

Original Article

Secular trend in size at birth of Vietnamese newborns during the last 2 decades (1980-2000)

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The aim of the study was to investigate the secular changes in size at birth of Vietnamese newborns, and to determine the relationship between size at birth of the infants and nutritional status of their parents. Length, weight, mid upper arm circumference and head circumference of 586 newborns from the two maternity houses Hoan Kiem and Hai Ba Trung in Hanoi, Vietnam were measured. Information on socioeconomic conditions, health status, weight, and height of the parents were also obtained. There was a significant increase of birth weight (190 g, $P=0.008$; T-test) and length (1.3 cm, $P=0.001$; T-test) of Vietnamese newborns compared to those of newborns of the 1980's (1980-1984). There was a positive secular trend in parent's height and weight after a period of one and a half decades (height and weight increase of mothers: 2.6 kg and 1.9 cm, respectively; height and weight increase of fathers: 4.5 kg and 1.6 cm, respectively). The data showed that the birth weight of infants in the Capital of Vietnam have caught up with those of infants from richer societies in the Northern hemisphere.

Key words: secular trends, newborns, birth weight, birth length, head circumference, Hanoi, Vietnam

Introduction

It is well established that mother's pre-pregnancy nutrition affects intrauterine growth and birth weight of the infant. Going further, growth in utero, even from the time of conception, is suggested to be crucially affected by nutrition, having consequences even throughout later life.¹ Hence, low birth weight infants have been shown to lead to growth failure in children and subsequently to small adults. Small maternal size is a risk factor for having small babies.² It was found that prevalence of low-birth-weight was decreasing in many parts of the world.³ However, there have been reports of an increased secular trend of recumbent length at birth only in France and Italy during the 1970's, but not in many other countries.⁴ Secular trends in birth weight are relatively more difficult to observe due to the smaller differences compared to weight differences older children.⁴ It is well acknowledged that the secular trend indicates environmental improvements, especially changes in living conditions and health practices.

In 1975, the Vietnamese references for anthropometric measurements were established. In 1997, there was a dramatic improvement in living conditions as assessed by possession of household goods.⁵ The GDP per capita increased in Vietnam from 534 in 1984 to 816 US\$ in 1995.⁶ However, little information is available on the extent to which this economic improvement has led to secular changes in newborn size delivered in Vietnam and which are the sensitive determinants of body size contributing to the secular change. The aim of this study was to investigate the secular changes during the last 2 decades 1980-2000 in size (weight, recumbent length, head circumference) at birth of Vietnamese newborns,

and to determine the relationship between size at birth of the infants and nutritional status of their parents.

Methods

Population

All babies born during the period from 1st of November 1997 to 30th January 1998 at two district maternity houses Hoan Kiem and Hai Ba Trung of Hanoi were included in the study. These two districts were selected for comparison since one of the surveys on newborns has been carried out during the 1980's there, and the results of this study would be compared to the previous one.

Data collection

A questionnaire was developed and pre-tested for the interview of mothers. Mothers were asked about their pre-pregnancy body weight and mother's health card was also checked to ensure that pre-pregnancy weight was not too different from the weight during the first trimester of pregnancy. Furthermore, the father's weight, before their partner became pregnant, was also recorded. A microtoise (CMS weighing equipment Ltd., London, UK) was used for measuring height of both parents. The parent's body mass index [body weight (kg)/ body height² (m)] was calculated for each person using self-reported pre-pregnancy weight or weight during the first trimester of pregnancy. Gestational age was calculated by using the first day of the last menstruation.⁷

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The weight of the newborns was obtained by using a weighing scale (Testut, Paris, France) and was recorded to the nearest of 10g with adjustment for clothing. The recumbent length of the infants was measured by using a babyboard (UNICEF, Copenhagen, Denmark) and the measurement was recorded to the nearest of 0.1cm. A non-flexible plastic tape was used for measuring mid upper arm circumference (MUAC) and head circumference of the newborns and the result was also recorded to the nearest of 0.1cm. All the measurements were obtained within 24 h after delivery. The methods of measurements used were based on the recommendation of the WHO.⁷⁻⁹ Enumerators were trained to fill in questionnaires and to use anthropometric techniques before conducting the study. The calibration of the weighing scale was carried out before conducting the study and regularly during data collection.⁸ All enumerators were experienced staff members of the National Institute of Nutrition, Hanoi and supervised by two of the authors.

