junko Tanaka[2], Susumu Tazuma[3], Kazuo Inoue[4], Tetsuhiro Owaki[5], Seitaro Iguchi[6], Takahiro Maeda[7]

1 Department of Community-Based Medical System, Institute of Biomedical and Health Sciences, Hiroshima University, Hiroshima, Japan

2 Department of Epidemiology, Infectious Disease Control and Prevention, Institute of Biomedical and Health Sciences, Hiroshima University, Hiroshima, Japan

3 Department of General Internal Medicine, Hiroshima University Hospital and Graduate School of Biomedical & Health Sciences, Hiroshima, Japan

4 Department of Community Medicine, Chiba Medical Center, Teikyo University School of Medicine, Chiba, Japan

5 Education Center for Doctors in Remote Islands and Rural Areas, Graduate School of Medical Sciences, Kagoshima University, Kagoshima, Japan

6 Department of Community Medicine, Niigata University Graduate School of Medical & Dental Sciences, Niigata, Japan

7 Department of Community Medicine, Nagasaki University Graduate School of Biomedical Science, Nagasaki, Japan

Corresponding author: Masatoshi Matsumoto

Department of Community Based Medical System, Institute of Biomedical and Health Sciences, Hiroshima University

1-2-3 Kasumi, Minami-ku, Hiroshima, 734-8551 JAPAN

Phone: +81-82-257-5894 Fax: +81-82 257-5895 Email: matmo10@jb3.so-net.ne.jp

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ABSTRACT

Introduction: Given the shortage of physicians, particularly in rural areas, the Japanese government has rapidly expanded the number of medical school students by adding *chiikiwaku* (regional quotas) since 2008. Quota entrants now account for 17% of all medical school entrants. Quota entrants are usually local high school graduates who receive a scholarship from the prefecture government. In exchange, they temporarily practice in that prefecture, including its rural areas, after graduation. Many prefectures have also scholarship programmes for non-quota students in exchange for postgraduate in-prefecture practice. The objective of this cohort study, conducted by the Japanese Council for Community-based Medical Education, is to evaluate the outcomes of the quota admission system and prefecture scholarship programmes nationwide.

Methods and analysis: There are three groups of study subjects: quota without scholarship, quota with scholarship, and non-quota with scholarship. Under the support of government ministries and the Association of Japan Medical Colleges, and participation of all prefectures and medical schools, passing rate of the National Physician License Examination, scholarship buying-out rate, geographic distribution and specialties distribution of each group are analysed. Subjects who voluntarily participated are followed by linking their baseline information to data in the government's biennial Physician Census. Results to date showed that, despite medical schools' concerns about academic quality, the passing rate of the National Physician License Examination in each group was higher than that of all medical school graduates.

Ethics and dissemination: The Ethics Committee for epidemiological research of Hiroshima University and the Research Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences permitted this study. No individually identifiable results will be presented in conferences or published in journals. The aggregated results will be reported to concerned government ministries, associations, prefectures and medical schools as data for future policy planning.

Strengths and limitations of this study

- Regional quota admission system of medical schools is one of the largest national policies ever conducted to redress maldistribution of physicians, and these entrants now constitute 17% of all medical school entrants in Japan.
- This study evaluates the outcomes of the quota admission system and prefecture scholarship programmes for medical students by cross-sectional survey to prefectures and medical schools, and analysing cohort of quota and scholarship subjects.
- Started in 2013, this is the first comprehensive and longitudinal study of this sort, with support from concerned ministries and the representative body of medical schools.
- All of Japan's prefecture governments and medical schools participate in this study, which yields precise information on the passing rate of the National License Examination for Physicians and scholarship buying-out rate of study subjects every year.
- Geographic and specialty distributions of all the study subjects voluntarily registered in the cohort can be followed until they retire as we link the baseline data to the government's national biennial census data, though increasing the recruitment rate of subjects is a challenge.

INTRODUCTION

Geographic maldistribution of physicians in Japan

Geographic maldistribution of physicians has long been recognised as a chronic social problem in Japan. No public agencies have a legal right to decide the allocation of physicians, and thus physicians are given unrestricted freedom to practice wherever they like. There is no

allocation system in which local governments or professional bodies place a cap on the number of physicians in each area as seen in other countries such as United Kingdom. In this context the concentration of physicians in urban areas and a corresponding shortage in rural areas are likely to occur,[1-3] and initiatives in Japan up to this time have yet to redress the maldistribution of physicians. Article 25 of the Japanese Constitution guarantees healthy living of all citizens and obliges the government to improve public health. So redressing the geographic maldistribution is usually recognised a responsibility of the national and local governments.

The national and prefectural governments have attempted to resolve this issue in several ways. First the government constructed one medical school in each prefecture between the 1960s and 1970s, founding new public medical schools in mainly rural prefectures where none had existed. Under this policy, the number of medical schools in Japan increased from 46 to 79 and the number of medical school entrants doubled.[4] Second, in 1972, the national and prefectural governments cooperated to found a special medical school, Jichi Medical School, solely to train rural physicians.[2 5 6] These policies increased both the number of practicing physicians nationwide and the number of rural physicians.[7 8] It is likely that the increase in the number of rural physicians contributed to the decrease in number of country's designated *muichiku* (non-physician communities).[2]

However, the equity of distribution of physicians has been almost unchanged; in other words the disparity between the number of urban and rural physicians has not diminished.[7 9 10] To make matters worse, a new residency training system started in 2004. In this new system, like the residency matching system of the United States, new graduates are matched to training hospitals nationwide in order of their preferences, which changed the distribution of young physicians who previously tended to concentrate in university hospitals.[11] This change decreased the physician-assigning capability of university hospitals which has traditionally dispatched physicians in rural hospitals.[3] Since the implementation of this new residency

scheme, the geographic distribution of physicians has reportedly worsened.[12-15] The shortage of physicians in rural areas and collapse of healthcare provision in such communities has resurfaced as a social concern.

Emergence of regional quotas as a national policy

The government responded by rapidly expanding the number of medical school entrants by adding *chiikiwaku*, a regional quota, in 2008.[16] Under the quota, applicants to a medical school, in most cases, must have graduated from a high school in that prefecture. An expressed intention to practice in that prefecture, preferably in one of its rural areas, is valued in the admission interview. Upon admission, entrants are usually offered six-year scholarships from the prefectural government in exchange for working in the prefecture, including its rural areas, for a designated obligation period after graduation (Figure 1).[16] The design of the quota varies substantially among medical schools. Some medical schools have quotas without scholarship, in which case the intention to practice in certain areas is valued in admission but the entrants have no obligation period. Some quotas require their students to work in rural areas or in a specialty which is recognised in severe shortage in the prefecture.

