する。

本研究にはいくつかの限界がある。一つ目は約2万人の未報告者の存在である。未報告者の実際の勤務状況は不明であり、退職、離職、死亡している場合や、実際は勤務しているが報告していない可能性がある。二つ目は将来推計に用いた仮定が今後変化してする可能性である。特に勤務状況間の移行率は2010年と2012年の1期間のみを用いているため、時代による変化を必ずしも十分に追跡できていない。また、退職年齢について、男女別に計算していない。男性歯科医師の方が女性歯科医師より退職年齢が遅いという海外の報告があり、男性の歯科開業医にとっては68歳という退職年齢が早い可能性がある。
以上より、本研究において歯科医師数の将来予測を勤務状況別に施行した結果、人口千人当たりの全体の総数は減少後増加に転じるが、歯科開業医数は減少しそれに対し歯科診療所勤務医数は増加することが予測された。

E.研究発表

1．論文発表

投稿中

2．学会発表

なし

F. 知的財産権の出願・登録状況

なし

表1.　2010年と2012年の歯科医師調査の参加者特性

	2010年調査						2012年調査					
	男性		女性		合計		男性		女性		合計	
	N	%	N	%	N	%	N	%	N	%	N	%
	80843	75.4	26406	24.6	107249	100	83349	74.8	28042	25.2	111391	100
平均年齢	47.0		41.2		45.6		48.4		42.2		46.8	
年齢												
≤29	5157	6.4	3910	14.8	9067	8.5	4734	5.7	3641	13	8375	7.5
30-39	16346	20.2	9272	35.1	25618	23.9	15427	18.5	9422	33.6	24849	22.3
40-49	22750	28.1	6703	25.4	29453	27.5	21463	25.8	7192	25.6	28655	25.7
50-59	26070	32.2	5235	19.8	31305	29.2	26854	32.2	5755	20.5	32609	29.3
60-69	10207	12.6	1240	4.7	11447	10.7	14403	17.3	1971	7	16374	14.7
≥70	313	0.4	46	0.2	359	0.3	468	0.6	61	0.2	529	0.5
勤務状況												
歯科開業医	47257	58.5	4268	16.2	51525	48	48066	57.7	4445	15.9	52511	47.1
歯科診療所勤務医	12684	15.7	11054	41.9	23738	22.1	13288	15.9	11725	41.8	25013	22.5
病院勤務医	2130	2.6	730	2.8	2860	2.7	2106	2.5	746	2.7	2852	2.6
大学勤務者	6170	7.6	3278	12.4	9448	8.8	6192	7.4	3432	12.2	9624	8.6
その他	1290	1.6	738	2.8	2028	1.9	1367	1.6	760	2.7	2127	1.9
未報告	11312	14	6338	24	17650	16.5	12330	14.8	6934	24.7	19264	17.3

