



A Nationwide Survey of Obstetric Care Status on Japan's Islands, with Special Reference to Maternal Transport to the Mainland

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Safe obstetric care is a worldwide requirement. In Japan, a reduced number of obstetricians has prompted the centralization of obstetric facilities, and Japan's islands are expected to experience problems in handling deliveries. Although many pregnant women "move" to the mainland at later gestational weeks, "transport" from the island to the mainland may be occasionally needed when disorders manifest before the "move." Other women plan within-island deliveries; however, transport is required when complications arise. Managing delivery- or pregnancy-related problems may differ in transport by the population size of islands. We investigated the following issues in relation to the population size of Japan's islands: 1) How were deliveries handled on islands? 2) How many pregnant women were transported to the mainland? 3) What was the reason for and what affected transport? A total of 142 municipalities were selected to participate in a questionnaire survey, and 108 institutions from 106 municipalities responded. A comparative analysis by island size was performed using 2014 data: small-sized (population < 1,000), mid-sized (1,000 to 5,000), and large-sized ($\geq 5,000$). The percentage of women transported to the mainland from small-sized islands was significantly higher than that from large-sized islands (6.8 vs. 2.6% of all births in a year, respectively, $P < 0.01$). Transport was mainly in response to threatened preterm labor. Adverse weather was the most frequent factor affecting transport reliability. Our findings may contribute to a more detailed understanding of the state of obstetric care on Japan's islands.

Keywords:obstetrics; preterm birth; remote islands; rural medicine; transport system
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Introduction

The Japanese archipelago contains 304 inhabited islands. Japan has maintained a low rate of perinatal mortality (3.6 per 1,000 births in 2016; Ministry of Health, Labour and Welfare 2017); however, there is a shortage of obstetricians and midwives (Ministry of Health, Labour and Welfare 2006; Yamauchi 2007; Matsumoto et al. 2010; Matsumura 2013). This situation prompted the Japanese government and the Japan Society of Obstetrics and Gynecology to attempt the centralization of obstetric care facilities to ensure safe delivery (Ministry of Health, Labour and Welfare 2005). However, this naturally implies that some difficulties may have arisen in handling deliveries on

the islands of Japan, and we hypothesized that these difficulties may be affected by the islands' population size.

Some women give birth on the island where they reside, whereas others move to the mainland usually several weeks before the due date. There have recently been fewer deliveries on Japan's islands (Kato 2013). In this situation, the transport of pregnant women to the mainland is required (Inoue et al. 1994; Imamichi et al. 2010; Chihara et al. 2011). However, these phenomena were not investigated by the population size of islands.

Here, we aimed to investigate the state of obstetric care on the islands of Japan by focusing on the following questions: 1) How were deliveries handled on islands? 2) How many pregnant women were transported to the main-

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land? 3) What was the reason for the transport, and what affected transport? We analyzed these three issues based on the population size of Japan islands.

Methods

According to a public data source, Japan has 180 islands with at least one doctor (Japan Remote Island Center 2019). As one island municipality could have multiple medical institutions, 142 island municipalities were finally chosen for the study. The questionnaire completed by the institutions contained 15 items on the attributes of island doctors (age, area of specialization [obstetrician or pediatrician], length of clinical experience, and time spent as a doctor on the corresponding island) as well as the number of births in 2014, number of women transported to the mainland in 2014, and other matters relevant to the transport of pregnant women. In the Annual Report of Isolated Island Statistics (Japan Remote Island Center 2019), islands are categorized by population as small-sized (population < 1,000), mid-sized (1,000 to 5,000), and large-sized islands ($\geq 5,000$); the same categorization was employed in this study. The Kruskal-Wallis and χ^2 tests were used to compare responses by the population size of islands. The IBM SPSS Statistics software was used for the statistical analysis, and the significance level was set at < 0.05 .

The survey was conducted ensuring participants' voluntary and anonymous participation. Under the Japanese ethical guidelines (Ministry of Health, Labour and Welfare 2014), the Jichi Medical University Ethics Committee acknowledged that this study did not require ethical review. There was no reward for participation in the survey.

