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Progress of Perinatal Medicine in Japan

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Abstract

Aim: The perinatal data of Japan listed in official materials were analyzed with statistical studies.

Results: One hundred and 13 years have passed after the first report of maternal mortality in Japan. The maternal mortality reduction rate was 1/2.5 in the first 50 years in home deliveries, while the reduction rate was 1/46 in succeeding 63 years in the deliveries in hospitals and clinics. Perinatal mortality reduction was closely correlated with maternal mortality and the reduction rate was 1/16.2 after 1950.

Comment: The progress of medicine, medical and neonatal care would be directly effective to definitely improve maternal and perinatal mortalities in Japan.

Conclusion: The progress of perinatal medicine in 113 years was analyzed after the first report of maternal mortality in 1899. The progress of medicine, medical and neonatal care would be beneficially influenced to improve the maternal and infantile states.

Keywords: Mother; Fetus; Neonate; Maternal mortality; Perinatal mortality; Medical care; Neonatal care; Total fertility rate; Birth space

Introduction

Since multiple potentialities are hidden in a baby, any possible morbidity and mortality should be prevented from the fetus and newborn in the period of perinatal life. It would be the base of perinatal medicine and medical care. Mothers should be also protected from all possible risks in the pregnancy and labor in every case. Therefore, maternal mortality and morbidity, as well as perinatal mortality of the fetus and neonate should be minimum in perinatal medicine.

Official records of perinatal statistics in Japan published by the Ministry of Health and Welfare since 1949 were studied and summarized in this report, where the perinatal medicine was initiated in 1899, the last year of 19th century, with the first report of maternal mortality [1], and the granting of the first official midwife license, in Japan.

Materials and Methods

Japanese official data reported in governmental publications [1] were analyzed statistically in every year in 1899 to 2010. Maternal mortality rate is an important index representing the status of perinatal medicine. Maternal mortality rate is Maternal deaths in a year×100,000 divided by total births, where maternal deaths are sum of direct obstetric deaths and indirect obstetric deaths, obstetric deaths of unknown origin, and obstetric tetanus and human immunodeficiency virus disease of pregnancy or until 42 days after the end of pregnancy, from 1995 [1].

Perinatal mortality rate is another important index in the perinatal statistics to estimate the outcomes of fetuses and neonates. Perinatal mortality rate is Perinatal death in a year (Fetal death after 22 weels of pregnancy+Early nronatal deaths within a week)×1,000 divided by Total births (Live births+Foetal deaths after 22 weeks of pregnancy) [1], where perinatal mortality is closely correlated to maternal mortalities in Japan therefore, some unreported perinatal mortality was estimated from maternal mortality in this review article. There are two regression equations in the correlation of perinatal mortality after 28 and 22 weeks of pregnancy in this article; where perinatal mortality after 28 weeks of pregnancy is estimated by equations 1 or 2,

$$\text{Log Y (28 weeks)} = 0.7826 \text{Log X (28 weeks)} + 0.08 \quad (1)$$

$$\text{Y (28 weeks)} = 0.3X + 4.3,\ R = 0.99,\ p < 0.001 \quad (2)$$

Perinatal mortality after 22 weeks of pregnancy is estimated by the equation 3;

$$\text{Y (22 weeks)} = X + 0.96,\ R = 0.98,\ p < 0.001 \quad (3)$$

The equation 3 is used in the cases after 1979, because the official perinatal mortality was calculated after 28 weeks of pregnancy in 1950, and changed to 22 weeks in 1979, because the neonate born after 28 weeks survived in 1950, whereas survived after 22 weeks in 1979. In the international comparison of perinatal mortality, the mortality after 28 weeks of pregnancy was utilized.

Societal influence on the statistics was discussed in this article. The influence of economical conditions was also studied in personal income of Japanese people.