図 1-1　歯科医師数の将来予測

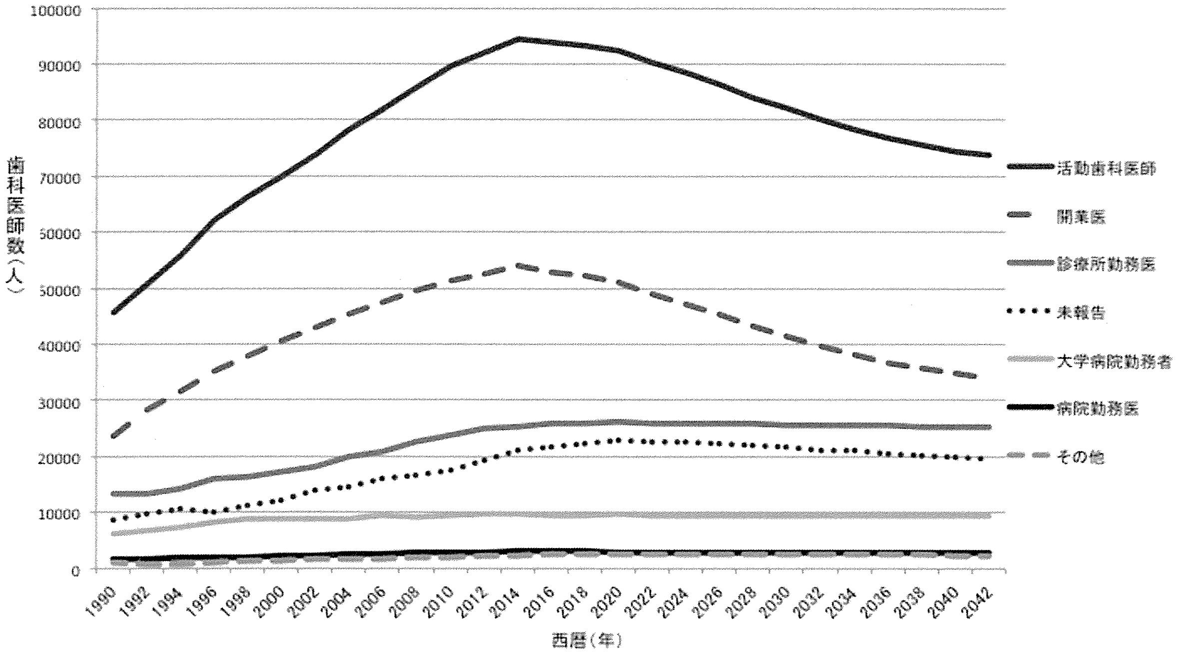


図 1-2　人口千人当たりの歯科医師数の将来予測

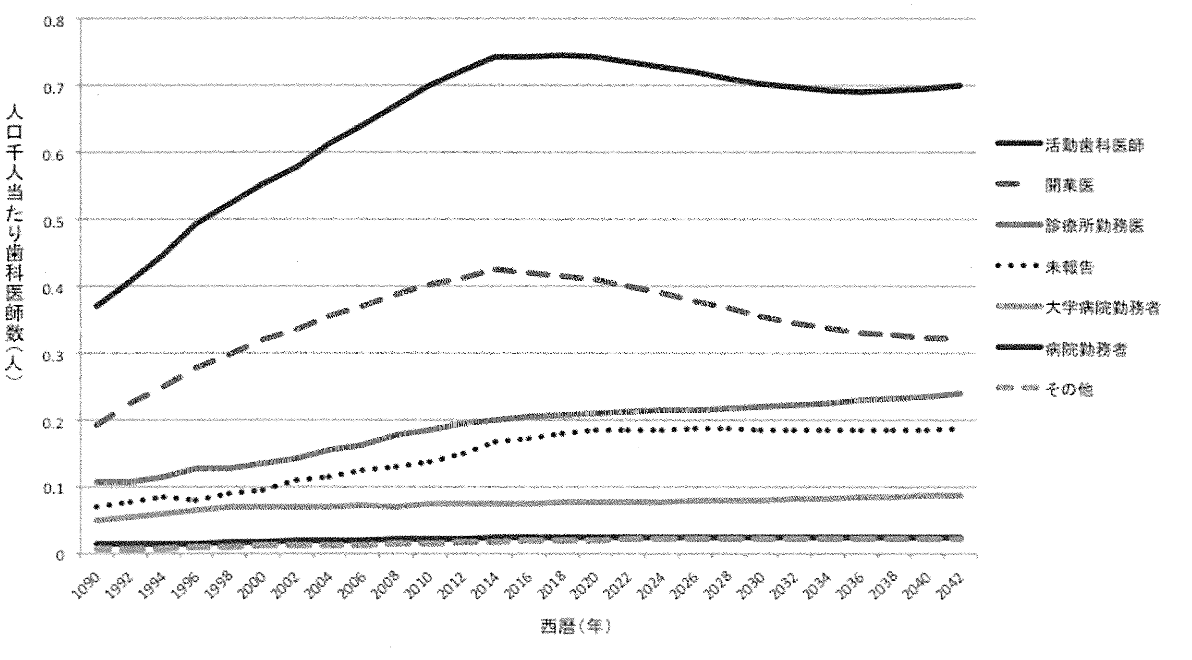