Currently 70 out of Japan's 80 medical schools have such quotas. The number of entrants to quota exceeded 1500 per year, amounting to 17% of all medical school entrants (Figure 2).[17] Historically this is one of the largest and most ambitious policies to rectify the maldistribution of physicians in Japan. Evaluation of outcomes of this policy thus is needed. However, the quota has only just started to graduate students, so there is as yet no comprehensive and longitudinal study to assess its effectiveness.

Prefecture scholarship for medical students independent of quota

Aside from the quota, many prefectures have independent scholarship programmes for medical students. This scholarship is also given in exchange for postgraduate practice within the

prefecture, usually including rural areas. The scholarship recipients are students who entered medical schools in a usual way (non-quota admission) or those who entered quotas without scholarship. Similar to the quota system, these scholarship programmes have recently expanded. Similar programmes are seen in other countries, but their outcomes are open to debate.[18-23] The outcomes of the prefecture scholarship programmes in Japan are not yet known.

Objectives of this study

This cohort study investigates the outcome of the quota admission system of medical schools and that of prefecture scholarship programmes for non-quota students. The cohort consists of three groups of physicians: quota without scholarship, quota with scholarship, and scholarship without quota admission. Passing rate of the National Physician License Examination, scholarship buying-out rate, geographic distribution, and specialty distribution of each group of subjects are evaluated and compared with those of all Japanese physicians in the same graduating year.

Methods and analysis

Study design

This study is conducted by the Japanese Council for Community-based Medical Education (JCCME). The JCCME is the official association of medical school departments which engage in community or rural health education and research. The mission of JCCME is promotion of community-based medical education. Many of the departments in JCCME educate and train quota students.

The outline of study design is shown in Figure 3. The study consists of three steps. In the first step, the cohort office of JCCME contacts all prefectural governments and medical schools and

obtains data for the yearly cross-sectional outcomes (lower part of figure 3). In the second step, the cohort office contacts individual subjects via prefectural governments or medical schools and obtains baseline data for follow-up (upper part). Finally, in the third step the each individual subject is followed up by obtaining the corresponding individual's data in the biennial national physician census and linking it to the baseline data.

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

Definitions of quota and scholarship

According to this study, a quota 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."

In the quota admission system, receiving the scholarship is often a condition for admission to the medical school. However, some medical schools have quotas without scholarships, so entrants are not obligated to practice in certain areas of Japan. In addition, some medical students who did not enter quotas (but did enter medical schools by passing the traditional written examination) but still hope for a prefecture scholarship. This study includes subjects of all the three groups.

Information on scholarship recipients with or without quota admission are obtained from each prefecture government. Information on subjects of quota without scholarship are obtained from each medical school.

Yearly cross-sectional outcomes

Every year the cohort office of JCCME begins this study by sending a questionnaire to each prefecture government to obtain information on the number of newly graduated subjects who received scholarship, number of the subjects who passed the National License Examination for Physicians, and number of subjects who bought out the scholarship to refuse the obligatory work. The cohort office sends a questionnaire also to each medical school to obtain information on the number of subjects in quotas without scholarship and number of the subjects who passed the National License Examination for Physicians (arrows 1 and 2 in Figure 3). The results are yearly cross-sectional outcomes. Some results to-date are shown later in this paper.

This step of survey started in 2014 and will be conducted every year at least until 2025.

Individual baseline data

In the second step, the cohort office requests each prefecture and medical school to forward a questionnaire (arrow 3 in Figure 3) and the prefecture and medical school forward the questionnaire to each potential study subject (arrow 4). Each subject then voluntarily sends back the answered questionnaire to the cohort office (arrow 5). Then the cohort office obtains the baseline data on each subject. The subjects consist of either of the three groups (quota alone, quota with scholarship, and scholarship alone) and are all newly licensed physicians.

The questionnaire for each subject in the group of quota with scholarship and in the group of scholarship alone includes information on whether the subject was admitted to a quota, physician identification number, name of the graduated medical school, graduation year, home prefecture, term of scholarship, length of postgraduate obligation period required by the scholarship, and length of rural service or service in a designated specialty during the obligation period. The questionnaire for each subject in the group of quota without scholarship includes information on physician identification number, name of the graduated medical school, graduation year, home prefecture, and conditions for admission to the quota. Demographic data

such as age, sex, marital status are not included in any questionnaire. The easiness to answer the questions was pre-checked using sample subjects (quota students) in selected medical schools before the study started. The precision of the answers they filled in was also pre-checked by faculty members of the selected schools.

This step in the survey also started in 2014 and will be conducted every year at least until 2025.

Follow-up of individual subjects

The third step is to follow up the subjects. The baseline individual data obtained in the second step is connected, through physician identification number, to the national census data of the "Survey of Physicians, Dentists and Pharmacists" (Physician Census) conducted by Ministry of Health, Labour and Welfare every two years (Figure 4). All licensed physicians in Japan are obligated to register in the Physician Census. The Physician Census includes information on practice location, type of medical facility, work contents, specialty, and board certification status. The connection between the baseline data and the data in Physician Census enables comparison of geographic distribution among the three subject groups and between each subject group and a control group of all physicians in the same generation in Japan. The cohort office will request the Ministry of Health, Labour and Welfare to provide individualised data of Physician Census every two years since 2016 in which data of 2014 Census will be available.

In this way, once the physician identification numbers are stored, the subjects can be followed up almost permanently (until the subjects retire or stop practicing in Japan). The end of the follow-up is thus not determined.

Analysis

Based on the data obtained directly from the prefectures and medical schools (arrow 2 in Figure 3), passing rates of the National License Examination for Physicians in the three groups

of subjects are calculated. These rates are compared with the passing rate of the entire medical school graduates in Japan reported every year by the Ministry of Health, Labour and Welfare. Also based on the data from the prefectures, scholarship buying-out rates of subjects in the groups of quota with scholarship and scholarship alone are calculated. The buying-out rate is, in other words, the number of subjects who refuse to comply with the conditions accompanied by receiving scholarship and thus pay back the awarded money.

