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Declining Mortality Rate from Postpartum Hemorrhage in Japan and Factors Influencing the Changes, 1950–2009

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INTRODUCTION

Although WHO[1] continues to list postpartum hemorrhage (PPH) as a major cause of maternal mortality, especially in the developing world, Japan, as an important member of the group of developed nations, has had small numbers of deaths from PPH in recent years. This chapter describes a 60-year trend of mortality from PPH using data from vital statistics[2]. It also outlines factors influencing PPH death rates.

MATERIALS AND METHODS

The International Classification of Diseases (ICD) for 1950–1967 assigned PPH with the codes 672 (ICD-6 and ICD-7)[3,4], 652–653 (ICD-8)[5] for 1968–1978, 666 (ICD-9)[6] for 1979–1994, and O72 (ICD-10)[7] for 1995–2009. ICD for 1909–1922 assigned puerperal hemorrhage with the codes 135 (ICD-2)[8], and 144 (ICD-3 and ICD-4)[9,10] for 1923–1943. In computing the PPH death rate, the number of PPH deaths was divided by the numbers of births (live and fetal births).

RESULTS

Yearly change of the PPH death rate

Table 1 shows the number of PPH deaths and the death rate during the period from 1950 to 2009. The PPH death rate was 23.0 per 100,000 births in 1954 and rapidly decreased to 2.1 in 1987, only to further decrease to 1.0 in 2009. Table 1 also shows the ratio of maternal deaths due to PPH. For the past 18 years, these ratios have fluctuated annually owing to the small numbers involved.

Figure 1 depicts the PPH death rate and maternal mortality from 1950 to 2009. The maternal death rate was 166.7 per 100,000 births in 1954, but rapidly declined to 15.1 in 1985 and gradually decreased further to 4.8 in 2009. Figure 1 also shows the 3-year average of maternal deaths due to PPH. The proportion of PPH deaths as a percentage of all maternal deaths was 11.8% in 1950, increased to 23.0% in 1985, declined again to 9.2 in 1996, and, finally, increased

thereafter to 20.5 in 2009. Despite these constant reductions in maternal death rates and the rate of deaths from PPH, the percentage of maternal deaths due to PPH varied from 9% to 23% during the entire period.

Table 1 Death rate due to postpartum hemorrhage (PPH), number of PPH deaths, ratio of the PPH deaths to maternal deaths and mean age at death during 1950–2009

Year	No. of deaths	Death rate (per 100,000)	Ratio* (%)	Mean age at death†	Year	No. of deaths	Death rate (per 100,000)	Ratio* (%)	Mean age at death†
1950	448	17.5	10.9	32.0	1980	61	3.7	18.9	32.1
1951	472	20.0	12.8	32.0	1981	68	4.2	23.1	32.0
1952	410	18.6	12.0	32.0	1982	46	2.9	16.5	32.3
1953	423	20.5	12.5	31.6	1983	45	2.8	19.2	32.6
1954	450	23.0	13.8	31.2	1984	53	3.4	23.2	33.3
1955	406	21.2	13.1	30.9	1985	55	3.7	24.3	33.2
1956	374	20.3	13.2	30.6	1986	40	2.8	21.4	32.7
1957	370	21.2	13.8	30.5	1987	29	2.1	17.9	33.0
1958	338	18.4	13.2	30.4	1988	18	1.3	14.2	32.2
1959	338	18.7	14.2	30.2	1989	17	1.3	12.6	33.9
1960	278	15.6	13.3	30.2	1990	13	1.0	12.4	33.3
1961	284	16.1	14.8	30.1	1991	18	1.4	16.4	33.8
1962	246	13.7	13.6	30.2	1992	21	1.7	19.0	32.8
1963	219	11.9	12.9	30.3	1993	9	0.7	9.9	33.4
1964	241	12.8	14.2	30.1	1994	13	1.0	17.2	32.4
1965	240	12.1	15.0	30.1	1995	4	0.3	4.7	33.0
1966	158	10.5	12.5	29.9	1996	10	0.8	13.8	33.5
1967	234	11.0	16.8	29.9	1997	7	0.6	9.0	33.6
1968	215	10.7	16.9	30.2	1998	12	1.0	14.0	34.1
1969	182	9.0	16.6	30.2	1999	9	0.7	12.5	32.8
1970	152	7.3	15.1	30.7	2000	11	0.9	14.2	33.7
1971	144	6.8	15.9	30.6	2001	7	0.6	9.2	31.7
1972	140	6.5	16.9	30.2	2002	14	1.2	16.6	32.7
1973	117	5.3	14.6	30.1	2003	17	1.5	24.4	33.3
1974	113	5.3	16.1	30.3	2004	10	0.9	20.3	33.5
1975	71	3.5	13.0	30.7	2005	6	0.5	9.6	33.5
1976	65	3.4	13.7	31.3	2006	7	0.6	13.0	34.1
1977	73	3.9	18.0	31.3	2007	9	0.8	25.9	34.4
1978	60	3.3	15.9	31.7	2008	6	0.5	15.3	34.6
1979	68	3.9	18.1	31.9	2009	11	1.0	20.9	33.4

