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Birth Weight Doubling Time of Thai Infants

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ABSTRACT

Background: For decades, birth weight doubling time (BWDT) has been used as an indicator for the assessment of physical growth of infants. However, the relevant data in the literature were obtained mainly from western subjects and no similar studies have been carried out for South East Asian or other Asian countries.

Objective: To determine BWDT and related variables for Thai infants.

Methods: A study was conducted from January to August 1999 at the well baby clinic of Bamrasnaradura Hospital. Apparently normal infants (335) with birth weight between 2,500 and 4,000 grams were recruited and followed up until they had doubled their birth weights. Data on infant birth weight, sex, mother education, occupation, income and feeding practices were collected.

Results: The mean BWDT was 114 days which was slightly less than that given in previous reports. Male infants doubled their birth weights in less time (104 days) than females (123 days) and the difference was statistically significant ($p<0.001$). Infants with lower birth weights doubled their birth weights earlier than those with higher birth weights ($p<0.001$). Infants who were not given complementary food had shorter BWDT than those who were ($p<0.001$), but we could not demonstrate any significant association between BWDT and type of food, mother's education or family income ($p>0.05$). Factors that did affect BWDT were birth weight, sex, daily weight gain and use of complementary food. However, by multivariate analysis only birth weight and daily weight gain showed significant association with BWDT ($p<0.001$).

Conclusion: Both prenatal and postnatal factors may affect BWDT significantly.

Keywords: birth weight doubling time, Thai infant

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INTRODUCTION

For decades, birth weight doubling time (BWDT) has been used as an indicator for the assessment of physical growth of infants[1-7]. It currently serves as a practical, economical and reliable method for determining growth or nutritional status of infants in pediatric clinics and community surveys. The setting of BWDT reference values is based on studies prior to the 1980's and our search of major databases has revealed no recent work on the subject. In addition, we could find no publications in English on similar studies for any Southeast Asian or other Asian countries. Since the data used to set BWDT reference values were derived from western infants, we questioned whether these values were appropriate for Thai infants or those of other Asians. We also wondered whether changes in socio-economic status, environment and life-styles during recent decades might not require adjustment of the previous reference values. The objectives of the study were to determine BWDT of Thai infants and to identify factors associated with BWDT, including infant factors (sex and BW), maternal factors (education and family income) and feeding factors (milk and complementary food*).

MATERIALS AND METHODS

The study was conducted at the well baby clinic, Bamrasnaradura Hospital from January to August in 1999. The hospital is situated in a suburb of Bangkok where residents can be considered socioeconomically representative of the general Thai population. Included in the study were normal infants aged two months with birth weights ranging 2,500-4,000 grams, born following gestation periods of 38-42 weeks and born to mothers of 20-35 years. To facilitate comparisons, infants were divided into three arbitrary birth-weight groups as low (2,500 to 2,999 g), medium (3,000 to 3,499 g) and high (3,500 to 4,000 g). Infants with chronic disease and serious illness were excluded. Data on infant birth weight, age, sex, body weight, types of food, time of starting complementary food, maternal education and family income were obtained

* Complementary food: solid foods with low-caloric density[8] that complement breast milk or formula.

from the mothers. The children were followed up until their birth weights had doubled. Expected BWDT of infants was also determined from daily weight gain. This was calculated by linear interpolation from current and previous weight measurements. Additional visits to those for routine immunisation were arranged for body weight measurement, according to the expected time to obtain the exact BWDT.

Types of feeding were classified as: (1) breast-feeding, if infants were breast-fed for at least four months or until they doubled their weights; (2) formula-feeding if they were breast-fed less than one week followed by formula feeding only; (3) combination-feeding if they were both breast-fed and formula-fed. In addition, we recorded whether infants in the study were given complementary food such as ground rice and mashed banana in addition to breast milk and/or formula.

STATISTICS

Statistical analyses were done using the Statistical Package for the Social Sciences (SPSS/PC programme). Descriptive statistics including mean, standard deviation and percentage frequency were used for describing background characteristics of the study group. Student's t-test, one-way ANOVA and multivariate analysis were utilised to test for association between BWDT and other variables with the level of confidence set at $p \leq 0.05$ for all analyses.

RESULTS

Among 335 infants enlisted for this study, 48 cases dropped out and four cases were eliminated because they developed serious illness. This left 283 normal infants as participants throughout the study. Table I shows that male and female infants comprised 140 (49.5%) and 143 (50.5%) of the total, respectively. The mean birth weights of male and female infants were 3,091 and 3,067 grams, respectively, showing no significant difference ($p>0.05$). The mean BWDT for the whole group was 114 days while that for males was 104 days and that for females was 123 days. Thus, male infants doubled their BW significantly faster than female infants ($p<0.001$). BWDT of infants with BW less than 3,000 grams (low group) was 94 days while that for infants with BW more than 3,500 grams (high group) was 149 days and this difference was statistically significant ($p<0.001$).

Regarding types of feeding (Table II), it was found that 51% of the whole study group were breast-fed, followed by combination-feeding (45%) and formula-feeding (4%). There was no significant association between BWDT and types of feeding ($p>0.05$). However, 2/3 of infants were given complementary

Table I. Descriptive statistics for infants included in the study.

Factors	n = 283	BWDT (days) mean ± SD	P value
Total	100.0%	114 ± 37	
Male	49.5%	104 ± 34	<0.001
Female	50.5%	123 ± 38	
Birth weight (grams)			
2,500 - 2,999 (low)	42.7%	94 ± 27	<0.001
3,000 - 3,499 (medium)	44.9%	123 ± 35	
3,500 - 4,000 (high)	12.4%	149 ± 41	
Mean = 3,079 ± 350			

Table II. Feeding factors related to birth weight doubling time of infants.