図 2-3　男性歯科医師数の将来予測

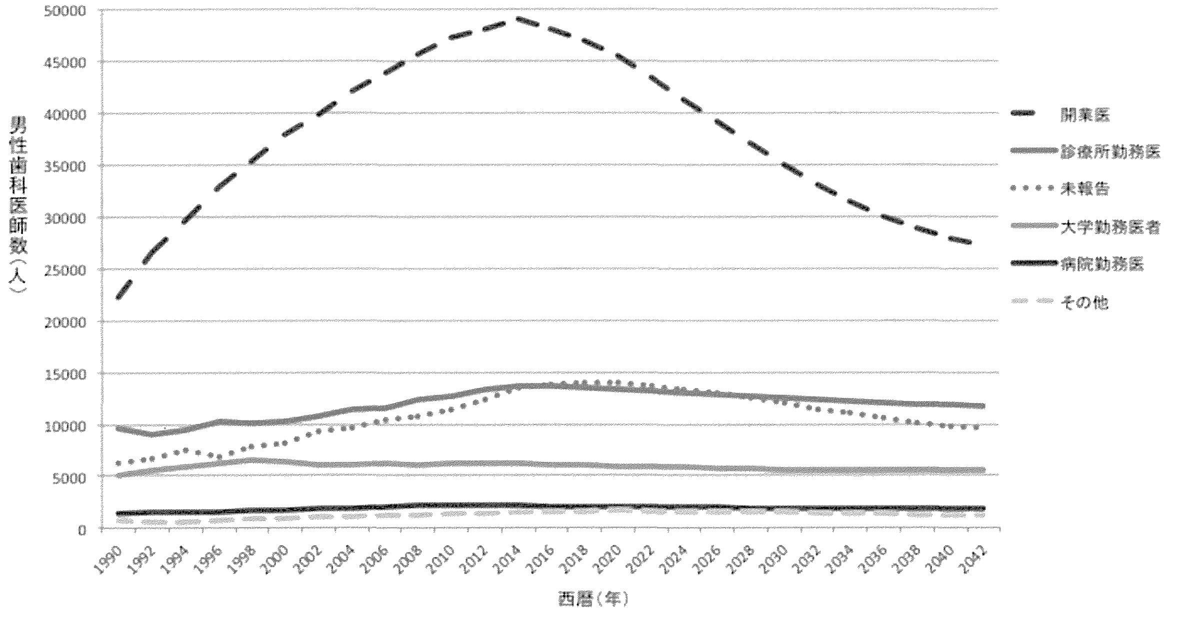
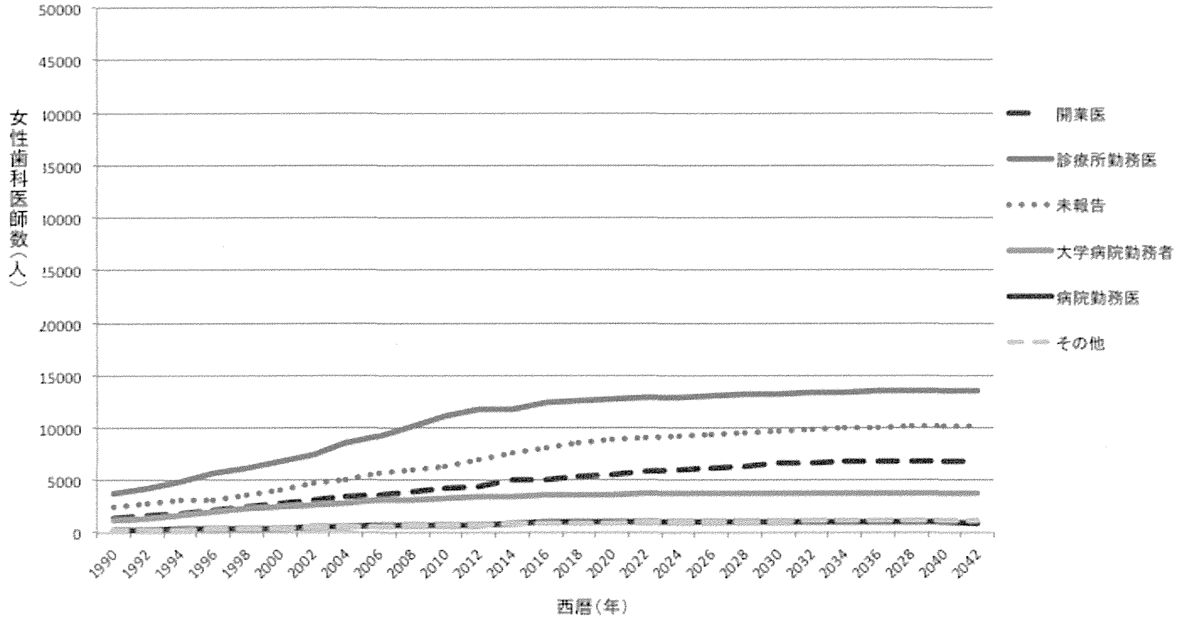