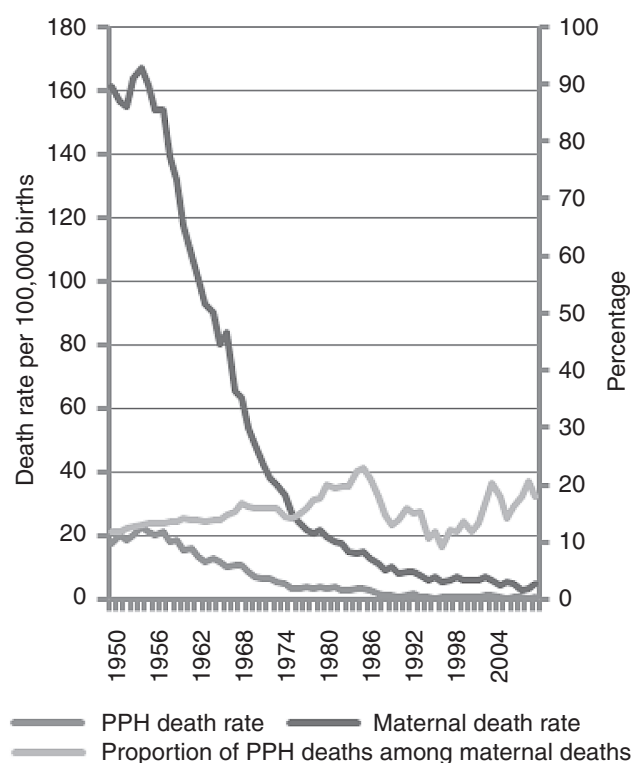*PPH deaths to number of maternal deaths; †3-year moving average at death

Figure 1 Death rate due to postpartum hemorrhage (PPH), maternal mortality and percentage of maternal deaths due to PPH, 1950–2009

the first 20-year period. More recently, in the past 20 years, the overall death rate decreased to 25% compared with the middle period. The death rate was 0.2 per 100,000 births in mothers under 20 years of age, but not unexpectedly increased with maternal age up to 45 years and over (7.9). Comparing the PPH death rates of the first and the most recent 20-year periods, the greatest declining rate was noted among mothers under 20 years of age (1/45), and this decreased with maternal age up to 45 years and over (1/8). Accordingly, the vast improvement of the PPH mortality was observed remarkably in the younger maternal years.

Table 1 demonstrates that the 3-year moving average of maternal age at death remained nearly constant (29.9–34.6 years) for 60 years. Table 2 shows averages of maternal age at death from PPH and live birth for the three time periods. Average ages at death are 30.8 years for 1950–1969, 31.4 years for 1970–1989, and 33.5 years for 1990–2009. The corresponding average maternal age at live birth is 27.8, 28.0 and 29.7 years, respectively. The differences between average ages at birth and at the time of death are 3–3.8 years, a very narrow range that has not changed in 40 years.

Geographical variations

Table 3 shows the PPH death rates according to prefectures during the periods from 1950–1979 and 1980–2009. The highest PPH death rate (per 100,000 births) occurred in Shimane Prefecture for both periods (18.9 and 4.0, respectively), whereas the lowest was noted in Okinawa Prefecture for both periods (3.2 and 0.4); these values were 6 and 10 times higher, respectively, in Shimane Prefecture compared with Okinawa Prefecture. In 1951 and 1953, the number of deaths from PPH was compared in urban and rural areas. The PPH death rate was 17.2 (139 deaths in 1951 and 140 in 1953) in urban areas and 22.1 (333 in 1951 and 283 in 1953) in rural areas. The difference between the death rates in the urban and in rural areas is significant at the 5% level (odds ratio 1.28 and 95%

Death rate by maternal age

Table 2 shows the PPH death rate according to maternal age for three consecutive periods of two decades each, beginning in 1950–1969 and ending with 1990–2009. In the first 20-year period, the PPH death rate was lowest (9.4–9.8 per 100,000 births) when the mother was under 25 years of age, increasing to 63.1 at 40–44 years and slightly decreasing thereafter (60.9). In the middle period, the overall death rate decreased to 25% compared with the earlier period, while the death rate by maternal age shows a similar pattern to