Statistical analysis

Data analysis was carried out using computer programs Epi-Info (version 6.01, Centers for Disease Control and Prevention, Atlanta, USA) and Statistical Package for Social Sciences (SPSS, Version 7.5 for Windows, SPSS Inc. Chicago, USA).¹⁰ Anthropometric indices weight-for-age, height-for-age and weight-for-height were calculated according to the recommendation of the World Health Organisation (WHO)^{8,9} using the reference data from the National Center for Health Statistics.¹¹ KS (Kolmogorov-Smirnov) test was used for checking normal distribution of all variables. The Student's T-test, Chi Square (χ^2) test were used for comparison of birth weight and length.

Ethical consideration

Ethical considerations were based on the guidelines from the Council for International Organizations of Medical Sciences.¹² The respondents were informed about the purpose of the study. Assurance was given that participation was voluntary, and the subjects could skip any questions that they did not want to answer. The Ethical Committee of the National Institute of Nutrition, Hanoi has approved the research protocol.

Results

Maternal characteristics

The demographic characteristics of the mothers are presented in Table 1. Age of most of the mothers (91.6%) ranged from 18-35 years and only one of the 586 mothers was younger than 18 years of age. The rate of illiteracy among the surveyed mothers was 0.5%. Nearly two third of the mothers completed 3-9 years of formal education and about 9.2% graduated from a university; there were no differences in mother's age and education level when the participants were compared to those of 1981-1984. More than half of the mothers had attended antenatal examinations at least 3 to 5 times during the last pregnancy, and 8.7% of them were examined less than 3 times. Almost all infants from both studies were born as either a first or a second child.

Anthropometric measurements

During the time span of observation 586 babies were born in the two district maternity homes (281 girls and 305 boys). Twenty-three newborns (3.9%) were pre-term births. Table 2 shows the size at birth (weight, recumbent length, MUAC and head circumference) of full-term babies. All anthropometric indicators of the males were significantly higher than those of the females. However, no significant differences were found in weight-for-age, height-for-age Z-scores between males and females.

Table 3 shows the classification of birth weight and birth length of all newborns from both studies in 1981-1984 and 1997-1998. The prevalence of low-birth-weight (<2500g) in 1997-1998 was 5.1% - which was lower than the prevalence calculated from the 1981-1984 data (9.4%). The prevalence of low-birth-weight was slightly higher in female babies (6.0%) than among males (4.3%). The proportion of birth weight class of 3000 to 3499g (Table 3) was largest for all sexes in both studies. However, the percentage of males in 1997-1998 (23.0%) with the birth weight \geq 3500g was higher than that of the females (11.4%). About half of the male newborns (49.8%) and sixty percent of females were of 48.0 to 49.9 cm in recumbent length. Similar to birth weight, the percentage of birth length category \geq 50cm was larger in males than in females (Table 3).

Comparison of birth weight, length and head circumference of Vietnam-born and French-born infants.

Table 4 demonstrates that there are positive trends in birth weight, length and head circumference among the Vietnamese infants in Hanoi during the period 1975-1998.

If birth weight and length of the recent cohort of newborns in Hanoi are compared with the birth cohort of the early 1980's, the increase in birth weight and recumbent length for both sexes, after one and half decades, was

Table 1. Selected maternal characteristics

Maternal characteristics	1981-1984 (N=331)	1997-1998 (N=586)
Age of the mothers (v)	%	%
<18	0	0.2
18-35	94.9	91.6
>35	5.1	8.2
Formal education (y)		
<3	0	0.5
3-9	28.7	36.9
>9-12	42.0	43.0
>12-15	15.7	10.4
University	13.6	9.2
Antenatal care (attention during pregnancy)		
<3	29.0	8.7
3-5	62.7	56.7
>5	8.3	34.6
Children (N)		
1	48.9	53.2
2	42.6	43.0
3	7.8	3.6
>3	0.7	0.2