図 2-4　女性歯科医師数の将来予測



Ⅲ. 研究成果の刊行に関する一覧表

書籍

該当なし

雑誌

発表者氏名	論文タイトル名	発表誌名	巻号	ページ	出版年
Matsumoto M, Koike S, Matsubara S, Kashima S, Ide H, Yasunaga H.	Selection and concentration of obstetric facilities in Japan: Longitudinal study based on national census data.	Journal of Obstetrics and Gynaecology Research	Epub ahead of print doi: 10.1111/jog.12663		2014

THE JOURNAL OF
Obstetrics and Gynaecology Research

doi:10.1111/jog.12663 J. Obstet. Gynaecol. Res. 2014

Selection and concentration of obstetric facilities in Japan: Longitudinal study based on national census data

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Abstract

Aim: A shortage of obstetricians with increased workload is a social problem in Japan. In response, the government and professional bodies have accelerated the 'selection and concentration' of obstetric facilities. The aim of this study was to evaluate the recent trend of selection and concentration.

Methods: We used data on the number of deliveries and of obstetricians in each hospital and clinic in Japan, according to the Static Survey of Medical Institutions in 2005, 2008 and 2011. To evaluate the inter-facility equality of distribution of the number of deliveries, number of obstetricians and number of deliveries per obstetrician, Gini coefficients were calculated.

Results: The number of obstetric hospitals decreased by 20% and the number of deliveries per hospital increased by 26% between 2005 and 2011. Hospital obstetricians increased by 16% and the average number of obstetricians per hospital increased by 19% between 2008 and 2011. Gini coefficient of deliveries has significantly decreased. In contrast, Gini coefficient of deliveries per obstetrician has significantly increased. The degree of increase in obstetricians and of decrease in deliveries per obstetrician was largest at the hospitals with the highest proportion of cesarean sections. The proportion of obstetric hospitals with the optimal volume of deliveries and obstetricians, as defined by Japan Society of Obstetrics and Gynecology, was 4% in 2008, and it had doubled to 8.1% 3 years later.

Conclusion: The selection and concentration of obstetric facilities is progressing rapidly and effectively in Japan.

Key words: health policy, health resource, Japan, obstetric delivery, workload.

Introduction

A shortage of obstetricians and subsequent demand–supply mismatch of obstetric care has recently emerged as a social and medical problem in Japan.[1–3] For the past 30 years, the number of obstetricians and gynecologists (OB-GYNs) has decreased by 5% while the total number of physicians has increased by 116%.[4] Of even greater concern is that the number of new medical graduates who chose OB-GYN has been steadily decreasing.[4] The number of obstetric facilities is also decreasing: between 1993 and 2008 the number of obstetric hospitals dropped by 37% and the number of clinics by 42%.[5] The national and prefectural

Received: July 2 2014.
Accepted: November 16 2014.
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governments have implemented various policies and invested substantial amounts of money to increase the number of OB-GYNs.[6–10] As a short-term trend, the number of OB-GYNs has slightly increased: between 2006 and 2012 it rose by 8%.[11,12]

