ANALYSIS OF MULTIPLE BIRTHS IN JAPAN

V. EFFECTS OF GESTATIONAL AGE, MATERNAL AGE AND OTHER FACTORS ON GROWTH RATE OF WEIGHT IN TWINS

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Summary Total body weight (sum of the body weight) of twins at one year of age was analysed in connection with gestational age, maternal age and other factors. Growth rate of total weight from birth to one year of age was strongly influenced by gestational age, maternal age, method of nutritions, family size, and employment of the mother during pregnancy.

INTRODUCTION

The present study aims at clarifying factors such as gestational age, maternal age and others, which affect growth rate of total weight (sum of the body weight) of twins from birth to one year of age.

SUBJECTS AND METHODS

Subjects were similar to those reported by Asaka, Imaizumi and Inouye (1980). They were taken from "Survey B" of "Survey on Socioeconomical Aspects of Vital Events—Plural Births in 1975" (Health and Welfare Statistics and Information Department, Ministry of Health and Welfare), consisting of 3,482 pairs both surviving at one year of age. A total of sixteen items included in the Survey was analysed:

- [1] Gestational age in months;
- [2] Maternal age at the twins' births;
- [3] The method of nutritions until three months of age,
 - (1) Both twins with breast feeding,
 - (2) Both twins with artificial feeding,
 - (3) Both twins with mixed feeding,
 - (4) Others: combination of the three methods mentioned above;

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- [4] Family size;
- [5] Employment or working status of the mother during pregnancy,
 - (1) Employed,
 - (2) Not employed, worked at home,
 - (3) Only engaged in housekeeping, not worked;
- [6] Maternal health conditions before pregnancy,
 - (1) Healthy, (2) Not healthy;
- [7] Maternal conditions during pregnancy,
 - (1) Healthy, (2) Not healthy;
- [8] Maternal health conditions after delivery,
 - (1) Healthy, (2) Not healthy;
- [9] Forty-seven prefectures, where the twins were born;
- [10] Nine districts, which were made up from the above prefectures;
- [11] Monthly expenditure of the household (10 thousand yen),
 - (1) 6 or less, (2) 6-, (3) 8-, (4) 10-, (5) 12-, (6) 14-, (7) 16-, (8) 18-, (9) 20 or more;
- [12] Multiple births in the relatives;
- [13] Multiple births in the mother's previous pregnancy (-ies);
- [14] Whether or not the twins were separated from the mother,
 - (1) Not separated,
 - (2) Either or both separated;
- [15] Whether or not the mother was treated with ovulation-inducing hormone;
- [16] The health conditions of the twins at the age of one year,
 - (1) Both healthy, (2) Either not healthy, (3) Both not healthy.

In this study, growth rate was defined as the percentage ratio of the increase from birth to one year of age of the total weight of twins to the total weight at birth. Growth rate was broken down by subgroups in each item above mentioned, and subjected to analysis of variance.

RESULTS

The results were summarized in Table 1. In addition to the growth rate, Table 1 also summarized the results of the analysis of the total weight at birth and at one year of age. Growth rate was significantly different among subgroups in the following items: [1] Gestational age in months, [2] Maternal age at the twins' births, [3] The method of nutrition until three months of age, [4] Family size, [5] Employment or working status of the mother during pregnancy and [7] Maternal health condition during pregnancy. Table 2 shows mean of the total weight at birth and at one year of age, and growth rate, according to gestational age and maternal age.

With respect to the effect of gestational age, mean total weight at birth was increased as gestational age was increased. The relationship between gestational age and mean total weight at birth was linear from 8 to 10 months of gestation and

Table 1. Summary of analysis of factors affecting total weight at birth and at one year of age, and growth rate.

Factors analysed#	Total weight at birth	Total weight at one year of age	Growth rate
[1] Gestational age	***	**	***
[2] Maternal age	***	ns	***
[3] Method of nutrition	***	**	***
[4] Family size	***	ns	***
[5] Employment or working status of the mother	**	ns	**
[6] Maternal health condition before pregnancy	ns	ns	ns
[7] Maternal health condition during pregnancy	**	ns	*
[8] Maternal health condition after delivery	ns	ns	ns
[9] Prefectures	ns	*	ns
[10] Districts	ns	**	ns
[11] Monthly expenditure	ns	*	ns
[12] Multiple births in the relatives	ns	ns	ns
[13] Previous multiple births	ns	ns	ns
[14] Separation from the mother	ns	ns	ns
[15] Hormonal therapy	ns	ns	ns
[16] Health condition of the twins	*	**	ns

See the text. ns: not significant. *: significant at the level of 0.05. **: significant at the level of 0.01. ***: significant at the level of 0.001.

from 20 to 39 years of maternal age groups, where sample size was large enough to draw a conclusion (Fig. 1). For the similar selected sample with large number of subjects almost similar result was obtained in total weight at one year of age (Fig. 2). On the other hand, for the same selected sample growth rate was linearly decreased as gestational age was increased (Fig. 3).