Table 2 Postpartum hemorrhage (PPH) death rate according to maternal age, mean maternal age at death due to PPH and mean maternal age at live birth from 1950–1969 to 1990–2009

Maternal age	1950–1969			1970–1989			1990–2009			Ratio of death rates for the oldest and the recent period
	Number of deaths	Death rate*	%	Number of deaths	Death rate*	%	Number of deaths	Death rate*	%	
Under 20	68	9.8	1.1	15	3.1	1.0	1	0.2	0.5	44.5
20–24	988	9.4	15.6	141	1.8	9.9	10	0.3	4.7	32.6
25–29	2009	12.2	31.8	464	2.7	32.4	43	0.5	20.1	25.6
30–34	1690	21.6	26.7	435	5.7	30.4	75	1.0	35.0	22.8
35–39	1104	40.4	17.5	292	17.3	20.4	61	2.3	28.5	17.9
40–44	434	63.1	6.9	78	32.5	5.5	23	6.2	10.7	10.1
Over 45	29	60.9	0.5	5	30.4	0.3	1	7.9	0.5	7.7
Total	6322	16.2	100	1430	4.1	100	214	0.9	100	18.2
Mean maternal age										
at death due to PPH		30.8			31.4			33.5		
at live birth		27.8			28.0			29.7		

*per 100,000 births

Table 3 Death rates for postpartum hemorrhage, 1950–2009

Prefecture	1950–1979			1980–2009		
	Number	Rate*	Ratio†	Number	Rate*	Ratio†
Hokkaido	411	12.7	13.8	28	1.6	21.7
Aomori	146	15.1	13.0	6	1.3	10.9
Iwate	157	17.4	14.2	3	0.7	5.8
Miyagi	118	10.6	13.1	18	2.4	24.3
Akita	117	15.5	13.4	6	1.8	18.2
Yamagata	77	10.7	12.2	6	1.6	18.2
Fukushima	192	15.2	15.6	15	2.2	22.7
Ibaraki	204	15.7	15.1	17	1.9	18.5
Tochigi	124	13.0	12.5	17	2.7	25.4
Gunma	156	16.1	16.2	7	1.1	14.9
Saitama	254	11.8	13.7	37	1.8	15.7
Chiba	208	11.4	14.3	35	2.0	20.8
Tokyo	506	8.8	12.3	62	1.8	18.7
Kanagawa	256	9.2	13.5	52	2.0	20.1
Niigata	162	11.6	13.2	6	0.8	11.3
Toyama	60	10.6	12.2	3	0.9	13.6
Ishikawa	62	10.8	13.3	4	1.1	14.3
Fukui	61	14.1	14.2	2	0.8	12.5
Yamanashi	77	17.4	16.8	5	1.9	17.9
Nagano	144	13.5	15.4	17	2.5	23.0
Gifu	88	8.8	9.4	13	2.0	19.7
Shizuoka	173	9.7	11.8	15	1.3	13.0
Aichi	255	8.6	12.0	25	1.1	12.2
Mie	112	13.2	14.8	11	2.0	25.0
Shiga	68	13.5	13.1	7	1.6	18.9
Kyoto	133	11.7	13.0	8	1.0	9.6
Osaka	429	10.7	12.8	55	2.0	19.4
Hyogo	332	13.3	14.2	25	1.5	15.9
Nara	74	15.1	14.2	8	1.9	22.9
Wakayama	76	13.6	12.5	7	2.2	25.9
Tottori	60	17.9	18.6	3	1.6	21.4
Shimane	86	18.9	15.6	9	4.0	30.0
Okayama	143	15.5	16.9	8	1.3	19.1
Hiroshima	204	15.4	17.2	11	1.2	20.4
Yamaguchi	109	12.5	12.0	9	2.0	19.6
Tokushima	89	19.3	16.3	4	1.7	16.7
Kagawa	62	12.5	12.8	5	1.6	25.0
Ehime	123	14.4	15.9	5	1.1	12.2
Kochi	80	18.5	16.4	4	1.7	14.8
Fukuoka	276	11.4	12.4	21	1.3	15.9
Saga	81	14.7	12.3	4	1.4	13.8
Nagasaki	167	15.0	14.2	12	2.3	19.1
Kumamoto	180	16.9	15.3	7	1.2	17.5
Oita	119	16.9	14.3	5	1.3	12.5
Miyazaki	116	16.1	14.2	5	1.3	14.3
Kagoshima	191	17.2	13.2	11	1.9	12.6
Okinawa	5	3.2	11.9	2	0.4	4.3
Total	7325	12.4	13.7	646	1.7	17.6