Japan Society of Obstetrics and Gynecology and Japan Association of Obstetricians and Gynecologists have noted that heavy workloads and long duty hours are the reasons for the shortage of OB-GYNs.[13,14] They have advocated expanding the scale of each delivery hospital and having obstetricians work in shifts.[13] The Society claims that ≥500 deliveries per year and six or eight obstetricians per 500 deliveries is the optimal volume of an obstetric hospital and has set the goal that most hospitals attain these optimal volumes by 2030.[15]

The Japanese government also recommends accelerating the selection and concentration of delivery hospitals,[16] and has earmarked funds to do so.[17,18] For example, in 2007 alone, the government subsidized 1251.7 million yen ($US12.5 m) to selected delivery hospitals to support their finances.[6] Selection and concentration of hospitals and subsequent upsizing of selected hospitals are certainly a rational option for making the best use of finite human resources. It is unknown, however, if these policies are effective and if the selection and concentration of delivery hospitals is progressing in reality.

The aim of this study was to investigate the recent trend in the selection and concentration status of deliveries and obstetricians among delivery facilities in Japan, based on national census data. We also analyzed a change in the inter-facility equality of distribution of delivery volume and obstetrician volume, which is potentially accompanied by selection and concentration. Based on the results, we discuss the effectiveness of current selection and concentration policies and the proposals of professional bodies.

Methods

Data used in this study were from the Static Survey of Medical Institutions (hospitals and clinics) in 2005, 2008 and 2011, provided with permission to use for research by Ministry of Health, Labour and Welfare. The Static Survey of Medical Institutions is conducted by the Ministry every 3 years. All clinics and hospitals in Japan are obliged by national law to report their activities and resources in the Survey. In Japan, a hospital is defined as a medical facility with ≥20 beds, and a clinic as one with <20 beds. The 2011 Survey did not cover all the facilities in Fukushima and some of the facilities in Miyagi prefecture because of the Great East Japan Earthquake.

Data on the number of deliveries and of obstetricians in each hospital or clinic were used. The number of vaginal and cesarean deliveries in September of each year was used. The number of obstetricians in the data was expressed as the number of full-time equivalent doctors, and the number was that on 1 October of the year. Data on the number of obstetricians in 2008 and 2011 were used because there was no obstetrician data in 2005 dataset. In order to estimate the capture rate of the Survey, that is, the rate of captured deliveries in the Survey among all the deliveries, the data were compared with the number of births in September of the year in the Vital Statistics conducted by the government based on Family Registration Law, which enumerates all births and deaths in Japan.[19]

As basic statistics, the following was calculated for all obstetric clinics and for all obstetric hospitals: total number of obstetric facilities, total number of deliveries, average number of deliveries per facility, total number of obstetricians, average number of obstetricians per facility, and the average number of deliveries per obstetrician. Facilities with one or more obstetricians were regarded as obstetric facilities in this study. In each year, the number of obstetric facilities that either stopped or started providing delivery services was calculated.

For evaluating the inter-facility equality of distribution of the number of deliveries, Gini coefficient was calculated. In the calculation, all of the obstetric facilities were ranked by number of deliveries, and the cumulative proportion of deliveries and that of individual obstetric facilities were plotted onto the plane of coordinates. The plotted line is the Lorenz curve, and the Gini coefficient is the area between the Lorenz curve and the 45° diagonal line, divided by the area of the whole triangle under the 45° line. The Gini coefficient ranges from 0 (complete equality) to 1 (complete inequality), according to the variation in deliveries. A similar procedure was conducted for the number of obstetricians and the number of deliveries per obstetrician. Significance test was conducted to examine the difference in Gini coefficient between 2 different years. This was done by calculating the bootstrapped standard errors for the Gini coefficient.[20]