Based on the data obtained from individual subjects (arrow 5 in Figure 3) and its linkage to Physician Census data, municipality (city, town, and village)-level distribution, Gini coefficients, proportion of those in rural areas, proportion of those in specialties that are reportedly in shortage nationwide (such as obstetrics and paediatrics) among the subjects in each group are evaluated. These values are compared with those of all the physicians in the same graduating year in the Census (control). Proportion of those who are retained in their home prefectures in each group is also calculated and will be compared with the proportion of other newly licensed physicians that has been or will be reported elsewhere.[17 24] Also the associations between baseline characteristics of subjects (such as sex and length of obligation period) and their geographic distribution are analysed using multivariate models. These results are longitudinally compared among different postgraduate years in the cohort of the same graduating year.

In short, the results are created based on the data which comprise an annual census of school- and prefectural-level statistics for the subjects, an incomplete annual census of the subjects themselves and a biennial national physician census.

Results

Although follow-up data has yet to be obtained as data of 2014 Physician Census is still unavailable, cross-sectional outcomes in 2014 and 2015 have already been obtained.

In 2014, 38 of Japan's 47 prefectures had study subjects who met the subject definitions. All of the 38 prefectures responded to our questionnaire (response rate 100%). Among all 80 medical schools in Japan, the number of those which had study subjects was 21. All of the 21 medical schools (100%) responded to our questionnaire. The results of the National Licence Examination for Physicians among the subjects are shown in Table 1. The passing rates of all the three groups of subjects were higher than the passing rate of all new medical graduates in Japan: 93.9%.

In 2015, 45 prefectures and 22 medical schools had study subjects, and all (100%) responded to the questionnaire. As shown in Table 1, this year again the passing rates of the all groups were higher than that of all new medical graduates in Japan: 94.5%.[25]

Table 1. Passing rates of the National Licence Examination for Physicians. Control data were from the Ministry of Health, Labour and Welfare. [25]

	2014			2015		
	New graduates	Passers	Passing rate	New graduates	Passers	Passing rate
Quota without scholarship	166	160	96.4%	253	244	96.4%
Quota with scholarship	144	141	97.9%	305	295	96.7%
Non-quota with scholarship	322	305	94.7%	391	377	96.4%
All new graduates in Japan (control)	7749	7275	93.9%	8250	7798	94.5%

These results are rather unexpected, taking into account the concern about academic capability of quota students which was and still remains among both the general population and medical school faculty members.

The number of 2014 licensed subjects who bought out their scholarship as of June 2015 was 9 (2.0%) out of all 446 scholarship awardee subjects. The comparable figure of 2015-lincensed subjects was 4 (0.6%) out of 672.

As for recruitment of individual subjects, in 2014 the cohort office sent a questionnaire, via prefecture or medical school to 603 subjects. Among them 241 (response rate 40.0%) responded. In 2015 the questionnaire was sent to 929 subjects and 398 (42.8%) responded to it. These respondents were registered as the cohort subjects.

Strengths and limits of the study

The first strength of this study is that this is the first nationwide and comprehensive longitudinal study on the quota admission system and the prefecture scholarship programme. The second is that, with the help of two related ministries and the national representative body of medical schools, all the prefecture governments and medical schools did and will participate in this study, which enables us to obtain precise information on the number of potential subjects, passing rate of the License Examination, and scholarship buying-out rate every year. In addition, with the full cooperation of prefectures and medical schools, the cohort office can send the questionnaire to all the potential individual subjects. The third strength of this study is that almost 100% of subjects registered in the cohort can be followed up until they either retire or stop practicing in Japan and drop out of the Physician Census. Using the national census data as a way of follow-up costs less money, time, and effort than usual follow-up in which the cohort office contacts each subject numerous times in the future.

One limitation of this study is that the participation of an individual subject is voluntary and thus recruiting all the potential subjects is quite difficult. This is particularly so because the questionnaire includes personal information such as physician identification number. The participation rate of subjects in 2014 was 40.0% and that in 2015 was 43%. We thus cannot exclude a selection bias of the registered cohort subjects, which might create a biased result on the geographic and specialities distribution of these subjects shown in the future.

Another limitation is that the baseline data of the subjects do not include the content of undergraduate medical education, which makes it impossible to evaluate the effect of undergraduate education, such as rural community-based clinical training, on workforce distribution.

Impact on global, national, and local policies

The special admission systems of medical schools aiming to improve the shortage of physicians in rural areas are conducted worldwide.[26-28] Also financial incentive programmes for return of service in underserved areas exist in many countries.[22 23] The results of this study will add evidence to show the effectiveness of these systems and programmes.

The expansion of medical school entrants by adding quota is continued, under a national law, until 2019. But after 2019, the future of the quota system is unknown. The government, prefectures, and medical schools have four options: expanding the system, continuing it as it is, restricting its scale, and abolishing it entirely. The results of this study, such as geographic distribution, specialty distribution, buying-out rate, and national examination passing rate of quota graduates, will enable the stakeholders to make the most informed choice. Moreover, the results of this study in each prefecture will enable the prefecture to consider what to do with its scholarship programme.

ETHICS AND DISSEMINATION

The Ethics Committee for epidemiological research of Hiroshima University and the Research Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences gave permission for this study. The cohort office explains in a document to all the prefectures, medical schools, and individual subjects that all the information in the questionnaire is used only for the research purpose and the data provided by an individual can be deleted any time

when the individual requests the cohort office to do so. The response to the sent questionnaire is voluntary.

The cohort data is collected and stored in the cohort office (Department of Community-based Medical System, Hiroshima University) without personal name of each individual subject (completely anonymous data). Aggregated results will be presented in conferences or published in journals. The aggregated results also will be reported to concerned government ministries, associations, and prefectures.

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. JT, ST and KI contributed to the study design, interpretation of data, and writing the draft. TO and SI contributed to the study administration, data collection, and draft writing.

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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, Institute 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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Figure legends

Figure 1. Example of regional quota system of a Japanese medical school (Hiroshima University School of Medicine and Hiroshima Prefecture). Each school designs its own quota system (yr, year; med, medical).

Figure 2. Number of entrants to Japanese medical schools (data from Ministry of Education, Culture, Sports, Science and Technology).[17]

Figure 3. Overview of study design (QE, questionnaire; JCCME, Japanese Council for Community-based Medical Education; yrs, years; exam, examination).