*Death rate per 100,000 births; †percentage of PPH deaths to maternal deaths

Table 4 Death rates (per 100,000 births) from postpartum hemorrhage (PPH) and maternal deaths (MD) and ratio of the PPH in each district, 1950–1979 and 1980–2009

District	1950–1979					1980–2009				
	Number		Death rate		PPH/ MD (%)	Number		Death rate		PPH/ MD (%)
	PPH	MD	PPH	MD		PPH	MD	PPH	MD	
Hokkaido	411	2983	12.7	92.0	13.8	28	129	1.6	7.6	21.7
Tohoku	807	5858	14.1	102.3	15.6	54	313	1.8	10.2	17.3
Kanto	1708	12,643	10.9	80.3	13.5	227	1191	1.9	10.0	19.1
Chubu	1194	9282	10.8	83.8	14.8	101	651	1.4	8.9	15.5
Kinki	1112	8364	12.1	91.0	12.5	110	622	1.7	9.6	17.7
Chugoku	602	3814	15.4	97.5	12.0	40	186	1.7	7.8	21.5
Shikoku	354	2294	15.7	101.9	16.4	18	112	1.5	9.0	16.1
Kyushu	1130	8337	14.7	108.4	13.2	65	426	1.5	9.8	15.3
Okinawa	5*	42*	3.2*	26.7*	11.9*	2	47	0.4	8.5	4.3

*1973–1979

1950–1979 and 1980–2009 in Table 4. The PPH death rate was the lowest in the Okinawa District (3.2 for the earlier period and 0.4 for the later period), and death rates in other districts ranged between 10.8 and 15.7 in 1950–1979 and 1.4 and 1.9 in 1980–2009. Therefore, with exception of the Okinawa District, the rate was similar among the other eight districts. However, the highest maternal death rate was seen in Kyushu District (108.4) in the period 1950–1979 and in Tohoku District (10.2) in the period 1980–2009, whereas the corresponding lowest values were seen in Okinawa District (26.7) and in Hokkaido District (7.6), respectively. The highest value was 1.2–1.3 times higher than the lowest for both periods. The variations of maternal death rates in the other nine districts were small.

Behind maternal deaths from PPH

Nakabayashi *et al.*[11] performed a nationwide study of critical obstetric cases in 2004 by sending an inquiry questionnaire to 834 departments of obstetric and gynecology and 164 emergency departments in Japan. A total of 335 departments responded, which covered 124,595 cases or 11.2% of all the deliveries in Japan. PPH was present in 934 cases (749 cases per 100,000 live births). Transfusion was carried out in 868 cases (696 cases per 100,000 live births) and hysterectomy or arterial embolization was performed in 134 cases (108 cases per 100,000 live births). Four maternal deaths were reported in the 934 PPH cases, which corresponds to a mortality rate of 0.4% or 3 per 100,000 live births. This mortality rate due to PPH was significantly lower than the death rate from maternal cerebrovascular disease (mainly cerebral hemorrhage, 38.9%), pulmonary embolization (33.3%) and sepsis and severe infective disease (7.1%) in Japan at the same time. It is important to note, however, that almost 7460 cases of PPH deaths were prevented each year by the management and effort of medical staff including obstetricians. (There are almost one million

confidence interval 1.11–1.48 between urban and rural areas).

The ratio of PPH deaths to maternal deaths was 13.7% for Japan overall in the period 1950–1979 where the highest ratio was 18.6% in Tottori Prefecture and the lowest (9.4%) in Gifu Prefecture (Table 3). Corresponding values in the period 1980–2009 were 17.6% for the whole of Japan, 30.0% in Shimane Prefecture and 4.3% in Okinawa Prefecture.

The PPH and maternal death rates and the ratio of PPH are recomputed in each district in the period for

life births per year in Japan, the number of PPH cases occurring per year is 749×10 (one million/100,000) = 7490. With three deaths due to PPH per 100,000 live births per year, 30 PPH deaths occur per year. Therefore, death is assumed to have been prevented in $7490 - 30 = 7460$ cases.)

