

Are Babies Getting Bigger? Secular Trends in Fetal Growth in Israel – A Retrospective Hospital-Based Cohort Study

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Abstract

Background: A paradoxical secular trend of an increase in preterm births and a decrease in low birth weights has been reported in many developed countries over the last 25 years.

Objective: To determine if this trend is true for Israeli neonates, and to add new information on secular trends in crown-heel length and head circumference.

Methods: A hospital-based historic cohort design was used. Anthropometric data for 32,062 infants born at Rabin Medical Center in 1986–1987, 1994–1996, and 2003–2004 were collected from the hospital's computerized registry and compared over time for absolute values and proportional trends.

Results: For the whole sample (gestational age 24–44 weeks) there was a significant increase in mean birth weight (by 41 g), crown-heel length (by 1.3 cm), and head circumference (by 0.1 cm) from 1986 to 2004 ($P < 0.001$). A similar trend was found on separate analysis of the post-term babies. Term infants showed an increase in mean length and head circumference ($P < 0.001$), but not weight, and moderately preterm infants (33–36 weeks) showed an increase in mean weight (81 g, $P < 0.001$) and mean length (1.0 cm, $P < 0.001$), but not head circumference. The proportion of post-term (42–44 weeks), preterm (24–36 weeks), very preterm (29–32 weeks), extremely preterm (24–28 weeks), low birth weight (< 2500 g) and very low birth weight (< 1500 g) infants decreased steadily and significantly over time ($P < 0.002$).

Conclusions: Babies born in our facility, term and preterm, are getting bigger and taller. This increase is apparently associated with a drop (not a rise) in the proportion of preterm infants. These results might reflect improvements in antenatal care and maternal determinants.

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these parameters in order to broaden our understanding of fetal growth.

Subjects and Methods

A hospital-based historic cohort study was conducted at Rabin Medical Center (Beilinson Campus). The Beilinson computerized medical birth registry database was searched for all infants born live between 24 and 44 weeks gestation during three time periods: a) mid-1986 (when the Registry was started) to 1987, b) 1994–1996, and c) 2003–2004. Data were collected on maternal age and parity, and infant gender, birth weight, birth crown-heel length and head circumference. At our center, weight is routinely measured by trained nurses within 1 hour of birth using electronic scales accurate to 5 g and calibrated before each measurement. Crown-heel length is measured at the same time to the nearest millimeter with an infantometer, with the head placed against the head plate and the knees fully extended. Head circumference is measured by a physician around the glabella and the occipital protuberance at the largest occipito-frontal circumference, at birth and again at discharge in cases of caput succedaneum or cephalhematoma. Gestational age is recorded in complete weeks and, in recent years, has been largely based on the last menstrual period, with increasing use of early fetal ultrasound.

Analyses of temporal changes in the growth parameters were performed for the whole sample and by gestational age. To avoid misclassification of gestational age by use of the last menstrual period [14,15], we also used absolute birth weight in grams for some of the comparisons. The premature infants were further classified into subgroups: moderately preterm (33–36 weeks), very preterm (29–32 weeks) and extremely preterm (24–28 weeks). For infants born before 29 weeks, who are not usually measured for crown-heel length, we used only the birth weight and head circumference parameters. Data from 2 or 3 years in each period were combined to increase the sample size and improve statistical stability.

Outcome measures for the study were as follows: a) change in mean birth weight, b) change in mean crown-heel length, c) change in mean head circumference, d) proportion of low birth weight infants (< 2500 g), e) proportion of very low birth weight infants (< 1500 g), f) proportion of high birth weight infants (> 4000 g), and g) proportion of very high birth weight infants (> 4500 g).

The last quarter century has witnessed a substantial decrease in the rate of low birth weight infants in Canada [1-3], the United States [4], Britain [5,6], Finland [7], Norway [8], and Hong Kong [9], but not France [10], and a concomitant, paradoxical, increase in the rate of preterm births [11-13]. Together, these trends indicate a real rise in fetal growth (i.e., birth weight for gestational age) [3,11,12].