Figure 4. Creation of follow-up data (MHLW, Ministry of Health, Labour and Welfare; ID, identification number)

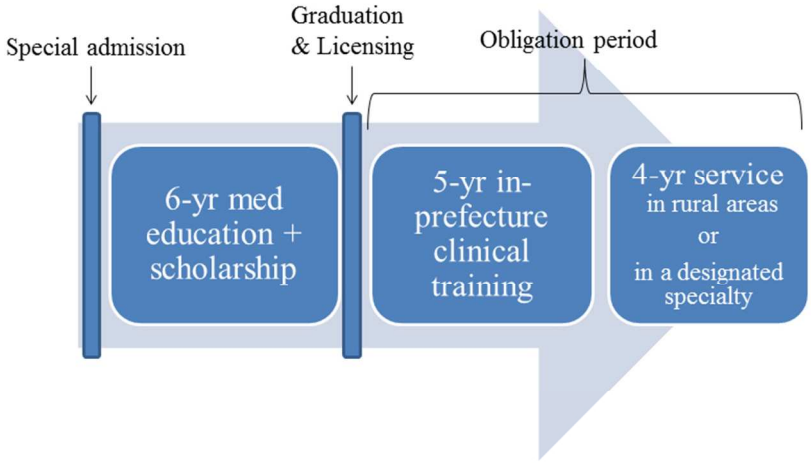

Figure 1
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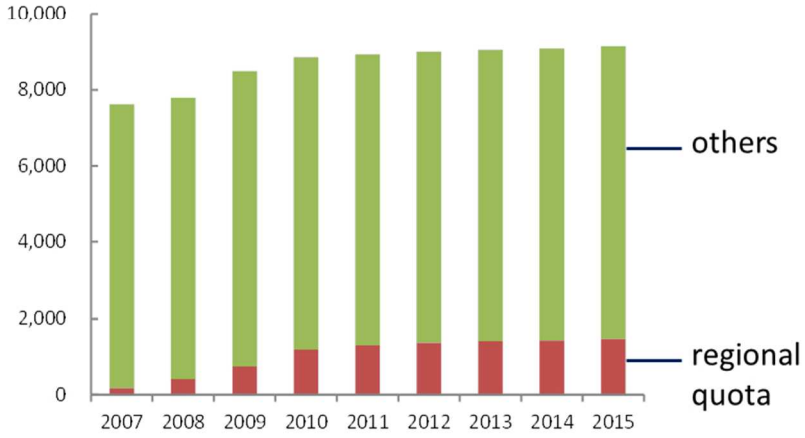

Figure 2
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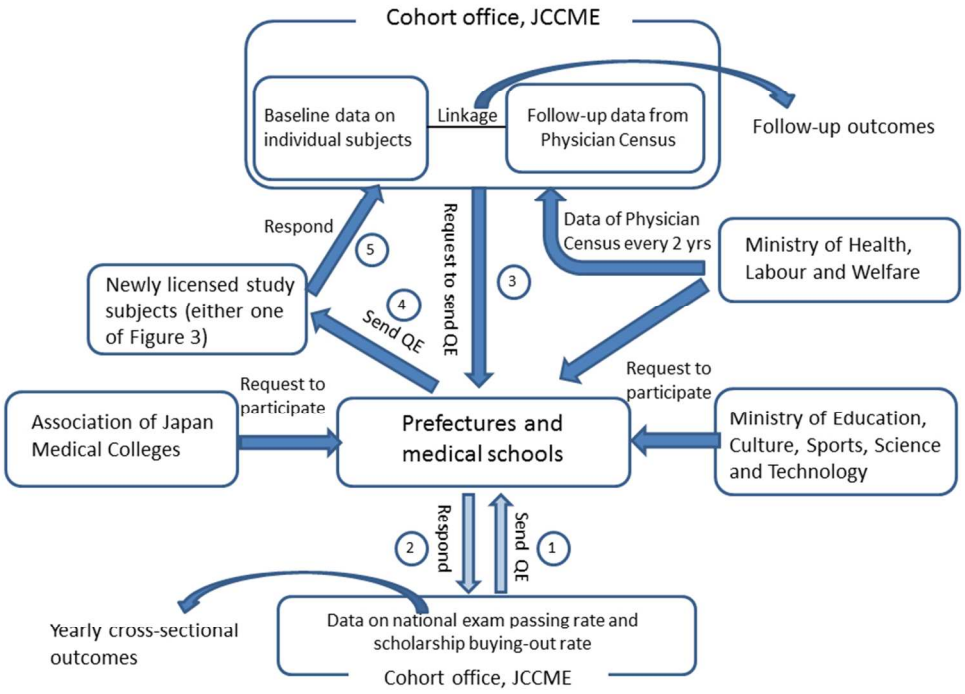

Figure 3
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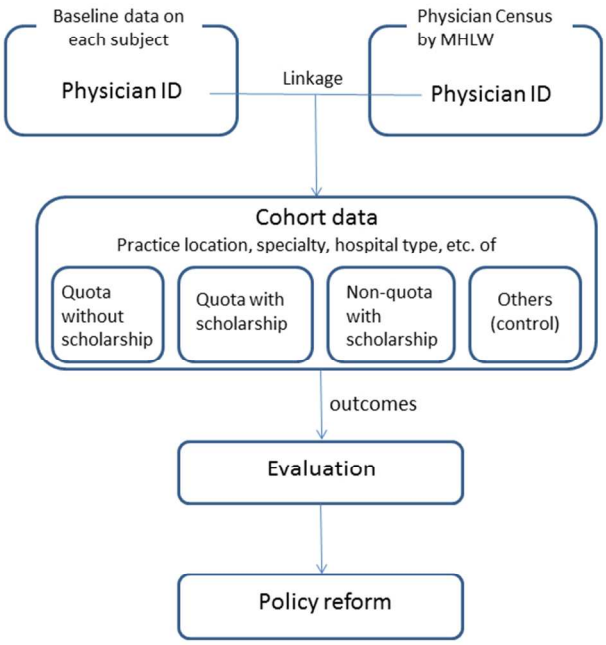

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BMJ Open

Follow-up study of the regional quota system of Japanese medical schools and prefecture scholarship programmes: a study protocol