Factors	n = 283	BWDT (days) Mean+SD	P value
Types of milk			
Breast milk	50.9%	111 ± 39	>0.05
Formula milk	3.9%	100 ± 20	
Combination	45.2%	118 ± 37	
Complementary food			
Given	66.8%	127 ± 37	<0.001
Not given	33.2%	89 ± 23	

Table III. Maternal factors related to birth weight doubling time of infants.

Factors	n = 283	BWDT (days) Mean ± SD	P value
Mother's Education			
Primary school	38.5%	119 ± 40	>0.05
Secondary school	46.3%	107 ± 34	
High school	6.4%	121 ± 44	
University	8.8%	119 ± 33	
Family income(Baht /month)			
≤10,000	65.4%	114 ± 38	>0.05
10,001 - 20,000	26.5%	111 ± 35	
≥20,001	8.1%	123 ± 38	

Table IV. Daily weight gain of infants by gender, birth weight and complementary food.

Variables	Daily weight gain (g) mean ± SD	p - value
Gender		
Male	32.1 ± 8.6	0.001
Female	26.8 ± 6.7	
Birth weight (grams)		
2,500 - 2,999 (low)	31.3 ± 8.2	0.002
3,000 - 3,499 (medium)	28.3 ± 7.6	
3,500 - 4,000 (high)	27.0 ± 8.7	
Types of milk		
Breast-fed	30.3 ± 8.8	>0.05
Formula-fed	31.6 ± 5.9	
Combination	28.2 ± 7.4	
Complementary food		
Given	25.7 ± 6.2	0.008
Not given	34.3 ± 7.9	

food (ground rice, mashed banana), and this practice was associated with a statistically significant ($p<0.001$) longer BWDT.

The mean age of the mothers was 26.6 years and the majority of them were housewives. Education for more than 80% (Table III) did not exceed the secondary school level and family income for 2/3 was less than 10,000 baht/month(1$ =45baht). There was no significant association between BWDT and level of mother education or family income ($p>0.05$).

Mean daily weight gains in male and female infants were 32.1 and 26.8 grams, respectively (Table IV) and the difference was statistically significant ($p < 0.001$). Furthermore, daily weight gain of infants with low BW (2,500-2,999 g) was significantly ($p=0.002$) greater than those with high BW (3,500-4,000 g). It was also found that infants not given complementary food had higher daily weight gain than infants given complementary food. However, there were no significant ($p>0.05$) associations between daily weight gain and type of feeding. Multivariate analysis revealed that only birth weight and daily weight gain showed significant ($p<0.001$) association with BWDT.

DISCUSSION

This study showed that average BWDT for healthy Thai children was about 114 days (three months plus 24 days). This was somewhat less than the period of 150 (five months) days given as the textbook reference value and the value reported in earlier studies[1-7]. In 1976 for example, Neumann and Alpaugh studied BWDT of 357 infants with birth weights of 2,500 - 4,100 grams in Los Angeles, mixed ethnic groups (165 Caucasian , 65 Mexican - American , etc.) and found that the mean BWDT was 119 days[9], and this was close to the value we found. About ten years later, Jung and Czajka-Narins examined 335 infants in Chicago (157 white and 178 black) and reported a BWDT of 141 days[10]. The discrepancy of these two studies might have resulted from differences in ethnic group or child rearing practice. Our finding that male infants doubled their birth weight significantly earlier than female infants was similar to those of others[9,10]. This has been explained by anatomical and physiological differences, in that male infants have larger heads and faces and a greater proportion of muscle tissue than female infants[2,7].

Smaller infants at birth had significantly shorter BWDT than larger infants, thus gaining weight more rapidly and allowing them to narrow the gap in total body weight with time. It is known that a period of rapid growth starts during the postnatal period and especially during the first months after birth, when intrauterine restraint has been removed[6,11]. Another study on the growth of exclusively breast-fed infants also reported that low birth weight infants doubled their weights by nine to ten weeks (63 to 70 days), while heavier babies took 15-18 weeks (105-126 days)[12].

As with Dewey et al[13] we found no association between type of feeding and BWDT. However, there was a significant difference in mean BWDT between infants given or not given complementary food (127 days vs. 89 days, respectively). This was due to the influence of relatives and grandparents who partly helped in child care. According to physiological development, digestive enzymes like amylase are not well developed before the third month of life[7] and giving of food other than milk during this interval might cause indigestion and abdominal discomfort. As a result, babies might take less milk, and this could, in turn, slow weight gain and lengthen BWDT. Sirikulchaynonta[14] has also reported that grandparents play an important role in rearing Thai children, especially during the mother's working hours, and that they often give complementary food before three months of age in the belief that these foods were good for babies, made them full, less fussy and sleep longer.

Although we found no significant association between BWDT and mother's education or family income, this may have been due to the small number of high income families included in the study and it might be that a larger study population would show significant associations. On the other hand, the nutritional needs of infants are usually a priority in Thailand and are usually well provided, regardless of a mother's education or family income. Other factors that might be considered in a future study are mother's experience in child rearing, frequency of babysitter use, age of mother, number of children, ethnic group (genetic), etc.

CONCLUSION

Thai infants doubled their birth weight on the average of about 114 days and multi-regression analysis demonstrated that only birth weight and daily weight gain were significantly associated with BWDT, while gender, maternal factors, feeding types and use of complementary food were not.

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