Table 2. Mean size at birth of full-term Vietnamese newborns 1997-1998

	Males (N= 292) (mean ±SD)	Females (N=271) (mean ±SD)
Birth weight (kg)	3.22 ± 0.33	3.14 ± 0.31**
Birth length (cm)	49.9 ± 1.7	49.5 ± 1.5*
MUAC (cm)	10.2 ± 1.2	9.8 ± 1.1**
Head circumference (cm)	33.6 ± 1.2	33.2 ± 1.1**
Weight-for-age (Z-scores)	- 0.19 ± 0.74	-0.13 ± 0.71
Height-for-age (Z-scores)	-0.28 ± 0.73	-0.20 ± 0.68
Weight-for-height (Z-scores)	-0.31 ± 0.36	-0.60 ± 0.39**

* $P < 0.05$; ** $P < 0.01$ Significant difference between male and female newborns (Independent-samples T-test)

Table 3. Classification of birth weight and birth length of all newborns (%)

Classes	1981-1984		1997-1998	
	Males (N=182)	Females (N=149)	Males (N=305)	Females (N=281)
Birth weight(g)	(%)	(%)	(%)	(%)
< 2500	8.2	10.7	4.3	6.0
2500 –2999	28.0	30.8	18.0	21.0
3000 –3499	50.5	50.3	54.8	61.6
3500 –3999	13.3	8.2	22.0	10.0
≥ 4000	0	0	1.0	1.4
Birth length (cm)				
< 46.0	2.5	2.7	0.7	1.4
46.0 – 47.9	9.3	8.7	8.5	7.8
48.0 – 49.9	52.7	57.0	49.8	60.1
50.0 – 51.9	28.9	27.6	25.2	22.4
≥ 52.0	6.6	4.0	15.7	8.2

190g and 1.3cm, respectively. Weight and length at birth of the infants from the current cohort (1997-1998) were significantly higher compared to birth cohorts during the 1980's.

For birthweight (BW) $P = 0.002$ for boys and $P = 0.000$ for girls; for birth length: $P = 0.000$ for both boys and girls; T-test. It was also significantly higher than that of the Reference for Vietnamese in 1975 for both sexes ($P < 0.01$ and $P < 0.001$ for BW and length, respectively) (Table 4). Birth lengths of both males and females Vietnam-born in 1997 and 1998 were significantly greater than the lengths of French-born infants during the late 1980s ($P = 0.002$ for boys and $P < 0.001$ for girls; T-test). Nevertheless, significant differences were not observed in

birth weight of Vietnamese infants born in Hanoi and in Paris ($P = 0.171$ for boys and $P = 0.471$ for girls; T-test).

It was further observed that not only did the mothers' BMIs increase, but so did their weight and height after one and half decades, an increase of 2.6kg and 1.9cm respectively (Table 5). The fathers' BMIs, heights and weights in the recent study were also higher than the results of the study in the early 1980's.³⁷

Discussion

Effects of maternal parameters on fetal growth

Many studies reported that the mother's size at the beginning of pregnancy determined the infant's size at birth and its subsequent growth.^{13,14} Mother's weight gain during pregnancy can have an influence on size at birth,¹⁵ which was confirmed in several studies.¹³⁻¹⁴ Mother's pre-pregnant weight and weight gain is found also to be positively correlated with infant length at birth.¹⁶ The results of this study are in agreement with published studies¹³⁻¹⁶; weight gain during pregnancy, mother's pre-pregnant weight and BMI of current cohort (1997-1998) were significantly higher compared to those of the previous study (1981-1984).

Low-birth-weight

Low-birth-weight (LBW) is common in many developing countries and the size of the baby is proportionate to the size of the mother. However, it was argued that Asians in the US have an unusually low proportion of low-birth weight infants.^{17,18} In this study, the proportion of LBW was 5.1%, which is similar to that (4.9% of LBW) of Vietnamese newborns in America¹⁸ and much lower than that of the study in 1981-1984 and the national data for all newborns from Vietnam (10.8%) or many other Asian countries.¹⁹ This differences in prevalence of LBW could reveal that the size of the infant at birth reflects nutritional status of the mothers rather than her size *per se*.²⁰