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Follow-up study of the regional quota system of Japanese medical schools and prefecture scholarship programmes: a study protocol

Masatoshi Matsumoto[1], Keisuke Takeuchi[1], Junko Tanaka[2], Susumu Tazuma[3], Kazuo Inoue[4], Tetsuhiro Owaki[5], Seitaro Iguchi[6], Takahiro Maeda[7]

1 Department of Community-Based Medical System, Institute of Biomedical and Health Sciences, Hiroshima University, Hiroshima, Japan

2 Department of Epidemiology, Infectious Disease Control and Prevention, Institute of Biomedical and Health Sciences, Hiroshima University, Hiroshima, Japan

3 Department of General Internal Medicine, Hiroshima University Hospital and Graduate School of Biomedical & Health Sciences, Hiroshima, Japan

4 Department of Community Medicine, Chiba Medical Center, Teikyo University School of Medicine, Chiba, Japan

5 Education Center for Doctors in Remote Islands and Rural Areas, Graduate School of Medical Sciences, Kagoshima University, Kagoshima, Japan

6 Department of Community Medicine, Niigata University Graduate School of Medical & Dental Sciences, Niigata, Japan

7 Department of Community Medicine, Nagasaki University Graduate School of Biomedical Science, Nagasaki, Japan

Corresponding author: Masatoshi Matsumoto

Department of Community Based Medical System, Institute of Biomedical and Health Sciences, Hiroshima University

1-2-3 Kasumi, Minami-ku, Hiroshima, 734-8551 JAPAN

Phone: +81-82-257-5894 Fax: +81-82 257-5895 Email: matmo10@jb3.so-net.ne.jp

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

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ABSTRACT

Introduction: Given the shortage of physicians, particularly in rural areas, the Japanese government has rapidly expanded the number of medical school students by adding *chiikiwaku* (regional quotas) since 2008. Quota entrants now account for 17% of all medical school entrants. Quota entrants are usually local high school graduates who receive a scholarship from the prefecture government. In exchange, they temporarily practice in that prefecture, including its rural areas, after graduation. Many prefectures have also scholarship programmes for non-quota students in exchange for postgraduate in-prefecture practice. The objective of this cohort study, conducted by the Japanese Council for Community-based Medical Education, is to evaluate the outcomes of the quota admission system and prefecture scholarship programmes nationwide.

Methods and analysis: There are three groups of study subjects: quota without scholarship, quota with scholarship, and non-quota with scholarship. Under the support of government ministries and the Association of Japan Medical Colleges, and participation of all prefectures and medical schools, passing rate of the National Physician License Examination, scholarship buy-out rate, geographic distribution and specialties distribution of each group are analysed. Subjects who voluntarily participated are followed by linking their baseline information to data in the government's biennial Physician Census. Results to date showed that, despite medical schools' concerns about academic quality, the passing rate of the National Physician License Examination in each group was higher than that of all medical school graduates.

Ethics and dissemination: The Ethics Committee for epidemiological research of Hiroshima University and the Research Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences permitted this study. No individually identifiable results will be presented in conferences or published in journals. The aggregated results will be reported to concerned government ministries, associations, prefectures and medical schools as data for future policy planning.

Strengths and limitations of this study

- Regional quota admission system of medical schools is one of the largest national policies ever conducted to redress maldistribution of physicians, and these entrants now constitute 17% of all medical school entrants in Japan.
- This study evaluates the outcomes of the quota admission system and prefecture scholarship programmes for medical students by cross-sectional survey to prefectures and medical schools, and analysing cohort of quota and scholarship participants.
- Started in 2013, this is the first comprehensive and longitudinal study of this sort, with support from concerned ministries and the representative body of medical schools.
- All of Japan's prefecture governments and medical schools participate in this study, which yields precise information on the passing rate of the National License Examination for Physicians and scholarship buy-out rate of study subjects every year.
- Geographic and specialty distributions of all the study subjects voluntarily registered in the cohort can be followed until they retire as we link the baseline data to the government's national biennial census data, though increasing the recruitment rate of participants is a challenge.

INTRODUCTION

Geographic maldistribution of physicians in Japan

Geographic maldistribution of physicians has long been recognised as a chronic social problem in Japan. No public agencies have a legal right to decide the allocation of physicians, and thus physicians are given unrestricted freedom to practice wherever they like. There is no

allocation system in which local governments or professional bodies place a cap on the number of physicians in each area as seen in other countries such as United Kingdom. In this context the concentration of physicians in urban areas and a corresponding shortage in rural areas are likely to occur,[1-3] and initiatives in Japan up to this time have yet to redress the maldistribution of physicians. Article 25 of the Japanese Constitution guarantees healthy living of all citizens and obliges the government to improve public health. So redressing the geographic maldistribution is usually recognised a responsibility of the national and local governments.

The national and prefectural governments have attempted to resolve this issue in several ways. First the government constructed one medical school in each prefecture between the 1960s and 1970s, founding new public medical schools in mainly rural prefectures where none had existed. Under this policy, the number of medical schools in Japan increased from 46 to 79 and the number of medical school entrants doubled.[4] Second, in 1972, the national and prefectural governments cooperated to found a special medical school, Jichi Medical School, solely to train rural physicians.[2 5 6] These policies increased both the number of practicing physicians nationwide and the number of rural physicians.[7 8] It is likely that the increase in the number of rural physicians contributed to the decrease in number of country's designated *muichiku* (non-physician communities).[2]

However, the equity of distribution of physicians has been almost unchanged; in other words the disparity between the number of urban and rural physicians has not diminished.[7 9 10] To make matters worse, a new residency training system started in 2004. In this new system, like the residency matching system of the United States, new graduates are matched to training hospitals nationwide in order of their preferences, which changed the distribution of young physicians who previously tended to concentrate in university hospitals.[11] This change decreased the physician-assigning capability of university hospitals which has traditionally dispatched physicians to rural hospitals.[3] Since the implementation of this new residency

scheme, the geographic distribution of physicians has reportedly worsened.[12-15] The shortage of physicians in rural areas and collapse of healthcare provision in such communities has resurfaced as a social concern.