Prevention of maternal death due to PPH: current projects

In 2010, the Japan Society of Obstetrics and Gynecology published 'Guidelines for management of critical bleeding in obstetrics' in conjunction with the other related academic societies[12]. In the guidelines, the severity of the patient's hemorrhage is stratified into three levels or 'codes', according to vital signs and reactivity to treatment: III bleeding but stable, II requiring vasopressor, and I threatening to cardiac arrest.

Furthermore, and of equal importance, a new nationwide survey of maternal death was commenced in 2010. To emulate work from the Center for Maternal and Child Enquiries (CMACE) in the UK, all maternal deaths should be reported, evaluated and examined for preventive strategy. The maternal deaths are reported to the Society of Obstetrics and Gynecology, which anonymizes the cases, so that they can be evaluated by experts. From January to December in 2010, a total of 39 cases of maternal deaths were investigated for cause. Of these, seven (23%) deaths were as a result of PPH and 12 (31%) from amniotic fluid embolism. PPH cases comprised two examples of uterine rupture, two of uterine inversion, one of cervical laceration, one placental abruption and three listed as miscellaneous.

Amniotic fluid embolism

Amniotic fluid embolism is a fatal obstetric condition characterized by hypotension, respiratory distress with cyanosis, disseminated intravascular coagulopathy (DIC) and neurological manifestations such as seizures. As a cause of maternal death, it is usually categorized as pulmonary embolism with thrombotic pulmonary embolism in the ICD-9 and 10. However, a Japanese study recently revealed that almost half of amniotic fluid embolism cases also manifested PPH[13]. We surveyed autopsy cases of maternal deaths from 1989 to 2004 in Japan. Out of 193 cases, amniotic fluid embolism was the leading cause (28% of all maternal deaths). Out of 42 cases of pathological amniotic fluid embolism, 21 (50%) cases were clinically diagnosed. The other 21 cases were diagnosed as DIC or shock after delivery.

Because of the lack of diagnostic techniques to differentiate amniotic fluid embolism–related PPH from all PPH, the present categorization of PPH for maternal death should be re-evaluated.

Death rate from puerperal hemorrhage before World War II

Data on vital statistics in Japan have been available since 1899, except for the period 1944–1946 due to World War II. Before World War II, the number of PPH deaths was not obtained, but data on deaths from puerperal hemorrhage were obtained during the period from 1909 to 1943. The cause of deaths for PPH and puerperal hemorrhage are not the same. The latter include PPH and other hemorrhage.

Table 5 shows the number of deaths from the puerperal hemorrhage, the puerperal hemorrhage death rate, and the ratio of the puerperal hemorrhage (the percentage of maternal deaths due to puerperal hemorrhage) during the period from 1909 to 1943. The puerperal hemorrhage death rate was 46.6 in 1909 and gradually increased to 63.2 in 1940 and decreased to 53.1 in 1943. The ratio of the puerperal hemorrhage was 13.5% in 1909 and increased to 27.4% in 1943. Table 5 also shows the maternal mortality rate from 1899 to 1943. The maternal mortality rate decreased from 409.8 in 1899 to 193.6 in 1943.

Table 6 shows the number of puerperal hemorrhage deaths, the death rate and ratio of PPH to maternal deaths during the periods 1909–1922 and 1933–1942 in each prefecture. For the earlier period, the highest puerperal hemorrhage death rate was 75.0 in Okinawa Prefecture and the lowest was 30.2 in Miyagi Prefecture. For the later period, the corresponding rates were 76.2 in Nara Prefecture and 37.5 in Aichi Prefecture. Therefore, the highest rates were 2.5 times higher than the lowest death rate in
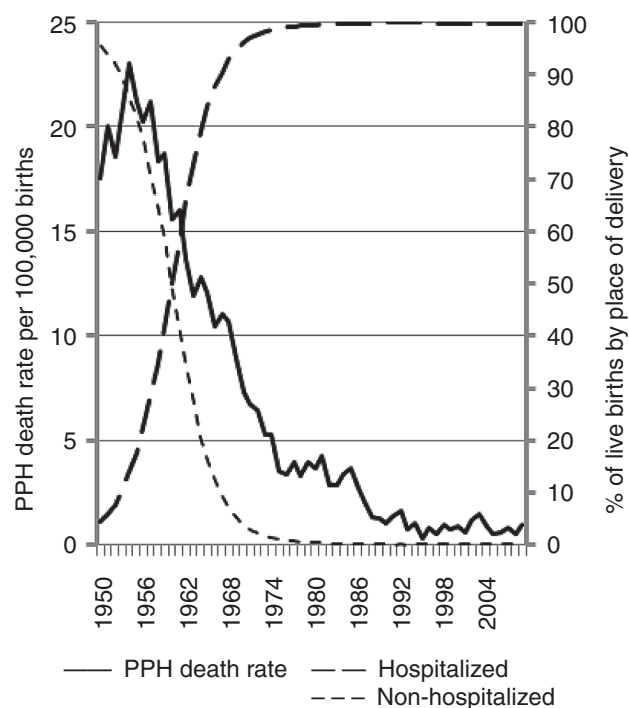
Table 5 Puerperal hemorrhage (PH) and maternal death (MD) rates for 1899–1943