Secular trends in size at birth

Secular trends in size at birth of term infants were observed in many developed countries such as in the United States and Canada.²¹ Secular increases in recumbent length at birth were observed in France and Italy.⁴ With this study, a positive secular trend regarding birth weight length at birth of Vietnamese newborns is described from a developing country. The increase in birth weight was 190g and 1.3cm in recumbent length for both sexes after one and half decades from the early 1980s to the period of 1997-1998 (Table 4). Recumbent length of Vietnamese male and female infants born in Vietnam were higher than infants born in France during the late 1980s.²² This increase in the size at birth appears to be related to increasing pre-pregnancy BMI²³, which is reflected in the higher gestational weight gain.^{24,25} Similar findings were also observed in this study. The weight gain during pregnancy increased from 8.5 kg in the early 1980s²⁶ to 10.6 kg in the years of 1997-1998 at the same maternities in Hanoi.

All these findings suggest that the improvement of socio-economic conditions in Hanoi have pushed a positive secular trend, reflected in an increased infant size

Table 4. Trends in size at birth of Vietnamese infants by sex born in Vietnam and in Paris -France (mean \pm SD)

	MOH (1975)	Hanoi (1981-1984)	Paris (1986-1990)	Hanoi (1997-1998)
Males				
Birth weight (kg)	3.07 \pm 0.29** ^a	3.03 \pm 0.30** ^b	3.30 \pm 0.40	3.22 \pm 0.33
Birth length (cm)	48.6 \pm 1.22*** ^a	48.6 \pm 1.55*** ^b	49.5 \pm 1.70** ^c	49.9 \pm 1.70
Head circumference at birth (cm)	31.3 \pm 1.07*** ^a	33.4 \pm 1.12	-	33.6 \pm 1.20
Females				
Birth weight (kg)	2.98 \pm 0.24** ^a	2.93 \pm 0.28*** ^b	3.10 \pm 0.40	3.14 \pm 0.31
Birth length (cm)	48.3 \pm 1.22*** ^a	48.3 \pm 1.46*** ^b	48.9 \pm 1.62*** ^c	49.5 \pm 1.50
Head circumference at birth (cm)	31.3 \pm 1.10*** ^a	32.9 \pm 1.07	-	33.2 \pm 1.10
Prevalence of LBW %		9.4	4.9	5.1

^aSignificant difference between the Reference of Vietnam 1975 and Hanoi 1997-1998; ^bSignificant difference between Hanoi 1980's and Hanoi 1997-1998; ^cSignificant difference between Paris 1980's and Hanoi 1997-1998; ** P < 0.01; *** P < 0.001 (T-test)

Table 5. Comparison of the parent's selected variables in the 1981-1984 and 1997-1998

	1981-1984 (N=300) (mean \pm SD)	1997-1998 (N=586) (mean \pm SD)	The differences between 2 studies
Weight gain during pregnancy (kg)	8.5 \pm 2.3	10.6 \pm 2.2***	2.1
Weight of the mothers before pregnancy (kg)	45.1 \pm 3.9	47.7 \pm 4.5***	2.6
Height of the mothers (cm)	154.5 \pm 3.9	156.4 \pm 4.3***	1.9
BMI of the mothers (kg/m ²)	18.9 \pm 1.6	19.6 \pm 1.5***	
Weight of the fathers before pregnancy (kg)	52.4 \pm 3.9	56.9 \pm 6.4***	4.5
Height of the fathers (cm)	166.0 \pm 4.4	167.6 \pm 4.6***	1.6
BMI of the fathers (kg/m ²)	19.0 \pm 1.2	20.4 \pm 1.9***	

*** P < 0.001 (T-test)

at birth. Parents' nutritional status and weight gain during pregnancy were the main determinants of birth weight and length at birth. It can be expected, that like other Asian countries with improving living conditions, the body size of the Vietnamese population will catch-up with the populations of the richer countries in the Northern and Southern hemispheres.