Emergence of regional quotas as a national policy

The government responded by rapidly expanding the number of medical school entrants by adding *chiikiwaku*, a regional quota, in 2008.[16] Under the quota, applicants to a medical school, in most cases, must have graduated from a high school in that prefecture. An expressed intention to practice in that prefecture, preferably in one of its rural areas, is valued in the admission interview. Upon admission, entrants are usually offered six-year scholarships from the prefectural government in exchange for working in the prefecture, including its rural areas, for a designated obligation period after graduation (Figure 1).[16] The design of the quota varies substantially among medical schools. Some medical schools have quotas without scholarship, in which case the intention to practice in certain areas is valued in admission but the entrants have no obligation period. Some quotas require their students to work in rural areas or in a specialty which is recognised to be in severe shortage in the prefecture.

Currently 70 out of Japan's 80 medical schools have such quotas. The number of entrants to quota exceeded 1500 per year, amounting to 17% of all medical school entrants (Figure 2).[17] Historically this is one of the largest and most ambitious policies to rectify the maldistribution of physicians in Japan and evaluation of outcomes of this policy thus is needed. However, the quota has only just started to graduate students, so there is as yet no comprehensive and longitudinal study to assess its effectiveness.

Prefecture scholarship for medical students independent of quota

Aside from the quota, many prefectures have independent scholarship programmes for medical students. This scholarship is also given in exchange for postgraduate practice within the

prefecture, usually including rural areas. The scholarship recipients are students who entered medical schools in a usual way (non-quota admission) or those who entered quotas without scholarship. Similar to the quota system, these scholarship programmes have recently expanded. Similar programmes are seen in other countries, but their outcomes are open to debate.[18-23] The outcomes of the prefecture scholarship programmes in Japan are not yet known.

Objectives of this study

This cohort study investigates the outcome of the quota admission system of medical schools and that of prefecture scholarship programmes for non-quota students. The cohort consists of three groups of physicians: quota without scholarship, quota with scholarship, and scholarship without quota admission. Passing rate of the National Physician License Examination, scholarship buy-out rate, geographic distribution, and specialty distribution of each group of subjects are evaluated and compared with those of all Japanese physicians in the same graduating year.

Methods and analysis

Study design

This study is conducted by the Japanese Council for Community-based Medical Education (JCCME). The JCCME is the official association of medical school departments which engage in community or rural health education and research. The mission of JCCME is promotion of community-based medical education. Many of the departments in JCCME educate and train quota students.

The outline of study design is shown in Figure 3. The study consists of three steps. In the first step, the cohort office of JCCME contacts all prefectural governments and medical schools and

obtains data for the yearly cross-sectional outcomes (lower part of figure 3). In the second step, the cohort office contacts individual subjects via prefectural governments or medical schools and obtains baseline data for follow-up (upper part). Finally, in the third step the each individual is followed up by obtaining the corresponding individual's data in the biennial national physician census and linking these data to the baseline data.

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

Definitions of quota and scholarship

According to this study, a quota 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."

In the quota admission system, receiving the scholarship is often a condition for admission to the medical school. However, some medical schools have quotas without scholarships, so entrants are not obligated to practice in certain areas of Japan. In addition, some medical students who did not enter quotas (but did enter medical schools by passing the traditional written examination) but may obtain prefecture scholarships. This study includes subjects in all the three groups.

Information on scholarship recipients with or without quota admission are obtained from each prefecture government. Information on subjects of quota without scholarship are obtained from each medical school.

Yearly cross-sectional outcomes

Every year the cohort office of JCCME begins this study by sending a questionnaire to each prefecture government to obtain information on the number of newly graduated subjects who received scholarship, number of the subjects who passed the National License Examination for Physicians, and number of subjects who bought out the scholarship to refuse the obligatory work. The cohort office also sends a questionnaire to each medical school to obtain information on the number of subjects in quotas without scholarship and number of the subjects who passed the National License Examination for Physicians (arrows 1 and 2 in Figure 3). The results are yearly cross-sectional outcomes. Some results to-date are shown later in this paper.

This step of survey started in 2014 and will be conducted every year at least until 2025.

Individual baseline data

In the second step, the cohort office requests each prefecture and medical school to forward a questionnaire to each potential study participant (arrow 3 and 4 in Figure 3). Each participant then voluntarily sends back the answered questionnaire to the cohort office (arrow 5). The cohort office then obtains the baseline data on each participant. The participants are members of one of the three groups (quota alone, quota with scholarship, and scholarship alone) and are all newly licensed physicians.

The questionnaire for each participant in the group of quota with scholarship and in the group of scholarship alone includes information on whether the participant was admitted to a quota, physician identification number, name of the graduated medical school, graduation year, home prefecture, term of scholarship, length of postgraduate obligation period required by the scholarship, and length of rural service or service in a designated specialty during the obligation period. The questionnaire for each participant in the group of quota without scholarship includes information on physician identification number, name of the graduated medical school, graduation year, home prefecture, and conditions for admission to the quota. Demographic data

such as age, sex, or marital status, are not included in the questionnaire. The ease in answering the questions was pre-checked using sample participants (quota students) in selected medical schools before the study started. The precision of answers they provided was also assessed by faculty members of the selected schools.

This step in the survey also started in 2014 and will be conducted every year at least until 2025.

Follow-up of individual participants

The third step is to follow up the participants. The baseline individual data obtained in the second step are connected, through physician identification number, to the national census data of the "Survey of Physicians, Dentists and Pharmacists" (Physician Census) conducted by Ministry of Health, Labour and Welfare every two years (Figure 4). All licensed physicians in Japan are obligated to register in the Physician Census. The Physician Census includes information on practice location, type of medical facility, work contents, specialty, and board certification status. The connection between the baseline data and the data in Physician Census enables comparison of geographic distribution among the three participant groups and between each participant group and a comparison group of all physicians in the same graduating year in Japan. The cohort office will request the Ministry of Health, Labour and Welfare to provide individualised data of Physician Census every two years beginning in 2016 at which time data of 2014 Census will be available.

In this way, once the physician identification numbers are stored, the participants can be followed up almost permanently (until the participants retire or stop practicing in Japan).

Analysis

Based on the data obtained directly from the prefectures and medical schools (arrow 2 in Figure 3), passing rates of the National License Examination for Physicians in the three groups

of subjects are calculated. These rates are compared with the passing rate of the entire medical school graduates in Japan reported every year by the Ministry of Health, Labour and Welfare. Also based on the data from the prefectures, scholarship buy-out rates of subjects in the groups of quota with scholarship and scholarship alone are calculated. The buy-out rate is derived from the number of subjects who refuse to comply with the conditions accompanied by receiving of the scholarship and thus return the awarded money.

