Table 3: Differences of birth weight between 2006 and 2010 before and after adjusting each confounding factor by ANCOVA.

	Value		Difference			
	2006	2010				
Difference of birth weight before adjustment by ANCOVA						
Birth weight (g)	2950.840	2937.520	13.320	—	—	13.320
Estimation for net effect on birth weight of each factor by ANCOVA						
Partial confounding factors				b^*	Net effect (g)†	Total effect (g)‡
Gestational age at delivery (weeks)	39.087	38.985	0.102	160.081	16.360	
Primiparity	0.530	0.544	−0.014	−104.796	1.496	
Cesarean delivery	0.236	0.285	−0.050	−2.046	0.102	
Weight gain during pregnancy (kg)	9.846	9.842	0.004	16.269	0.064	
Female gender	0.489	0.487	0.002	−107.150	−0.236	
Induction of labor	0.236	0.269	−0.033	9.714	−0.322	11.156
Pregestational BMI	21.057	21.092	−0.035	22.250	−0.774	
IVF-ET	0.023	0.044	−0.021	37.404	−0.785	
Smoking habit	0.053	0.044	0.009	−107.593	−0.954	
Maternal height (cm)	158.338	158.471	−0.133	10.270	−1.366	
Maternal age (year)	31.119	32.002	−0.883	2.752	−2.428	
Difference of birth weight after adjustment by ANCOVA						
Birth weight (g)						2.164

$^*b$ meant a partial regression coefficient. †Net effect was calculated by product of difference and partial regression coefficient. ‡Total effect was derived from sum of net effect.
ANCOVA: analysis of covariance, BMI: body mass index, and IVF-ET: *in vitro* fertilization and endometrial transfer.

Using ANCOVA, we calculated the difference of BW in order to clarify the effect of each confounding factor, and it has been shown that no significant change in the BW was seen between 2006 and 2010 after adjusting each factor (the difference was 2.164 g, $P = 0.414$) (Table 3).

4. Discussion

The data from the JPDB in 2006 and 2010 were used to identify the underlying factors influencing BW in Japan and to investigate the current risk factors for BW. The present study showed data that were consistent with prior investigations regarding the relationship between the BW and perinatal/obstetrical factors [3, 4]. Among singleton pregnancies, a shorter gestational length (duration), female infant, maternal primiparity, and smoking have previously been demonstrated to be the main factors for BW. Particularly, the gestational duration mostly affected the BW, because this net effect of BW (16.36 g) was the highest in all confounding factors (Table 3). A reduction of 13 g in BW may not matter for an individual infant but represents a substantial change for an overall population. It is unclear why gestational age at birth is reducing in Japan. It may be a result of the increase in planned delivery before the due date with a doctor shortage and the increase in complicated pregnancy.

Although there has been an increase in the infants BW in the past, this upward trend in BW has more recently been reversing [13]. For example, from 1990 to 2005, the BW decreased among term births in the United States, especially after 1999 [8, 14].

The Children and Infant Growth Survey is a national Japanese survey on anthropometric parameters (weight, height, head circumference, and chest circumference) in children between birth and six years old, and it has been carried out every 10 years since 1950. Information on the birth and maternal background has also been recorded in this survey [15]. Using this database consisting of randomly selected population-based surveys, Takimoto et al. reported the prevalence of LBW infants in Japan from 1980 to 2000 [4]. They showed that the proportion of LBW infants was 4.2% in 1980, 6.1% in 1990, and 8.3% in 2000, and that the mean BW were 3,189 g in 1980, 3,123 g in 1990, and 3,033 g in 2000, which were compatible to corresponding vital statistics reports (3,190 g in 1980, 3,080 g in 1990, and 3,030 g in 2000, resp.), and the increase in preterm deliveries and multiple gestations were found to be important factors with regard to the increase in LBW infants in Japan. Ohmi et al. hypothesized that a decrease in BMI in young females could be related to the increase in LBW infants [3]. Indeed, it has been demonstrated that the increase in nutritionally derived underweight females with an insufficient diet while pregnant has led to poor maternal weight gain and to affecting optimal fetal growth [4].

Although they did not demonstrate a strong effect of smoking and maternal age on the LBW increase, we have shown a significant correlation between them in the present study. Other important factors influencing pregnancy outcomes, such as the weight gain during pregnancy [16, 17], use of assisted reproductive technologies (ART) [18], pregnancy complications [11], induction of labor [14], and mode of delivery [19, 20], were also assessed in this survey.

As a result, we found the maternal height, pregestational BMI, weight gain during pregnancy, use of ART, and induction of labor to all have a positive effect on the BW. Because information on the medical indications for the induction of labor could not be obtained from the database, we could not explain the potential cause of this increase.

In brief, we have herein extracted the maternal and neonatal characteristics associated with fetal growth and gestational age as possible factors related to the infant BW. This is a major strength of this study. For example, Kramer et al. reported temporal trends in fetal growth. Although their report was a hospital-based study in Canada, various pieces of information, such as the parity or use of ART, were lacking [21]. In Lehmann's report from Australia, the maternal height, weight gain during pregnancy, smoking, use of ART, and mode of delivery were all unknown [22]. Second, we assessed the gestational duration as gestational days, not in gestational weeks. Although the gestational age at birth is generally reported in completed weeks, it is possible that a decrease of gestational length of a few days within each gestational week might account for the observed decline in fetal growth.