To ascertain how the inequality is created, we classified all hospitals into equal-size tertiles (low, medium and high) according to the proportion of cesarean sections among all deliveries (CS rate) at each hospital in each year. We assumed, although indications for CS are sometimes relative rather than absolute,[21,22] that hospitals with a higher CS rate tended to be hospitals to which larger numbers of high-risk deliveries/ pregnancies were referred. In the Static Survey of Medical Institutions used in this study, for example, the average CS rate of advanced treatment hospitals (*tokutei-kinou-byouin*), community center hospitals (*chiiki-iryou-shien-byouin*) and others in 2011 was 39.9%, 29.3% and 21.6%, respectively. The average number of deliveries, obstetricians, and deliveries per obstetrician in each tertile of hospitals was calculated, and the differences in these values between 2 years were compared.

In its 'Grand design for improving obstetric health system 2010 version 1.21,' the Japan Society of Obstetrics and Gynecology proposed the volume of a obstetric hospital be ≥500 deliveries per year and obstetrician-delivery ratio be ≥6 (necessary level), or ≥8 (sufficient level) per 500 deliveries in order to standardize the working hours and workload of obstetricians.[15] Based on the optimal volumes, the numbers and proportions of obstetric hospitals with ≥500 deliveries in which the obstetrician : delivery ratio was ≥6/500 (necessary volume) were calculated. The number and proportion of obstetric hospitals with ≥500 deliveries in which the obstetrician : delivery ratio was ≥8/500 or more (sufficient volume) were also calculated. Then the change of the proportion of the hospitals with the necessary or sufficient volume between 2008 and 2011 was obtained.

Statistical analysis

Statistical analysis was done using SPSS version 21 (IBM-SPSS Japan, Tokyo), except for calculation of Gini coefficients and significance test for their differences; these were done with STATA (version 12, College Station, TX, USA). The Ethics Committee, Graduate School of Medicine and Faculty of Medicine, University of Tokyo assessed and gave permission for this study (assessment number 10128).

Results

Based on the birth data in Vital Statistics, the capture rate of delivery in the Static Survey of Medical Institutions was estimated to be 91.8% in 2005, 93.8% in 2008, and 92.3% in 2011.

Basic statistics of obstetric hospitals are listed in Table 1. The number of obstetric hospitals in Japan decreased by 15% between 2005 and 2008 and by 7% between 2008 and 2011. The number of deliveries was almost unchanged between 2005 and 2011, thus the number of deliveries per hospital increased by 26%, indicating the progression of concentration of deliveries at fewer hospitals. The number of hospital obstetricians increased by 16% and the average number of obstetricians per hospital increased by 19% between 2008 and 2011, indicating the growing concentration of obstetricians. The number of deliveries per obstetrician decreased by 16% over the three-year period. Basic statistics of obstetric clinics are shown in Table S1. In clinics, the concentration of deliveries likewise increased, but that of obstetricians was unchanged.

The distribution of deliveries, obstetricians, and deliveries per obstetrician among obstetric hospitals is shown in Table 2. The Gini coefficient of delivery decreased between 2005 and 2011. This indicates that the number of deliveries at each hospital is becoming increasingly balanced. The Gini coefficient of obstetricians increased among hospitals from 2008 to 2011, suggesting that the distribution of obstetricians among

Table 1 Statistics for obstetric hospital in Japan

		Year 2005	2008	2011
Obstetric hospitals	Total	1 321	1 126	1 051
Deliveries	Estimated annual total†	514 216	532 328	511 810
	Total in September	44 865	46 404	45 052
	Average per hospital	34.0	41.2	42.9
	SD	28.7	33.2	32.9
Obstetricians	Total		4 910	5 689
	Average per hospital		4.7	5.6
	SD		3.7	4.6
Deliveries per obstetrician			9.5	7.9

†Based on the study data and birth data in Vital Statistics.[19]

hospitals is increasingly skewed, although the trend was not statistically significant. Gini coefficient of deliveries per obstetrician increased among hospitals between 2008 and 2011, indicating a widening disparity of the delivery volume per obstetrician among hospitals. The results for clinics are shown in Table S2. A similar trend was found in clinics.