Results

Statistics regarding maternal mortality in Japan in 1899 was 409.8 per 100,000 births, with most births occurring in the home. By 2008, some 109 years later, maternal mortality in Japan had decreased to 3.5 per 100,000 births, and its reduction rate was 1/117.1 (3.5/409.8) (Figure 1) [1]. This is significantly greater than the gradual decline in maternal mortality in the first 50 years of record keeping (maternal mortality was 161.2 per 100,000 births in 1950, where a reduction rate was 1/2.5 [161.2/409.8]) [1]. The marked decrease in maternal mortality to 3.5 since 1950 can be attributed to the significant decline in home births and an increase in the number of births in hospitals and/or clinics (hospital births). For example, the number of non-hospital

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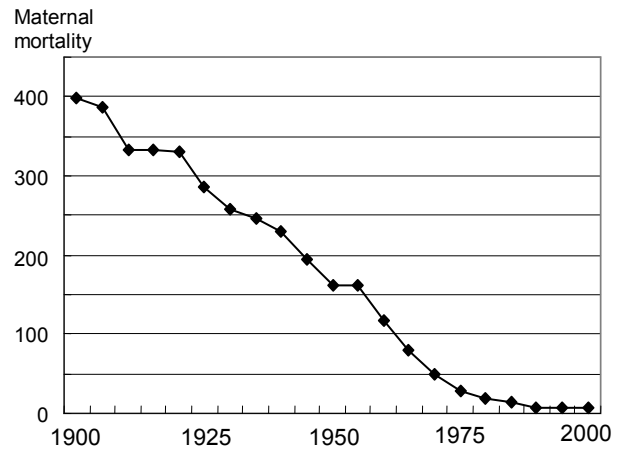


Figure 1: Maternal mortality gradually decreased in the first 50 years of home delivery, whereas the reduction was very rapid in the later 50 years of hospital births [1].

Year	Hospital births (%) mortality (<50%)	Maternal (%) rate	Year	Hospital births mortality (>50%)	Maternal rate
1899	non-hospitalized	409.8	1960	50.1	117.5
1905	non-hospitalized	378.8	1965	80.4	
1910	non-hospitalized	333.0	1970	96.1	48.7
1915	non-hospitalized	332.5	1975		27.3
1920	non-hospitalized	329.9	1980	99.5	19.5
1925	non-hospitalized	285.4	1985		15.1
1930	non-hospitalized	257.9	1990	99.9	8.2
1935	non-hospitalized	247.1	247.1		6.9
1940	non-hospitalized	228.6	2000	99.8	6.3
1947	non-hospitalized	160.1	2005		5.7
1950	4.6	161.2	2009	99.8	4.8
N=11	248.9 ± 25.1*		N=11	35.0 ± 14.5*	

Table 1: Hospital birth and maternal mortality rate in Japan.

births in 1950, 1960, 1970, and 1980 was 95.4%, 49.9%, 3.9%, and 0.5%, respectively. A corresponding increase in the number of hospital births was observed over the same period of time, with rates of hospital births reported to be 4.6%, 50.1%, 96.1%, 99.5%, and 99.5%-99.9% in 1950, 1960, 1970, 1980, and 1990-2008, respectively. Consequently, maternal mortality decreased from 161.2 per 100,000 births in 1950, to 117.5, 48.7, 19.5, 8.2, 5.8, and 3.5 per 100,000 births in 1960, 1970, 1980, 1990, 2000 and 2008, respectively [1,2]. In the 58 years from 1950 to 2008, the reduction in maternal mortality ratio was 1/46.1 (3.5/161.2), with a greater reduction in mortality for women giving birth in hospitals (hospitalization rate>50%) than in those who did not give birth in hospitals (hospitalization rate<50%) (Table 1). It is likely that improved medical knowledge and appropriate disease management, including obstetric problems, contributed to the effective reduction in maternal deaths for women giving birth in hospitals in Japan.