Results

We received responses from 106 out of 142 municipalities (effective recovery rate: 74.6%), with a combined total of 108 responding medical institutions. Table 1 indicates some fundamental characteristics of how deliveries were handled on islands. The median island population was 1,326, with a population range of 16-60,000. Mean doctors' age was 53.0 ± 15.0 years (mean \pm standard deviation), with no significant differences between the three groups (divided by island size). There were a total of 16 obstetrician-gynecologists on large-sized islands, but no obstetricians or midwives on small- or mid-sized islands. On the large-sized islands, there was 1 obstetrician and 1 midwife per 108.9 and 41.5 births, respectively, per year, including births handled on the mainland (including the "move before labor onset" fraction). Women were advised to move to the mainland at a gestational age of 33.9 ± 2.7 weeks; this did not differ significantly between the three island groups.

During the year 2014, a total of 60 pregnant women were transported to the mainland. The rate of transport from the island to the mainland was 2.6-6.8% of all births in a year depending on island size (Table 1). The proportion of transport from small-sized islands (6.8% [3/44]) was significantly higher than that from large-sized islands (2.6% [45/1,742]).

Threatened preterm labor was the most frequent cause for transporting pregnant women to the mainland, regardless of island size (Table 2). More than 90% of the medical institutions on all of the islands experienced transport due to threatened premature labor. On large-sized islands, in addition to threatened preterm labor, premature rupture of the membranes, fetal growth restriction, and abruptio pla-

Table 1. State of obstetric care on Japan islands by their population size.

Population size of islands	< 1,000	1,000 to 5,000	$\geq 5,000$	P value
Number of facilities (n)	52	28	28	—
Medical institution characteristics				
Doctor's age (years old; mean \pm SD)	51.3 ± 17.5	51.9 ± 11.7	57.7 ± 11.9	0.35
Years of clinical experience (median)	29 (range 3-60)	28 (range 4-44)	30 (range 4-47)	0.58
Years spent as a doctor on the island (median)	3 (range 0-36) ^{a,b}	7 (range 1-35) ^a	11 (range 0-37) ^b	< 0.01
Number of obstetricians (n)	0	0	16	—
Number of pediatricians (n)	2	3	0	—
Number of midwives (n)	0	0	42	—
Gestational age at which moving to mainland was advised (weeks; mean \pm SD)	32.4 ± 2.2	35.0 ± 2.2	34.1 ± 1.8	0.10
Number of births (n/year)	44	327	1,742	—
Number of pregnant women transported to mainland (n/year)	3	12	45	—
Percentage of pregnant women transport to mainland (n [%])	3 (6.8%) ^b	12 (4.6%)	45 (2.6%) ^b	< 0.01

SD, standard deviation.

^a< 1,000 vs. 1,000 to 5,000 ($P < 0.01$); ^b< 1,000 vs. $\geq 5,000$ ($P < 0.01$).

Table 2. Reason of maternal transport on Japan islands by their population size.

Population size of islands	< 1,000	1,000 to 5,000	≥ 5,000
Number of medical institutions carried maternal transport in 2014 (n)	3	7	11
Threatened premature labor	3 (100.0%)	7 (100.0%)	10 (90.9%)
Premature rupture of the membranes	0 (0%)	2 (28.6%)	6 (54.5%)
Fetal growth restriction	0 (0%)	0 (0%)	5 (45.5%)
Abruptio placentae	0 (0%)	1 (14.3%)	4 (36.4%)
Hypertensive disorder of pregnancy	0 (0%)	0 (0%)	4 (36.4%)
Non-reassuring fetal status	0 (0%)	0 (0%)	4 (36.4%)
Postpartum hemorrhage	0 (0%)	0 (0%)	3 (27.2%)
Placenta previa	0 (0%)	0 (0%)	3 (27.2%)
Oligohydramnios · Hydramnios	0 (0%)	0 (0%)	2 (18.2%)
Multiple pregnancy	0 (0%)	0 (0%)	2 (18.2%)
Medical complication	0 (0%)	0 (0%)	1 (9.1%)
Fetal malformation	0 (0%)	0 (0%)	1 (9.1%)
Infection	0 (0%)	0 (0%)	1 (9.1%)
Abnormal umbilical cord	0 (0%)	0 (0%)	0 (0.0%)

Multiple answers were allowed.