As for the effect of maternal age, significant differences were observed in total weight at birth and growth rate. At birth mean total weight was the highest (5,141 g) in maternal age 19 or less, another mode was seen in maternal age group of 30-34 (5,087 g). Mean growth rate ran to the opposite direction as mean total weight at birth.

With respect to the effect of the method of nutritions, growth rate was the highest in twins both with artificial feeding, who had the lowest mean total weight at birth (Table 3).

Concerning family size of the twins, total weight at birth was significantly different among six groups (Table 4). Mean was the lowest in family size 4 or less, in which mean growth rate was the highest.

Among classes of employment or working status of the mother during pregnancy significant differences of total weight at birth and growth rate were indicated (Tables 1, 5). Mean total weight at birth was the lowest in "Employed" and the

Table 2. Mean of total weight (g) at birth and at one year of age, and growth rate, according to gestational age in months and maternal age at twins' births.

Gestational age (months)	Maternal age at twins's births (years)						Total
	-19	20-24	25-29	30-34	35-39	40-	
Total weight at birth							
7	—	3,435 (2)	—	3,050 (1)	—	—	3,307 (3)
8	—	3,447 (17)	3,585 (47)	3,576 (25)	2,837 (7)	2,700 (2)	3,487 (98)
9	4,618 (5)	4,202 (189)	4,280 (339)	4,389 (138)	4,417 (40)	4,218 (4)	4,292 (716)
10	5,359 (12)	5,097 (561)	5,177 (1,329)	5,308 (586)	5,328 (83)	5,001 (14)	5,195 (2,586)
11	—	5,396 (7)	5,928 (4)	5,973 (7)	4,200 (1)	—	5,657 (19)
Total	5,141 (17)	4,841 (776)	4,958 (1,719)	5,087 (757)	4,908 (131)	5,614 (20)	4,958 (3,422)
Total weight at one year of age							
7	—	20,500 (2)	—	16,760 (1)	—	—	19,253 (3)
8	—	17,861 (16)	18,437 (38)	17,582 (20)	16,257 (7)	16,300 (1)	17,904 (82)
9	17,233 (3)	18,393 (165)	18,493 (302)	18,442 (117)	18,917 (33)	15,280 (2)	18,460 (623)
10	20,427 (11)	18,875 (496)	18,592 (1,121)	18,685 (473)	18,873 (62)	19,038 (8)	18,698 (2,172)
11	—	19,229 (7)	19,125 (4)	20,333 (4)	11,100 (1)	—	18,971 (16)
Total	19,743 (14)	18,744 (686)	18,569 (1,465)	18,611 (615)	18,634 (103)	18,105 (11)	18,626 (2,896)
Growth rate							
7	—	533 (2)	—	450 (1)	—	—	505 (3)
8	—	432 (16)	431 (38)	402 (20)	476 (7)	594 (1)	430 (82)
9	271 (3)	347 (165)	340 (302)	327 (117)	337 (33)	266 (2)	338 (623)
10	279 (11)	275 (495)	265 (1,121)	257 (473)	264 (62)	296 (8)	265 (2,171)
11	—	261 (7)	232 (4)	257 (4)	164 (1)	—	245 (16)
Total	277 (14)	296 (685)	284 (1,465)	275 (615)	301 (103)	318 (11)	286 (2,895)

Note: figures in parentheses indicate the number of twin pairs.

highest in "Only engaged in housekeeping, not worked," while mean total weight at one year of age and mean growth rate were the highest in the former and the lowest in the latter.

Among other findings listed in Table 1, significant differences of total weight at birth and growth rate were seen between two classes of maternal health condition

Fig. 1. Mean total weight at birth according to gestational age and maternal age.

Fig. 2. Mean total weight at one of year of age according to gestational age and maternal age.