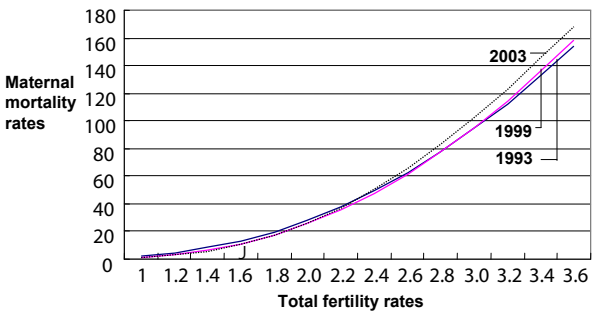
The societal factor that most likely contributed to the improvements in maternal mortality during this time in Japan was the considerable migration after 1950 of young people from rural to urban areas. This was a time of significant industrial development in Japan, with evident external societal changes. Moving from homes in rural areas to a new life in the cities, young expectant parents no longer having the support of old families would have looked to obstetric hospitals and clinics to provide safe environment for the birth of their children [3], where actually the availability of prompt and appropriate medical care at the time of birth would effectively reduce both maternal mortality and morbidity.

Other factors have also contributed to the reduction of maternal mortality, with global reports indicating that maternal mortality was significantly reduced when the births spacing interval was 36 or more months [2] and that lower maternal mortality is associated with a lower total fertility rate, e.g. maternal mortality was less than 100 per 100,000 births if the total fertility rate was lower than 3, and actually the maternal mortality rate was 3.1 when the total fertility rate was 1.34 in 2007 in Japan (actually 35 women died in pregnancy, labor and puerperium in 1,089,818 births) (Figure 2) [1]. On the basis of these observations, the correlation of reducing the number of births per woman and a reduction in maternal mortality was evident.

Maternal mortality and its reduction rate are compared to some developed countries in the world in 1950 and 2009. The mortality in Japan in 1950 was 176.1 and reduced to 4.2 in 2009, i.e., the mortality reduced to 1/41.93. Country of the lowest mortality in 2009 and highest reduction rate in 1950/2009 was Switzerland (Table 2).

Perinatal Mortality in Japan

Statistics are available for perinatal mortality in Japan after 22 and 28 weeks of pregnancy. Information regarding perinatal mortality after 22 weeks of pregnancy is available from 1979 (Figure 3) [1]. Herein, >22 weeks mortality statistics have been used to officially compare current mortality rates, whereas statistics for >28 weeks mortality have been used for long term studies.



2003 LogY=-2.48X2+5.31X+0.04 (X=Log total fertility rate) R^2=0.8, p<0.001
J: Maternal mortality rate in Japan

Figure 2: Total fertility rates and maternal mortality in the world.

Country	1950	2009	Reduction rate
			(1950/2009)
Japan	176.1	4.2	41.93
Canada	113.2	5.9	19.19
USA	83.3	18.4	4.53
France	86.1	7.6	11.33
Germany	206.2	6.1	33.8
Italy	153.2	2.3	66.61
Sweden	61.5	1.9	32.37
UK	88.2	7.3	12.08
Netherlands	105.5	4.3	24.54
Switzerland	140.4	1.3	108
Australia	109.1	3.4	32.09
New Zealand	90.3	15.2	5.94

Table 2: Maternal mortality in Japan compared to some developed countries in 1950 and 2009.

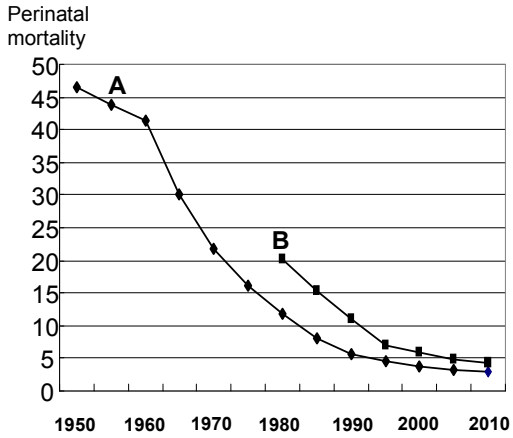


Figure 3: Although a perinatal mortality rate was reported after 28 weeks of pregnancy since 1950 (A), official perinatal mortality is calculated after 22 weeks since 1979 (B) [1].