The overall aim of the present study was to determine if these secular trends are true also in Israel. Additionally, in all the previous studies, except the one from Hong Kong [9], the only growth parameter studied was birth weight; there was no calculation of either linear growth or head circumference. Therefore, the secondary aim of the study was to add new information on

Statistical analyses were performed with the chi-square test for linear trends for dichotomous variables and one-way analysis of variance (ANOVA) for continuous variables. Post hoc comparisons were done as appropriate. All statistical analyses were carried out using SPSS 10 for Windows. Results were expressed as mean (SD). A value of $P < 0.05$ was considered statistically significant.

Results

During the three periods studied, a total of 32,611 infants were born live in our facility. The exclusion of infants born before 24 weeks gestation and those with missing birth weight data yielded a final study sample of 32,062 infants.

There were no statistically significant differences in maternal characteristics between the three time periods. However, there was a trend towards a higher rate of women aged > 35 years from the earlier to the later periods that was almost significant ($P = 0.06$).

Table 1 summarizes the changes over time in the growth variables. For the whole sample (24–44 weeks), mean birth weight, mean crown-heel length, and mean head circumference increased significantly throughout the 18 year period, with a net increase of 41 g in weight, 1.3 cm in length, and 0.1 cm in head circumference. Analysis by gestational age revealed a significant net increase in the post-term babies (42–44 weeks) in mean birth weight (89 g), mean birth length (1.3 cm), and mean head circumference (0.4 cm). A similar significant increase in mean crown-heel length and head circumference was also observed in the term infants (37–41 weeks), but to a lesser degree; however, mean birth weight in this group did not increase. The moderately preterm infants (33–36 weeks) showed a significant increase in both mean birth weight (81 g) and mean crown-heel length (1.0 cm). There were no differences in the very preterm (29–32 weeks) and extremely (24–28 weeks) preterm groups in mean birth weight or head circumference.

Table 2 summarizes the trends in the proportion of infants in the different low/high gestational age and birth weight categories. Apart from the proportion of moderately preterm infants (33–36 weeks), which remained unchanged, all the other categories showed a statistically significant trend for a decreased proportion of infants over the three periods.

Discussion

The present study shows an increase in mean birth weight, crown-heel length, and head circumference of live-born infants from 1986 to 2004, in agreement with studies from many other developed countries [1-8]. In Canada, a net mean birth weight increase of 35 g occurred between 1981 and 1997 [3]. This was restricted to term (46 g) and post-term (70 g) births, whereas neonates born before 36 weeks did not show a mean increase in birth weight. Ananth and Wen [4] studied growth trends in neonates born between 1985 and 1998 in the United States and Canada. The 37–40 week gestational age group showed a net increase of 36 g for the Canadian infants, 27 g for the American black infants, and 9 g for the American white infants. In the preterm group (28–36 weeks), mean birth weight increased for

Table 1. Trends in anthropometric measures at birth in Israeli infants (1986–2004)