Despite the fact that this analysis was based on a large number of subcohorts of pregnancies, some limitations of this study merit attention. First, our data was limited to information derived from discharge record abstracts. The second shortcoming of our study is the use of a database, in which coding errors are known to occur. Other factors not recorded in a database that might contribute to the decline in gestational length or fetal growth include trends in maternal physical activity, stress, socioeconomic factors, pollution or toxicant exposures, or unrecorded medical conditions, such as asthma or thyroid disease. More detailed studies of smaller populations would be needed to explore the role of these factors [8]. Third, because we examined an annual change in BW in only two time points, we could not show yearly trends, although there was a reduction in BW by about 15 g.

In conclusion, we have demonstrated that the difference of BW of babies born at term in Japan was explained by maternal factors and the difference of maternal background. Further studies to ascertain all factors contributing to the decrease in BW over time, including other factors that might contribute to declines in fetal growth, are warranted. In addition, future study is also needed whether the prediction of the annual trends is possible, considering the chronological change in obstetrical background.

Conflict of Interests

The authors have no conflict of interests to declare.

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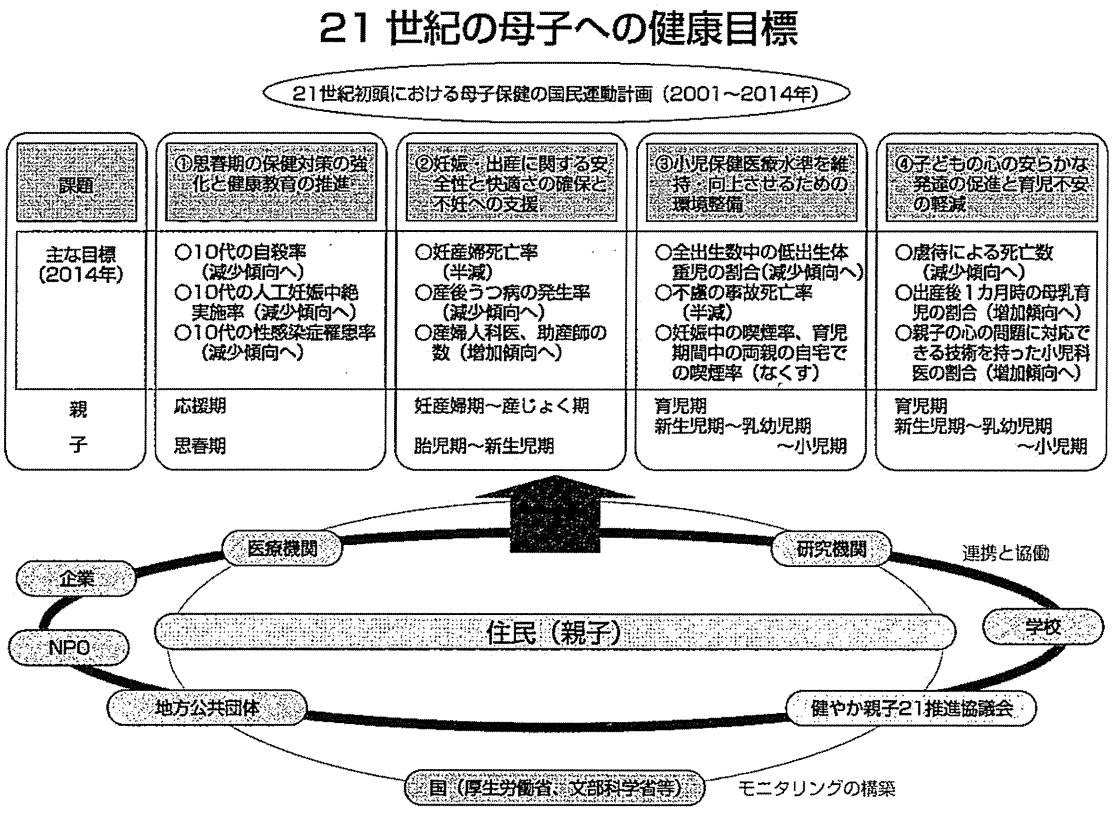
3-17　健やか親子21



健やか親子21のホームページ　http://rhino.med.yamanashi.ac.jp/sukoyaka/

平成12年に、21世紀の母子保健の取り組みの方向性を示した「健やか親子21」が策定された。基本視点として、20世紀中に達成された母子保健水準を低下させない、20世紀中に達成しきれなかった課題を早期に克服する、20世紀中盤に顕著化し21世紀にさらに深刻化することが予想される新たな課題に対応するために、新たな価値尺度や国際的な動向を踏まえた斬新な発想や手法によって取り組むべき課題を探求することとした。そこで、主要課題を、①思春期保健対策の強化と健康教育の推進、②妊娠・出産の安全性と快適さの確保と不妊への支援、③小児保健医療水準の維持・向上のための環境整備、④子どもの心の安らかな発達の促進と育児不安の軽減とした。ヘルスプロモーションにその基本理念を置き、61の目標値を設定した。また、「健やか親子21推進協議会」を設置し、関連団体の自主的な取り組みを推進した。期間は当初設定の平成22年が26年まで延長された。これまで、2回の中間評価が行われ、指標の7割以上が改善していた。改善していない指標については達成に向けた対策や指標の見直しが行われた。

参照：本編105～106頁（第3編第2章　1.母子保健）

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