Year	1950	1960	1970	1980	1990	2000	2009
Perinatal mortality rate (y)	46.6	41.4	21.7	11.7	5.7	3.8	2.9
% Hospital births (x)	4.6	50.1	96.1	99.5	99.9	99.8	99.8

Regression analysis of the data yields the equation y =–0.45x+54.09 (R^2=0.83, two-tailed P=0.004), where x is % hospital births and y is perinatal mortality rate

Table 3: Correlation between perinatal mortality and the rate of hospital births.

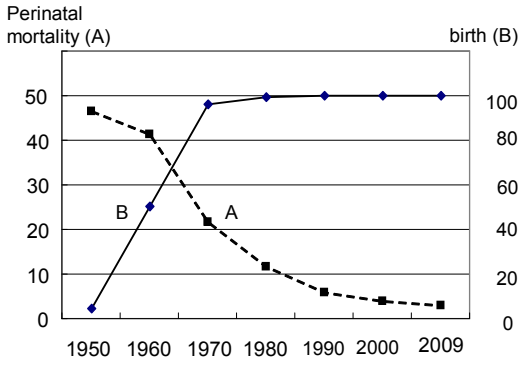


Figure 4: Perinatal mortality rate was inversely correlated with the % of hospital births in Japan [1].

As indicated in table 3 and figure 4, there is a significant correlation between perinatal mortality (at >28 weeks) and the rate of hospital births. As the rate of hospital births increased from 1950, there was a concomitant decrease in perinatal mortality, reflecting improvements in the medical environment of both the mother and child [1].

Analysis of the available data indicates a close correlation between maternal mortality and perinatal mortality in the period 1980-1999 (Figure 5). Because significant decreases in both maternal and perinatal mortality have been seen with increases in the rate of hospital births, prompt and appropriate medical care in case of maternal or perinatal problems appears to be an important factor contributing to improvements in the outcomes for both the mother and children in the case of hospital births. These changes highlight the effects of improvements in medical care on maternal and perinatal mortality.

The perinatal mortality after 22 weeks of pregnancy (B) was closely

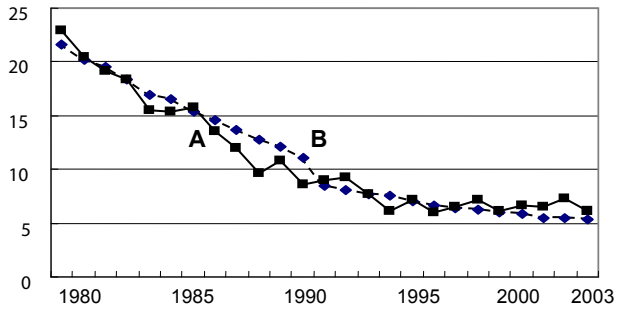


Figure 5: The perinatal mortality after 22 weeks of pregnancy.

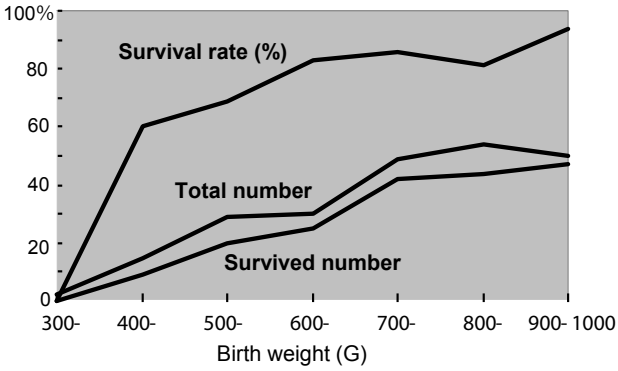


Figure 6: The survival of extremely low birth weight infants, e.g., 60% of 400-500 gs neonates survived in the NICU of Tokyo Women's Medical College.