Table 3. Problems with maternal transport on Japan islands by their population size.

Population size of islands	< 1,000	1,000 to 5,000	≥ 5,000	P value
Adverse weather (unavoidable)	43 (97.7%)	23 (100.0%)	15 (83.3%)	–
Doctors absent (from the island) during transportation	19 (43.2%)	7 (30.4%)	5 (27.8%)	0.41
Shortage of medical staff accompanying transportation	15 (34.1%)	7 (30.4%)	6 (33.3%)	0.95
Difficulty determining need for transportation	14 (31.8%) ^a	6 (26.1%) ^b	12 (66.7%) ^{a,b}	< 0.05
Difficulty finding a suitable hospital to accept patient	7 (15.9%)	1 (4.3%)	3 (16.7%)	0.35

Multiple answers were allowed.

^a< 1,000 vs. ≥ 5,000 (P < 0.05); ^b1,000 to 5,000 vs. ≥ 5,000 (P < 0.05).

centae were the main reasons for transport.

Table 3 indicates the issues affecting maternal transport. The weather was the most frequently cited factor, which was an unavoidable problem; difficulty finding a suitable hospital (a modifiable issue) was the least frequent. On large-sized islands, difficulty determining the need for transportation was reported more frequently than in other islands (P < 0.05). As a main transport method, large-sized islands used firefighting disaster prevention helicopters and helicopters of Japan Ground Self-Defense Force more often than other islands (P < 0.01). Ambulance boat and liner were used significantly more often on small- and mid-sized islands than on large-sized islands (P < 0.05 and P < 0.01, respectively; Table 4).

Discussion

This study yielded the following three findings. First, we illustrated how deliveries were handled on Japan islands by presenting fundamental data on the state of obstetric care according to island population size. Second, the rate of transport differed according to island size. Third, threatened preterm labor was the most frequent reason for transport, and the weather was the most frequent problem affecting transport.

As expected, there were differences in the degree of obstetric care available based on the island population size. This may be partly due to the lack of obstetricians and midwives on small-sized islands. Considering the decreasing number of obstetricians in Japan, sending obstetricians or midwives to small- or mid-sized islands may be less cost-

Table 4. Main methods of transport on Japan islands by their population size.

Population size of islands	< 1,000	1,000 to 5,000	≥ 5,000	P value
Doctor helicopter	18 (35.3%)	15 (53.6%)	13 (46.4%)	0.11
Firefighting disaster prevention helicopter	8 (15.7%) ^a	6 (21.4%) ^b	13 (46.4%) ^{a,b}	< 0.01
JGSDF (Japan Ground Self-Defense Force) helicopter	5 (9.8%) ^a	5 (17.9%) ^b	12 (42.9%) ^{a,b}	< 0.01
Civilian aircraft	0 (0.0%)	2 (7.1%)	2 (7.1%)	0.11
Hospital-owned Cessna machine	0 (0.0%)	0 (0.0%)	0 (0.0%)	–
Maritime security boat	0 (0.0%)	1 (3.6%)	0 (0.0%)	0.66
Ambulance boat	18 (35.3%) ^c	9 (32.1%) ^d	1 (3.6%) ^{c,d}	< 0.05
Liner	32 (62.7%) ^a	15 (53.6%) ^b	2 (7.1%) ^{a,b}	< 0.01

Up to three answers were allowed.