Based on the data obtained from individual participants (arrow 5 in Figure 3) and its linkage to Physician Census data, municipality (city, town, and village)-level distribution, Gini coefficients, proportion of those in rural areas, proportion of those in specialties that are reportedly in shortage nationwide (such as obstetrics and paediatrics) among the participants in each group are evaluated. These values are compared with those of all the physicians in the same graduating year in the Census (comparison group). The proportion of those who are retained in their home prefectures in each group will be calculated and will be compared with the proportion of other newly licensed physicians that has been or will be reported elsewhere.[17] [24] Also the associations between baseline characteristics of participants (such as sex and length of obligation period) and their geographic distribution are analysed using multivariate models. These results are longitudinally compared among different postgraduate years in the cohort of the same graduating year.

In short, the results are created based on the data which comprise an annual census of school- and prefectural-level statistics for the subjects, an incomplete census of the cohort participants themselves and a biennial national physician census.

Results

Although follow-up data has yet to be obtained as data of 2014 Physician Census is still unavailable, cross-sectional outcomes in 2014 and 2015 have already been obtained.

In 2014, 38 of Japan's 47 prefectures had study subjects who meet the study definitions. All of the 38 prefectures responded to our questionnaire (response rate 100%). Among all 80 medical schools in Japan, 21 had study subjects and all 21 schools (100%) responded to our questionnaire. The results of the National Licence Examination for Physicians among the subjects are shown in Table 1. The passing rates of all the three groups of subjects were higher than the passing rate of all new medical graduates in Japan: 93.9%.

In 2015, 45 prefectures and 22 medical schools had study subjects, and all (100%) responded to the questionnaire. As shown in Table 1, this year again the passing rates of the all groups were higher than that of all new medical graduates in Japan: 94.5%.[25]

Table 1. Passing rates of the National Licence Examination for Physicians. Comparison data were from the Ministry of Health, Labour and Welfare. [25]

	2014			2015		
	New graduates	Passers	Passing rate	New graduates	Passers	Passing rate
Quota without scholarship	166	160	96.4%	253	244	96.4%
Quota with scholarship	144	141	97.9%	305	295	96.7%
Non-quota with scholarship	322	305	94.7%	391	377	96.4%
All new graduates in Japan (comparison)	7749	7275	93.9%	8250	7798	94.5%

These results were unexpected, taking into account the concern about academic capability of quota students which was and still remains among both the general population and medical school faculty members.

The number of 2014 licensed subjects who bought out their scholarship as of June 2015 was 9 (2.0%) out of all 446 scholarship awardee subjects. The comparable figure of 2015-lincensed subjects was 4 (0.6%) out of 672.

As for recruitment of individual participants, in 2014 the cohort office sent a questionnaire, via prefecture or medical school to 603 subjects and received 241 responses (40.0%). In 2015 the questionnaire was sent to 929 subjects and 398 (42.8%) responded. These respondents were registered as the cohort participants.

Strengths and limits of the study

The first strength of this study is that this is the first nationwide and comprehensive longitudinal study on the quota admission system and the prefecture scholarship programme. The second is that, with the help of two related ministries and the national representative body of medical schools, all the prefecture governments and medical schools did and will participate in this study, which enables us to obtain precise information on the number of potential subjects, passing rate of the License Examination, and scholarship buy-out rate every year. In addition, with the full cooperation of prefectures and medical schools, the cohort office can send the questionnaire to all the potential individual subjects. The third strength of this study is that almost 100% of participants registered in the cohort can be followed up until they either retire or stop practicing in Japan and drop out of the Physician Census. Using the national census data as a way of follow-up costs less money, time, and effort than usual follow-up in which the cohort office contacts each potential subject numerous times in the future.

One limitation of this study is that the participation of an individual subject is voluntary and thus recruiting all the potential subjects is quite difficult. This is particularly so because the questionnaire includes personal information such as physician identification number. The participation rate of subjects in 2014 was 40.0% and that in 2015 was 43%. We thus cannot exclude a selection bias of the cohort participants, which might create a biased result on the geographic and specialities distribution of the participants in future analyses.

Another limitation is that the baseline data of the participants do not include the content of undergraduate medical education, which makes it impossible to evaluate the effect of undergraduate education, such as rural community-based clinical training, on workforce distribution.

Impact on global, national, and local policies

The special admission systems of medical schools aiming to improve the shortage of physicians in rural areas are conducted worldwide.[26-28] Also financial incentive programmes for return of service in underserved areas exist in many countries.[22 23] The results of this study will add evidence to show the effectiveness of these systems and programmes.

The expansion of medical school entrants by adding quota is continued, under a national law, until 2019. But after 2019, the future of the quota system is unknown. The government, prefectures, and medical schools have four options: expanding the system, continuing it as it is, restricting its scale, and abolishing it entirely. The results of this study, such as geographic distribution, specialty distribution, buy-out rate, and national examination passing rate of quota graduates, will enable the stakeholders to make the most informed choice. Moreover, the results of this study in each prefecture will enable the prefecture to consider what to do with its scholarship programme.

ETHICS AND DISSEMINATION

The Ethics Committee for epidemiological research of Hiroshima University and the Research Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences gave permission for this study. The cohort office explains in a document to all the prefectures, medical schools, and individual participants that all the information in the questionnaire is used only for the research purpose and the data provided by an individual can be deleted any time

when the individual requests the cohort office to do so. The response to the sent questionnaire is voluntary.

The cohort data are collected and stored in the cohort office (Department of Community-based Medical System, Hiroshima University) without personal name of each individual participant (completely anonymous data). Aggregated results will be presented in conferences or published in journals. The aggregated results also will be reported to concerned government ministries, associations, and prefectures.

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. JT, ST and KI contributed to the study design, interpretation of data, and writing the draft. TO and SI contributed to the study administration, data collection, and draft writing.

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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, Institute 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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Figure legends

Figure 1. Example of regional quota system of a Japanese medical school (Hiroshima University School of Medicine and Hiroshima Prefecture). Each school designs its own quota system (yr, year; med, medical).