Fig. 3. Growth rate according to gestational age and maternal age.

Table 3. Mean of weight (g) at birth and at one year of age, and growth rate according to method of nutrition.

Method of nutrition	Total weight at birth	Total weight at one year of age	Growth rate
Both twins with breast feeding	5,086 (n= 136)	18,460 (n= 113)	268 (n= 113)
Both twins with artificial feeding	4,873 (n=2,272)	18,615 (n=1,907)	293 (n=1,906)
Both twins with mixed feeding	5,152 (n= 871)	18,796 (n= 754)	274 (n= 754)
Others*	4,970 (n= 159)	17,981 (n= 136)	269 (n= 136)
Total	4,957 (n=3,438)	18,626 (n=2,910)	286 (n=2,909)

* Combination of the three methods mentioned above.

Table 4. Mean of total weight (g) at birth and at one year of age, and growth rate according to family size.

Family size	Total weight at birth	Total weight at one year of age	Growth rate
4 or less	4,788 (n= 905)	18,576 (n= 806)	299 (n= 805)
5	5,033 (n=1,133)	18,671 (n= 932)	281 (n= 932)
6	5,011 (n= 621)	18,565 (n= 521)	280 (n= 521)
7	4,969 (n= 428)	18,570 (n= 361)	282 (n= 361)
8	5,008 (n= 237)	18,842 (n= 196)	286 (n= 196)
9 or more	5,060 (n= 118)	18,668 (n= 96)	274 (n= 96)
Total	4,957 (n=3,442)	18,625 (n=2,912)	286 (n=2,911)

Table 5. Mean of total weight (g) at birth and at one year of age, and growth rate according to employment or working status of the mother during pregnancy.

Employment or working status of the mother during pregnancy	Total weight at birth	Total weight at one year of age	Growth rate
Employed	4,844 (n= 827)	18,662 (n= 712)	296 (n= 711)
Not employed, worked at home	4,975 (n= 422)	18,627 (n= 347)	285 (n= 347)
Only engaged in house-keeping, not worked	4,998 (n=2,183)	18,615 (n=1,848)	282 (n=1,848)
Total	4,958 (n=3,432)	18,628 (n=2,907)	286 (n=2,906)

during pregnancy. Mean total weight at birth was higher in "Healthy" mother, but mean growth rate was higher in "Not healthy" mother during pregnancy.

Among 47 prefectures total weight at one year of age was significantly different, and its mean was higher in north-east Aomori, Iwate and Fukushima prefectures. Among seven districts a significant difference was seen in total weight at one year of age, mean of which was the largest in north-east Tohoku district. As for monthly expenditure of the household, the difference was significant in total weight at one year of age, mean of which was larger in higher monthly expenditure classes, namely, 18-20 and 20 or more 10 thousand yens than in other classes. As for the health conditions of the twins at the age one year, mean total weight at one year of age was the heaviest in twins both healthy, which was seen also in total weight at birth. No difference was seen in growth rate.

DISCUSSION

Among factors affecting growth rate of total weight from birth to one year of age both gestational age and maternal age seem to play an important role: the former factor indicated a linear relationship to the growth rate, while in the latter there were depressions in groups less than 19 years and 30-34 years. In order to confirm the contribution of the above two factors, stepwise multiple regression analysis was attempted, using growth rate as dependent variable and gestational age and maternal age as two independent variables. Regression equation obtained is:

$$GR = -75.74 \times GESTAT - 1.14 \times MAGE + 1,054.53,$$

where GR means growth rate, GESTAT gestational age and MAGE maternal age. Standardized regression coefficients were -0.5438 for gestational age and -0.0609 for maternal age. It is apparent that gestational age contributes to the growth rate more strongly than maternal age. Simple correlation coefficient between the growth rate and the gestational age was -0.5433 and it was -0.0562 for the maternal age, which is in accordance with the above result of regression analysis.

As far as the method of nutrition was concerned, it was shown that the largest

growth rate was obtained by twins with artificial feeding who had the lowest total weight at birth.

As for the effect of family size, no linear relationship was revealed, but the smallest size with family members 4 or less showed the largest growth rate, the mechanism of which remains to be resolved.

It was also revealed that the growth rate was dependent on the employment or working status of the mother during pregnancy, and that the rate was the largest in the mothers who were employed than those who were not employed, worked at home, or only engaged in house keeping or not worked.

REFERENCES

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