Figure 7: Perinatal mortality suddenly dropped (arrow) immediately after the introduction of surfactant therapy for neonatal respiratory distress syndrome in Japan.

correlated with maternal mortality (A) in the period of 1980 to 2003 [1] (Figure 5). Y(B)=1.03X (A)+0.17, R^2=0.94, p<0.001. Perinatal mortality calculated after 28 weeks of pregnancy was also closely correlated to maternal mortality in the period of 1950 to 1900 [4]. The same medical environment for the mother and child in hospital births would be the reason of the close correlation.

Another factor that has accelerated the decline in perinatal mortality in Japan has been the National Health Insurance scheme [3]. Immediately after World War II, new medical care effectively treated infectious disease of infants to suddenly prolong the expectant life of male and female for 5 years respectively. Neonatal asphyxia reduced, perinatal mortality was lowered and cerebral palsy was reduced

Country	1952	2009	Reduction rate
			(1952/2009)
Japan	45.6	2.9	15.72
Canada	35.8	6.3	5.68
USA	32	6.8	4.71
France	31	10.9	2.84
Denmark	34.6	8	4.33
Germany	48.8	5.5	8.87
Hungary	41	7.1	5.78
Italy	51.3	4.5	11.4
Sweden	31.5	4.9	6.43
UK	38.8	8.5	4.57
Netherlands	31.5	5.8	5.43
Australia	31.8	5.9	5.39
New Zealand	31.2	6	5.2

Table 4: Perinatal mortality in Japan compared to some developed countries in the world in 1952 and 2009 [1].

after full intrapartum fetal monitoring in a general hospital [5]. Perinatal mortality was decreased in fetal monitoring group for 1/3 of simultaneous non-monitoring control group [6], and the rate of cerebral palsy was reduced significantly to 1/3 of historical control after wide use of fetal monitoring in the research of pediatric neurologists in around 70,000 births [7]. The medicine and medical care were effective to reduce perinatal mortality and morbidity.

The increased survival of immature preterm babies

The perinatal mortality was defined by fetal and neonatal deaths born after 28 weeks of pregnancy in 1950, indicating that preterm birth cases after 28 weeks of pregnancy was able to survive despite of the neonatal care in the neonatal intensive care unit (NICU), whereas the definition changed to the deaths after 22 weeks of pregnancy in 1979 in Japan. It meant that a preterm born infant after 22 weeks of pregnancy survives by the care in the NICU, i.e., it is a great progress of neonatal medicine, and an example is shown in figure 6.

The effect of artificial surfactant in the reduction of respiratory distress syndrome

The reductions in perinatal mortality were seen immediately after the introduction of artificial surfactant for the treatment of neonatal respiratory distress syndrome. The change highlights the effects of improvements in medical care in the neonatology (Figure 7).

Although improved economic conditions indirectly result in improvements in perinatal mortality, similar improvements have not always been seen in neonatal mortality [3]. The factor that directly contributes to reductions in maternal and perinatal mortality is timely and appropriate medical intervention for the mother, fetus, and neonate. Therefore, perinatologists ensure that their medical knowledge is up-to-date to enable them to provide mothers and babies with the best possible medical care.

Perinatal mortality in Japan was compared to some developed countries in the world in 1952 to 2009. Perinatal mortality was the lowest in Japan in 2009, and the reduction rate was largest in Japan in 1952 to 2009 (Table 4).

Conclusion

The success in the reduction of maternal and perinatal mortalities was achieved by the progress of medicine and medical care and its appropriate intervention to the reproductive process in Japan.

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