Year	No. of deaths PH	MD	Death rate (per 100,000) PH	MD	Year	No. of deaths PH	MD	Death rate (per 100,000) PH	MD
1899	–	6240	–	409.8	1922	1116	6565	53.1	312.4
1900	–	6200	–	397.8	1923	1114	6897	51.2	316.8
1901	–	6671	–	402.6	1924	1154	6273	54.3	295.3
1902	–	6556	–	392.9	1925	1268	6309	57.4	285.4
1903	–	6071	–	369.3	1926	1179	5721	52.9	256.7
1904	–	5742	–	361.7	1927	1207	5765	55.4	264.7
1905	–	6185	–	387.8	1928	1213	5997	53.8	265.8
1906	–	6237	–	403.9	1929	1234	5867	56.2	267.4
1907	–	6728	–	379.4	1930	1250	5681	56.7	257.9
1908	–	7091	–	388.4	1931	1254	5667	56.5	255.4
1909	864	6399	46.6	344.9	1932	1318	5530	57.2	240.2
1910	843	6228	45.1	333.0	1933	1347	5763	60.3	257.8
1911	812	6192	42.7	325.4	1934	1307	5709	60.6	264.7
1912	706	5770	37.4	306.1	1935	1322	5698	57.3	247.1
1913	778	5900	40.8	309.7	1936	1241	5384	56.1	243.3
1914	782	6418	40.0	328.4	1937	1268	5444	55.3	237.5
1915	824	6452	42.5	332.5	1938	1186	4877	58.5	240.5
1916	871	6337	44.8	325.8	1939	1206	4818	60.3	240.9
1917	870	6368	44.6	326.1	1940	1402	5070	63.2	228.6
1918	1056	6812	54.6	352.1	1941	1370	4929	57.5	207.0
1919	910	5910	47.6	309.2	1942	1192	4586	51.2	196.9
1920	1100	7158	51.2	329.9	1943	1245	4542	53.1	193.6
1921	1092	7181	51.3	337.3					

Table 6 Death rates of puerperal hemorrhage (PH), and ratio of PH to maternal deaths, 1909–1942

Prefecture	1909–1922		1933–1942		Ratio of PH to maternal deaths	
	No. of PH	Death rate	No. of PH	Death rate	1909–1922	1933–1942
Hokkaido	615	57.0	692	62.2	17.27	27.2
Aomori	150	24.5	168	42.5	10.4	19.8
Iwate	223	50.3	206	49.9	11.7	18.3
Miyagi	149	30.2	286	63.5	11.2	32.1
Akita	231	47.1	295	73.0	11.8	25.0
Yamagata	208	41.5	248	62.6	15.0	32.8
Fukushima	308	47.5	338	60.3	15.9	31.7
Ibaraki	238	36.1	300	56.4	11.5	28.0
Tochigi	268	50.4	261	63.5	16.0	30.1
Gunma	305	58.7	315	73.3	19.1	33.3
Saitama	322	46.7	319	60.3	15.3	27.5
Chiba	265	40.5	307	60.9	12.2	25.2
Tokyo	866	65.2	1271	67.0	15.3	26.1
Kanagawa	278	51.1	433	71.6	15.4	28.8
Niigata	468	50.0	422	60.6	15.1	30.0
Toyama	168	41.9	125	45.1	11.5	20.9
Ishikawa	166	42.9	127	53.0	11.7	19.9
Fukui	115	36.7	91	44.9	12.5	20.5
Yamanashi	174	61.4	155	72.0	16.4	28.7
Nagano	365	52.7	380	71.5	15.3	32.4
Gifu	191	35.3	206	49.7	11.3	23.1
Shizuoka	322	42.4	345	52.7	13.9	26.0
Aichi	359	36.8	352	37.5	14.0	21.0
Mie	200	39.2	197	53.1	13.9	24.5
Shiga	164	52.4	117	57.1	17.9	25.5
Kyoto	333	63.7	242	54.3	14.2	21.0
Osaka	560	60.0	803	69.6	13.0	22.6
Hyogo	524	54.7	433	51.0	15.2	20.8
Nara	133	47.7	135	76.2	13.6	24.7
Wakayama	162	47.4	138	57.3	13.0	22.4
Tottori	84	42.2	85	58.7	13.2	23.9
Shimane	179	58.2	126	55.0	13.2	21.1
Okayama	262	51.1	189	49.6	12.4	20.3
Hiroshima	361	50.9	224	42.4	15.4	20.8
Yamaguchi	248	60.3	213	61.8	13.4	19.7
Tokushima	224	66.5	118	48.5	19.1	22.4
Kagawa	175	48.6	95	40.7	16.7	19.8
Ehime	224	45.5	188	49.5	13.4	25.1
Kochi	117	40.4	121	60.3	12.1	24.8
Fukuoka	437	52.1	495	56.8	13.6	21.9
Saga	166	52.0	112	49.8	15.3	22.7
Nagasaki	277	61.9	239	56.2	17.3	24.1
Kumamoto	249	49.2	230	54.1	11.9	22.9
Oita	184	48.7	186	59.0	12.8	21.7
Miyazaki	156	58.6	162	57.3	14.8	24.1
Kagoshima	322	55.6	277	53.3	13.5	22.7
Okinawa	129	75.0	69	43.0	9.5	12.5
Total	12,624	49.9	12,836	57.9	14.1	24.6