^a< 1,000 vs. ≥ 5,000 (P < 0.01); ^b1,000 to 5,000 vs. ≥ 5,000 (P < 0.01); ^c< 1,000 vs. ≥ 5,000 (P < 0.05); ^d1,000 to 5,000 vs. ≥ 5,000 (P < 0.05).

effective. In this study, we could not retrieve the number of women who actually gave birth on a small- or mid-sized islands: Table 1 shows the number of deliveries (i.e., 44 and 327 for small- and mid-sized islands, respectively); however, the number of women delivering on the islands or moving to the mainland was not identified. Irrespective of this, at least some fraction of pregnant women was considered to have undergone antenatal checkups on islands. Although small- or mid-sized islands showed a higher rate of transport than large-sized islands (as discussed below), the transport rate was still relatively low (6.8 and 4.6%, respectively). This suggests that antenatal checkups (detecting high-risk pregnancies that will eventually require transport) may function. We assume that many doctors working on the islands have comparatively longer clinical experience, which may be beneficial during antenatal checkups, even if they have not specialized as obstetricians.

The percentage of pregnant women transported to the mainland was significantly higher on small-sized islands than large-sized islands (6.8 vs. 2.6%). This may be because non-obstetricians on small- and mid-sized islands are more likely to request transport than obstetricians on large-sized islands. In addition, small-sized islands often employ doctors with little clinical experience, which might also contribute to the higher transport rates. Considering the safety of pregnant women, this may not be a severe problem at present.

The most frequent condition requiring transport was threatened preterm labor. This is a common emergent cause not only on islands but also across mainland Japan (Chihara et al. 2011; World Health Organization 2017; Nakai 2019). Various transport efforts are described to manage threatened preterm labor. For example, telemedicine and transport by helicopter can be used not only to pick up candidates with threatened preterm labor but also to bring doctors from the mainland to islands to ensure appropriate antenatal care or safe delivery (Ohara et al. 2008).

Regarding the factors affecting transport, the most fre-

quently cited issue on all islands was adverse weather, which is an unavoidable problem and irrespective of pregnancy. Difficulty in finding a suitable hospital was the least cited factor regardless of the population size of islands. These reasons were similar to the situations as reported in Nagasaki Prefecture and Okinawa Prefecture where the remote island's medical policy for a transportation system has been advanced (Yasaka 2014; Yonaha 2017). Since there are few, if any, cases of "transport refugees," we believe that the transport of pregnant women from islands to the mainland works well at this point.

The present survey revealed that the method of transport was dependent on the population size of islands; there was a higher use of helicopters on large-sized islands than on small- and medium-sized islands. A study on large-sized islands by Kato (2013) described that Japan Ground Self-Defense Force helicopters, doctor helicopters, and firefighting disaster prevention helicopters were used for emergency transport. In general, there are no fire departments and paramedics, and doctor helicopters are rarely requested on small- and medium-sized islands (Sakamoto et al. 2009). This can explain the high use of helicopters on large-sized islands. Difficulty in determining the need for transportation was a more frequent issue on large islands than on small- and mid-sized islands. Unlike small-sized islands with the lack of obstetricians and midwives, high-risk pregnant women are seen on the large-sized islands where obstetricians and midwives work and the decision of parturition or neonatal resuscitations is not easy in some cases of high-risk pregnancy (Odagiri 2014). It may make determination of transportation difficult as found in the present survey.

This study had some limitations. We analyzed deliveries among women residing on all the islands; however, women's medico-social situation differed markedly, even within islands of the same size. For example, geographical factors differed substantially, such as the distance between the island and the mainland, and the presence or absence of

regularly operated aircraft, and would have naturally affected the decision-making of both mothers and doctors. The present analysis did not consider these factors. In addition, we could not retrieve data regarding the outcome of each delivery. Thus, we could not determine whether, for example, the transportation was conducted in an appropriate time and manner. These limitations may be, to some extent, inherent to this type of study. However, to our knowledge, this study was the first to illustrate the connection between "island and delivery"; thus, we believe that our study provides fundamental data on this issue.

In summary, between 6.8% (small-sized islands) and 2.6% (large-sized islands) of pregnant women were transported from the islands of Japan to the mainland in 2014. The main reason for transport was threatened preterm labor. Finding a mainland facility equipped to deal with these cases was not difficult. Our findings may contribute to a better understanding of the current state of obstetric care on Japan islands and serve as a future point of discussion for improving obstetric care in these remote settings.

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Conflict of Interest

The authors declare no conflict of interest.

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