The average number of deliveries, obstetricians and deliveries per obstetrician according to CS tertile (low, medium and high CS rate) is shown in Table 3. Between 2008 and 2011 the number of deliveries increased most in the low CS tertile, while the number of obstetricians increased most rapidly in the high CS tertile. As a result, the most pronounced decrease in the number of deliveries per obstetrician was found in the high CS group.

The number and proportion of hospitals that ceased or started delivery service is shown in Table 4. In both 2005–2008 and 2008–2011, the number of hospitals that ended delivery service exceeded the number of those that began offering this service. The gap, however, narrowed in 2008–2011 compared with 2005–2008 due to the decrease in the number of hospitals that stopped performing deliveries. The results for clinics are shown in Table S3. A similar trend was observed in clinics.

Table 2 Gini coefficients for obstetric hospitals

	2005	2008	2011	P1	P2
Delivery	0.425	0.402	0.395	**0.01**	0.536
Obstetrician		0.375	0.389		0.27
Deliveries per obstetrician		0.330	0.357		**0.022**

Gini coefficient ranges between 0 (complete equality) and 1 (complete inequality). P1, *P*-value for 2005–2011 difference; P2, *P*-value for 2008–2011 difference.

Table 5 lists the number and proportion of hospitals with optimal delivery and obstetrician volumes set by the Japan Society of Obstetrics and Gynecology. The proportion of obstetric hospitals with ≥500 annual deliveries slightly increased between 2008 and 2011. The proportion of the hospitals that had both ≥500 and obstetrician-delivery ratio ≥6/500 was only 4% in 2008, but doubled to 8.1% by 2011. Similarly, the proportion of the hospitals with ≥500 deliveries and ≥8/500 obstetrician-delivery ratio doubled over the 3-year period from 2.0% to 4.2%.

Discussion

The concentration of deliveries and of obstetricians has progressed rapidly. The distribution of obstetrician volume among hospitals has become unequal and the disparity of delivery volume per obstetrician has increased. The growing disparity, however, might be attributable to the increasing concentration of obstetricians at secondary and tertiary referral hospitals that have a larger proportion of high-risk deliveries. The work environment of hospital obstetricians overall is likely to be improving. The number of hospitals with the optimal volume of deliveries and obstetricians has increased rapidly. These trends accord with governmental policies and plans of professional bodies.

The national government is putting forth concrete policies that facilitate selection and concentration of obstetric hospitals. For example, a preferential fee schedule of social health insurance has been given to hospitals that have a neonatal intensive care unit (NICU), that accept patients with obstetric emergency, or that perform high-risk deliveries.[18] Subsidies are provided to general perinatal medical centers and community perinatal medical centers, both of which

Table 3 Change in delivery and obstetrician statistics over time

	CS tertile†	Average ± SD			2011–2005	2011–2008
		2005	2008	2011	Difference %	Difference %
Deliveries	Low	31.7 ± 32.0	37.9 ± 36.0	40.7 ± 37.3	28.4	7.4
	Medium	40.4 ± 29.6	47.7 ± 32.7	48.6 ± 32.0	20.4	1.9
	High	29.9 ± 22.7	39.4 ± 28.5	40.2 ± 28.6	34.1	1.9
Obstetricians	Low		3.4 ± 2.3	3.9 ± 2.8		16.8
	Medium		4.6 ± 3.0	5.4 ± 3.6		16.2
	High		6.1 ± 4.9	7.5 ± 6.0		21.6
Deliveries per obstetrician	Low		11.2 ± 7.2	10.8 ± 7.9		−3.6
	Medium		11.1 ± 5.9	10.2 ± 5.9		−8.2
	High		7.5 ± 4.6	6.8 ± 5.0		−10.3

†All hospitals were classified to equal-size tertiles in each year according to the CS rate at each hospital. Data given as counts for September. CS, cesarean section.