Figure 2 Relationship between PPH death rate and percentage of live births by place of delivery, 1950–2009

DISCUSSION – WHY DID POSTPARTUM HEMORRHAGE DECREASE IN JAPAN?

Our results indicate that of the common risk factors for PPH (prolonged third stage of labor, pre-eclampsia, mediolateral episiotomy, previous PPH, maternal age, twin pregnancy, arrest of descent, soft-tissue lacerations, Asian ethnicity, augmented labor, forceps or vacuum delivery, Hispanic ethnicity, midline episiotomy and nulliparity)[14,15], maternal age (over 35 years) plays an important role. A prior Japanese study by Ohkuchi *et al.*[16] had indicated that age was a risk factor among Japanese parturients, but this study was hospital based, much shorter in duration and could not, by definition, consider moving averages at age of death. Figure 2 shows the relationship between the PPH death rate and the percentage of live births by place of delivery: institutional (hospital, clinic or maternity home) and non-institutional (home and others) from 1950 to 2009. The percentage of non-institutional deliveries was 95% in 1950, and decreased to 50% in 1960 and, finally, drastically decreased to 1% in 1975. However, the percentage of institutional deliveries was only 5% in 1950, but rapidly increased to 50% by 1960, 90% by 1967, and then became 99% in 1974 and nearly 100% for the period 1980–2009. The relationship between the PPH death rate and the percentage of non-hospitalized deliveries is strongly correlated (correlation coefficient 0.92). According to Nagaya *et al.*[17], during 1991–1992, 197 maternal deaths occurred within a hospital and 22 outside a medical facility; 11 deaths were without available records. The percentage of maternal deaths due to PPH was 55% (12/22) outside medical facilities, but there was no information about deaths due to PPH in the hospital. According to

1909–1922 and 2 times higher in 1933–1942. The ratio of puerperal hemorrhage deaths to maternal deaths was 14.1% for Japan overall in the period 1909–1922, where the highest ratio was 19.1% in Tokushima Prefecture and the lowest was 9.5% in Okinawa Prefecture. The corresponding values were 24.6% for Japan overall, 33.3% in Gunma Prefecture and 12.5% in Okinawa Prefecture, in the period 1933–1942.

the Japanese vital statistics[2], the percentage of maternal deaths due to PPH was 17.6% (39/221) for the period 1991–1992. Even assuming that there were no PPH deaths in the 11 maternal deaths without records, the percentage due to PPH is 13.7% (27/197) in hospital, which is an overestimated value. However, it is of great importance to Asian countries that deaths due to PPH will decline as a higher percentage of institutional deliveries becomes the norm.

The traditional definition of PPH is a blood loss of more than 500 ml, but this definition is now considered questionable, as it is based on a study published in 1964 which was uncontrolled and underpowered. More recently, Kubo[18] undertook a hospital-based study on blood loss of PPH in Japan. They retrospectively analysed 253,607 cases for the blood loss at delivery in the years from 2001 to 2005. Their definitions of usual blood loss of PPH by means of 90% of distribution as normal were 800 ml or more in singleton vaginal births, 1500 ml or more for singleton of cesarean birth, 1600 ml or more for multiple birth delivered vaginally, and 2300 ml or more for multiple births delivered by cesarean. Given these values, it is entirely reasonable to suggest that the definition of PPH be modified in such a manner as to include fetal multiplicity and delivery route. Of interest, the American College of Obstetrician and Gynecologists mentioned in its practice bulletin that PPH was defined as blood loss in excess of 500 ml following a vaginal birth or a loss of greater than 1000 ml following cesarean birth[19]. If more articles such as those by Kubo[18] and Nakabayashi[11] continue to appear, it would be reasonable for practitioners to call upon their respective national colleges to rethink their positions.