Figure 2. Number of entrants to Japanese medical schools (data from Ministry of Education, Culture, Sports, Science and Technology).[17]

Figure 3. Overview of study design (QE, questionnaire; JCCME, Japanese Council for Community-based Medical Education; yrs, years; exam, examination).

Figure 4. Creation of follow-up data (MHLW, Ministry of Health, Labour and Welfare; ID, identification number)

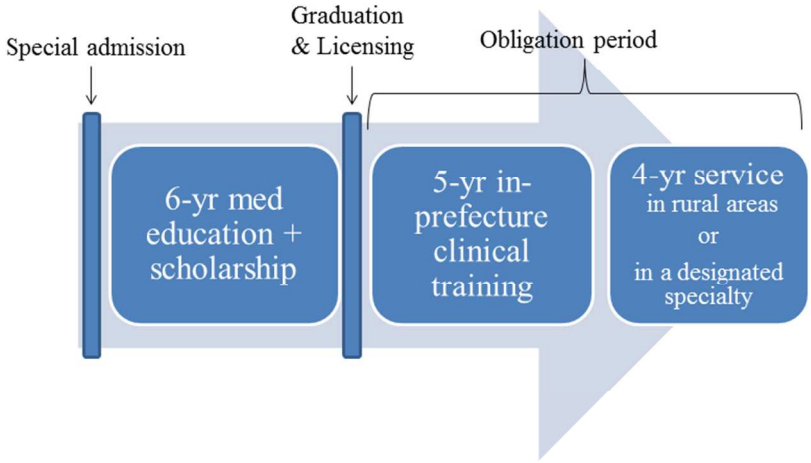

Figure 1
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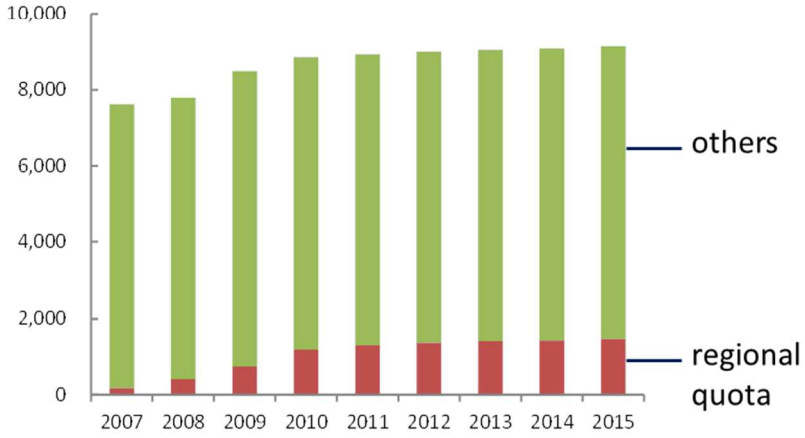

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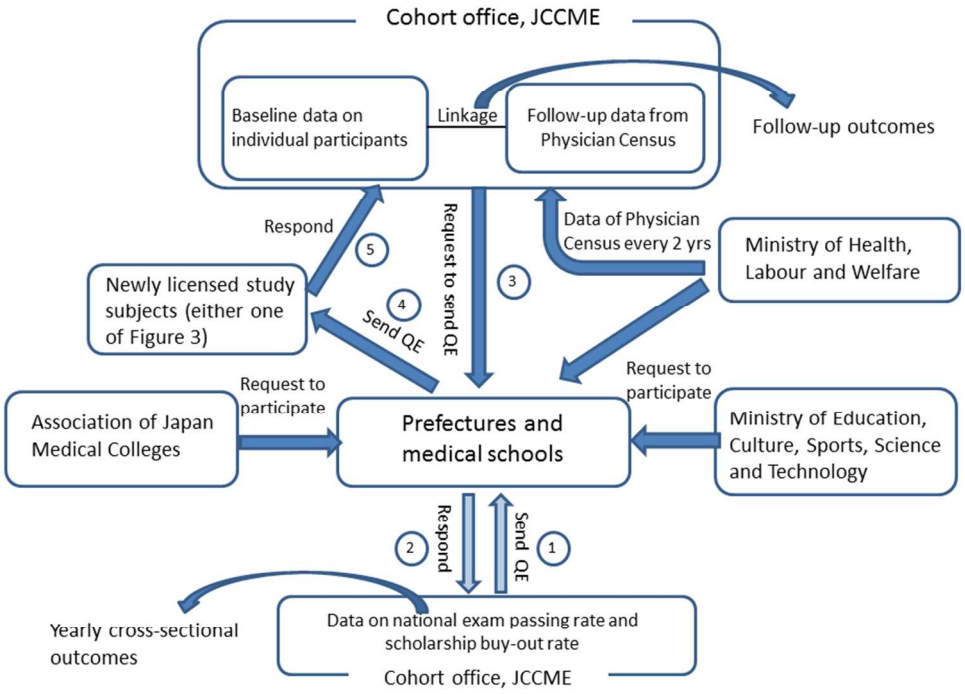

Figure 3
254x190mm (96 x 96 DPI)

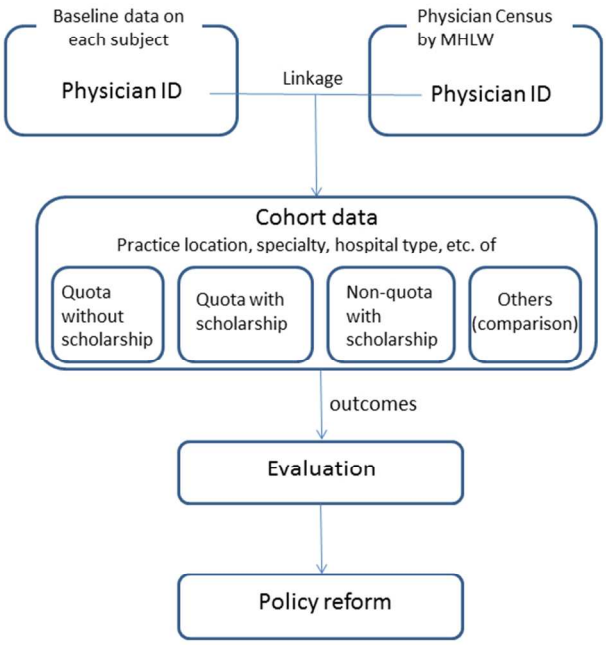

Figure 4
254x190mm (96 x 96 DPI)