Table 4 Hospitals that ceased or started to deliver

	2005 → 2008		2008 → 2011	
	n	%	*n*	%
Cease	240	18.2	116	10.3
Start	45	4.0	41	3.9

Table 5 Optimal delivery and obstetrician volume hospitals†

	2008 ($n = 1126$)		2011 ($n = 1051$)	
	n	%	*n*	%
Annual deliveries ≥500	408	36.2	403	38.3
and obstetrician-delivery ratio ≥6/500	45	4.0	85	8.1
and obstetrician-delivery ratio ≥8/500	23	2.0	44	4.2

†Defined by the Japan Society of Obstetrics and Gynecology as ≥500 deliveries per year and ≥6 or 8 obstetricians per 500 deliveries per hospital.

are designated by prefecture government.[17] Another subsidy has been earmarked to construct a network system among obstetric facilities within a prefecture.[17] These policies have potentially advanced the concentration of deliveries at some selected, large-scale hospitals. High-volume labor units, compared with low-volume ones, have been found to have had fewer neonatal mortalities and morbidities.[23–26] This suggests that the selection and concentration policies not only lightened the workload of hospital obstetricians, but also improved the safety of delivery.[27] In contrast, selection and concentration can cause closure of low-volume obstetric facilities and subsequent worsening of patient access to obstetric service. In the present study the number of facilities ceasing to deliver exceeded that of facilities starting to deliver. The national government therefore subsidizes small obstetric facilities in rural and remote areas.[17] At a time of rapid growth of selection and concentration, it seems important to balance centralization of resources with equal access. Policies should focus on providing access to women residing in remote or rural areas, while making the most of the advantages of high-volume labor units.

Effective placement of obstetricians seems to be progressing. The worsening of equality indicators for obstetrician and obstetrician workload shown in this study does not necessarily mean a worsening of their distribution and workload. The inequality seems to have evolved in a way that has concentrated obstetricians most rapidly at tertiary referral hospitals, meaning that obstetricians are increasingly distributed among the facilities that are in greatest need of their services. Appropriate distribution of obstetricians should be consistently pursued with the cooperation of the national and local governments, professional bodies, and, above all, medical schools, which traditionally have the largest physician-placement function in Japan.

The proportion of hospitals with optimal delivery and obstetrician volume defined by the Japan Society of Obstetrics and Gynecology has doubled for the past 3 years. Although the progression was rapid, the proportion was still low (8.1% or 4.2%). Political support from the national and prefectural governments and initiative by professional bodies should be continued, and the optimal volume needs to be revised by the Society based on the reality. Also the shrinking number of deliveries per obstetrician at tertiary referral hospitals might make it difficult for obstetricians to maintain their clinical skills. It is thus necessary for obstetricians, particularly young obstetricians in training, to rotate through hospitals of different levels in order to assist with an adequate number of deliveries, including high-risk ones.

In interpreting the results, the following needs to be accounted for. Deliveries range from low to high risk. High-risk deliveries, sometimes threatening fetal, neonatal and maternal lives, add to the workload of obstetricians; low-risk deliveries may be safely performed by midwives without requiring the presence of an obstetrician. Thus, the workload of each obstetrician depends on the presence or absence of complications. The 'number of deliveries per obstetrician' in this study thus may not necessarily reflect the real workload of an obstetrician. The trend of workload and workload disparity focused on in this study, however, would be less influenced by this problem. Some of the gaps in Gini coefficients were statistically insignificant, possibility because of the short observation period (3 years). To confirm the gaps, a longer-term study is needed.

Conclusion

Selection and concentration of deliveries and of obstetricians is progressing rapidly and effectively in Japanese hospitals. Continuous support from the national and local governments, professional bodies, and medical schools is recommended to maintain this trend.

Acknowledgments

This study was supported by Health Labour Sciences Research Grant of the Ministry of Health, Labour and Welfare, Tokyo, Japan (H25 – Research on Region Medical – 006).

Disclosure

The authors declare no potential conflicts of interest.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Table S1 Basic statistics of obstetric clinics in Japan.
Table S2 Gini coefficients of delivery, obstetrician and deliveries per obstetrician among obstetric clinics.
Table S3 Clinics that ceased or started to deliver.