Nagaya et al.[17] investigated 220 cases of maternal deaths in 1993 and 1994 in Japan. PPH with antepartum hemorrhage was the leading cause of maternal death, accounting for 40% of all deaths. These authors compared the results with the corresponding results in the UK, and attributed the higher rate of PPH in maternal deaths to the thinly distributed number of hospitals for labor and delivery. In other words, there were more hospitals but fewer numbers of doctors to conduct deliveries in Japan compared with in the UK. These authors thought that the scarcity of staff could have caused delay for patients to be transferred to a tertiary center or to be managed intensively with transfusion. Although this article was not published until 2000, the data obviously were made available to the proper authorities, because the Japanese government took the initiative in 1998 to establish comprehensive maternal hospitals to centralize medical staff and materials for high risk pregnancy and delivery such as PPH.

References

1. World Health Organization. WHO recommendations on the prevention of postpartum hemorrhage: A summary of the results from a WHO technical consultation. Geneva, Switzerland: World Health Organization, 2006
2. Japan, Ministry of Health and Welfare. Vital Statistics, 1950–2009, Health and Welfare Statistics and Information Department, Ministry of Health and Welfare, Tokyo, 1952–2010. Japan: Ministry of Health and Welfare [in Japanese]
3. World Health Organization. International Classification of Diseases, 6th Revision. Geneva, Switzerland: World: World Health Organization, 1950
4. World Health Organization. International Classification of Diseases, Seventh Revision. Geneva, Switzerland: World Health Organization, 1957
5. World Health Organization. International Classification of Diseases, 8th Revision. Geneva, Switzerland: World Health Organization, 1968
6. World Health Organization. International Classification of Diseases, Ninth Revision. Geneva, Switzerland: World Health Organization, 1977
7. World Health Organization. International Classification of Diseases, 10th Revision. Geneva, Switzerland: World Health Organization, 1993
8. The International Statistical Institute. International List of Causes of Death, 2nd Revision. Paris, France: International Statistical Institute, 1909
9. The International Statistical Institute. International List of Causes of Death, 3rd Revision. Paris, France: International Statistical Institute, 1920
10. The International Statistical Institute. International List of Causes of Death, 4th Revision. Paris, France: International Statistical Institute, 1929
11. Nakabayashi M, Asakura H, Kubo T, Kobayashi T, Saito S, Sato S. Committee report of maternal death and critical obstetrical cases. Nippon Sanka Fujinka Gakkai Zasshi 2007; 59:1222–4 [in Japanese]
12. Irita K, Inada E. Guidelines for management of critical bleeding in obstetrics. Masui 2011;60:14–2213
13. Kanayama N, Inori J, Ishibashi-Ueda H, et al. Maternal death analysis from the Japanese autopsy registry for recent 16 years: significance of amniotic fluid embolism. J Obstet Gynecol Res 2011;37:58–63
14. Combs CA, Murphy EL, Laros RK Jr. Factors associated with postpartum hemorrhage with vaginal birth. Obstet Gynecol 1991;77:73
15. Cameron MJ, Robson SC. Vital statistics: an overview. In: B-Lynch C, Keith LG, Lalonde A, Karoshi M, eds. A Textbook of Postpartum Hemorrhage. London: Sapiens Publishing, 2006:17–34
16. Ohkuchi A, Onagawa T, Usui R, et al. Effect of maternal age on blood loss during parturition: a retrospective multivariate analysis of 10,053 cases. J Perinat Med 2003;31:209–15
17. Nagaya K, Fetters MD, Ishikawa M, et al. Cause of maternal mortality in Japan. JAMA 2000;283:2661–7
18. Kubo T. Clinical conference 2, Management of obstetrical abnormal hemorrhage: A new concept for abnormal blood loss at delivery. Nippon Sanka Fujinka Gakkai Zasshi 2010; 62:121–5 [in Japanese]
19. American College of Obstetricians and Gynecologists. Practice bulletin 76: Postpartum Hemorrhage. Obstet Gynecol 2006;108:1039–47