	1986–1987 Mean (SD)	1994–1996 Mean (SD)	2003–2004 Mean (SD)	<i>P</i>
24–44 wks	n=5862	n=8488	n=17712	
Birth weight (g)	3107 (669)	3101 (644)	3148 (585)	< 0.001
Birth length (cm)	48.6 (2.9)	49.2 (2.1)	49.9 (7.4)	< 0.001
HC (cm)	34.0 (1.5)	34.2 (1.6)	34.1 (1.6)	< 0.001
42–44 wks	n=182	n=222	n=424	
Birth weight (g)	3425 (438)	3440 (431)	3514 (395)	< 0.02
Birth length (cm)	49.9 (1.7)	50.1 (2.0)	51.2 (1.8)	< 0.001
HC (cm)	34.6 (1.0)	34.7 (1.1)	35.0 (1.2)	< 0.001
37–41 wks	n=5006	n=7255	n=15619	
Birth weight (g)	3267 (453)	3255 (448)	3251 (447)	NS
Birth length (cm)	49.1 (2.0)	49.3 (1.9)	50.1 (7.7)	< 0.001
HC (cm)	34.1 (1.2)	34.3 (1.5)	34.3 (1.4)	< 0.001
33–36 wks	n=400	n=657	n=1265	
Birth weight (g)	2263 (527)	2266 (485)	2344 (480)	< 0.001
Birth length (cm)	45.6 (2.8)	46.1 (1.8)	46.6 (2.2)	< 0.001
HC (cm)	32.0 (1.7)	32.2 (1.7)	32.1 (1.6)	NS
29–32 wks	n=166	n=249	n=263	
Birth weight (g)	1439 (381)	1445 (339)	1489 (416)	NS
HC (cm)	28.6 (3.2)	29.1 (2.0)	29.2 (1.9)	NS
24–28 wks	n = 108	n = 105	n = 141	
Birth weight (g)	897 (190)	914 (235)	897 (338)	NS
HC (cm)	24.9 (3.3)	25.8 (1.5)	24.9 (3.0)	NS

HC = head circumference

Table 2. Trends in proportion of neonatal characteristics in Israeli infants, 1986–2004

	1986–1987	1994–1996	2003–2004	<i>P</i> (χ^2)
Post-term, 42–44 wks (%)	3.1	2.6	2.4	< 0.002
Preterm, 24–36 wks (%)	11.5	11.9	9.4	< 0.001
Moderately preterm, 33–36 wks (%)	6.8	7.7	7.1	NS
Very preterm, 29–32 wks (%)	2.8	2.9	1.5	< 0.001
Extremely preterm, 24–28 wks (%)	1.8	1.2	0.8	< 0.001
Very high birth weight (> 4500 g) (%)	0.6	0.6	0.3	< 0.001
High birth weight (> 4000 g) (%)	5.4	4.8	4.5	< 0.02
Low birth weight (< 2500 g) (%)	12.5	13.4	11.0	< 0.001
Very low birth weight (< 1500 g) (%)	3.7	3.3	1.8	< 0.001

the Canadian infants by 28 g but no change was noted for the American infants (white or black). In the present study, the increase in mean birth weight was restricted to post-term and moderately preterm infants (33–36 weeks), whereas in very preterm infants (29–32 weeks) the difference of 50 g did not reach statistical significance, possibly because of a type 2 error. Regarding the additional growth parameters, crown-heel length increased significantly in babies born between 33 and 44 weeks, and mean head circumference increased significantly in full-term and post-term infants but not in preterm infants. The drop in low birth weight infants (absolute value in grams and by percentage) in our center was associated with a concomitant drop (not increase) in the proportion of preterm infants. Thus, the

reported “paradoxical” trend of increased birth weight/increased preterm births reported by others [3,11,12] was not observed in our study.

A few limitations of our study should be noted. First, we used a hospital-based and not a population-based sample. Therefore, the generalizability of the findings to the whole newborn population in Israel is unclear. Second, the estimation of gestational age in the present study was largely based on the date of the last normal menstrual period and not on early fetal ultrasound. This may place the validity of our gestational age determination, and the growth measures categorized by gestational age, in doubt. Because of this limitation, we included trends in fetal growth that are not affected by the accuracy of the gestational age determination. Third, data on maternal, environmental and other determinants of fetal growth were not available from the database registry. Nevertheless, it has been shown that the recent increases in maternal anthropometry, reduced cigarette smoking, and changes in sociodemographic factors have led to an increase in the weight of infants born at or after term [2].

In conclusion, our historical hospital-based cohort study shows that over the last decade, infants have been getting bigger and taller. These findings may reflect improved antenatal care and the possible beneficial effects of public health advances. Their clinical importance has yet to be determined.

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