References

- Barker DJP. Mothers, babies, and disease in later life. London: BMJ Publishing Group, 1994.
- ACC/SCN. Women's nutritional status. Second report on the World Nutrition Situation. Volume I: Global and Regional Results. Geneva: ACC/SCN, 1992.
- ACC/SCN. Update on the Nutrition Situation. Administrative committee on Coordination, Subcommittee on Nutrition, Geneva: ACC/SCN, 1994.
- Roche AF. Secular trends in human growth, maturation and development. Monogr Soc Res Child Dev 1979; 44 (3-4): 1-120.
- Hop LT, Gross R, Giay T, Schultink W, Thuan BTN, and Sastroamidjojo S. Longitudinal observation of growth of Vietnamese children in Hanoi, Vietnam from birth to 10 years of age. Eur J Clin Nutr 1997; 51: 164-171.
- UNDP. Human development indicators. Human development report. United Nations Development Programme. New York: Oxford University Press, 1998; 140-145.
- WHO. Physical status: the use and interpretation of anthropometry. Geneva: World Health Organisation, 1995.
- WHO. Measuring change in nutritional status. Geneva: World Health Organization, 1983.
- WHO. Young people health-a challenge for society. Report of a WHO Group on Young People and "Health for all by the year 2000". WHO Technical Report Series, No. 731. Geneva: World Health Organization, 1986.
- Anonymous. SPSS Base 7.5 for Windows: User's guide. Copyright 1997 by SPSS Inc. Chicago, USA, 1997.
- NCHS. NCHS growth curves for children. Birth-18 years. US Department of Health, Education and Welfare Publication No. (PHS), 78-1650. Hyattsville: National Center for Health Statistics, 1977.
- CIOMS. International Guidelines for Ethical Review of Epidemiological Studies. Geneva: Council for International Organizations of Medical Sciences, 1991.
- Khoi HH, Hop LT, Hau CT, Hoa PT. Nutritional status of pregnant and lactating women in Hanoi City and some northern rural areas. In: Khoi HH, Giay T, eds. Nutr Monogr 1980-1990. Hanoi: Hanoi Medical Publication, 1991; 47-50.
- Institute of Medicine (IOM). Nutrition during pregnancy and lactation. Food and Nutrition Board. Washington DC: National Academy Press, 1990.
- Falkner F, Holgreve W, Schloo RH. Prenatal influences on postnatal growth: overview and pointers for needed research. Eur J Clin Nutr 1994; 48 (1 Suppl.): S15-S24.

16. Newmann CG, Harrison GG. Onset and evolution of stunting in infants and children. Examples from the Human Nutrition Collaborative Research support program. Kenya and Egypt studies. *Eur J Clin Nutr* 1994; 48 (1 Suppl.): S90-S102.
17. Yip R, Scanlon K, Trowbridge F. Improving growth status of Asian refugee children in the United States. *JAMA* 1992; 267: 937-940.
18. Le LTK, Kiely JL, Schoendorf KC. Birth weight outcomes among Asian American and Pacific Islander subgroups in the United States. *Int J Epid* 1996; 25 (5): 973-979.
19. WHO. Low-birth-weight a tabulation of available information. Maternal Health and Safe Motherhood Programme, Geneva, WHO/MCH/92.2 update version of Sept 1996. Geneva: World Health Organization, 1992.
20. Kusin JA, Kardjati S, Houtkooper JU, Renqvist, UH. Energy supplementation during pregnancy and postnatal growth. *Lancet* 1992; 340: 623-626.
21. Arbuckle TE, Sherman GJ. An analysis of birth weight by gestational age in Canada. *Can Med Assoc J* 1989; 140: 157-165.
22. Roville-Sausse F. Growth in Vietnamese children born in France. *Anthropol Sci* 1994; 102: 295-303.
23. Flegal KM, Harlan WR, Landis JR. Secular trends in body mass index and skinfold thickness with socioeconomic factors in young adult women. *Am J Clin Nutr* 1998; 48: 535-543.
24. Niswander K, Jackson EC. Physical characteristics of the gravida and their association with birth weight and perinatal death. *Am J Obstet Gynecol* 1974; 119: 306-313.
25. Kepell KG, Taffel SM. Pregnancy-related weight gain and retention: implications of the 1990. Institute of Medicine Guidelines. *Am J Public Health* 1993; 83: 1100-1103.
26. Thuan BTN, Hoa, HV, Hop LT. Anthropometric assessment of newborns in the north of Vietnam 1981-1982. In: Khoi HH, Giay T, eds. *Nutr Monogr 1980-1990*. Hanoi: Hanoi Medical Publication, 1991; 45-46.