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Anthropometry in Brazilian Newborn Infants: Studies of Association with Some Maternal Factors

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This paper describes a study coordinated by Professor Fernando José de Nóbrega and produced by a working team on undernutrition from the Brazilian Society of Pediatrics (1). A population of 101,126 live newborn infants was investigated. These infants were born during the period of 1 year (1978 through 1979) in maternity hospitals of all the state capitals of Brazil. The data used in this study were collected by medical or auxiliary personnel who were coordinated locally. Standardized data collection forms were used to relay the information to the central coordinators.

MATERNAL FACTORS

The authors studied the relationship between anthropometry of the newborn (weight, length, head circumference) and the following eight maternal variables: socioeconomic level, age, birth order, smoking habits, weight before pregnancy, height, adequacy of weight/height, and prenatal care. The socioeconomic level was defined according to a score made up from the father's occupation, education, and marital status. These criteria provided a classification into groups corresponding to high (1), medium (2), and low (3) social class. The adequacy of weight/height was obtained from the ratio between pre-gestational weight and the ideal weight for height according to Jelliffe (2). Prenatal care was considered to be effective if the mothers attended at least three antenatal clinics during the pregnancy.

NEWBORN DATA

Birthweight in grams was measured in the first 3 hr of life, using a baby scale which was checked for accuracy before the measurement was done. Length and head circumference (in cm) were determined in the first 24 hr of life.

STATISTICAL ANALYSIS

The association between each one of the maternal variables and anthropometric measures of the newborn was tested with the use of the χ^2 statistics. For the study of contrasts between proportions the Goodman statistics were calculated.

RESULTS

Table 1 shows the birthweight data according to socioeconomic level. Analysis using the Goodman (g) statistics test showed that there was no significant difference between socioeconomic levels 1 and 2 in the numbers of infants with birthweights <2,500 g and between 2,501 g and 3,000 g, but significantly more infants in these weight categories were born to women in the lowest social class group. The opposite was true for birthweights over 3,000 g.

If birthweights below 3,000 g are considered inadequate (i,e., low birthweight <2,500 g, and insufficient birthweight 2,501–3,000 g), then the number of infants of inadequate birthweight in this population was 34.6%.

Table 2 shows the distribution of birthweight according to maternal weight, which is divided into six bands. As maternal weight increased, there was a significant decrease in the number of infants with birthweights <2,500 g and between 2,501 and 3,000 g, and an increase in infants weighing >3,000 g.

Tables 3 and 4 show the distribution of birthweight according to maternal height and adequacy of weight/height, which are again divided into bands. The same pattern was repeated, with fewer infants <3,000 g as height and weight/height increased. The results obtained for birthweight were the same as for length and head circumference measurements.

TABLE 1. *Distribution of birthweight according to socioeconomic level (SEL)*

	Birthweight (g)							
	≤ 2,500		2,501–3,000		> 3,000		Total	
SEL	n	%	n	%	n	%	n	%
1	131	4.6	637	22.2	2,102	73.2	2,870	3.4
2	457	5.2	1,848	21.1	6,463	73.7	8,768	10.3
3	6,459	8.8	19,780	27.0	46,917	64.2	73,156	86.3
Total	7,047	8.3	22,265	26.3	55,482	65.4	84,794	100.0

Association test: calc χ^2 = 435.52; crit χ^2 = 9.49.
Contrasts study:
≤ 2,500 = {(prop SEL 1) = (prop SEL 2)} < {(prop SEL 3)}.
2,501–3,000 = {(prop SEL 1) = (prop SEL 2)} < {(prop SEL 3)}.
> 3,000 = {(prop SEL 1) = (prop SEL 2)} > {(prop SEL 3)}.
prop, proportion.

TABLE 2. *Distribution of birthweight according to maternal weight*

Maternal weight (kg)	Birthweight (g) ≤ 2,500 n	%	2,501–3,000 n	%	> 3,000 n	%	Total n	%
< 45	1,114	13.1	3,075	36.3	4,316	50.7	8,505	11.6
45–49	1,560	9.9	4,814	30.6	9,370	59.5	15,744	21.4
50–54	1,466	7.8	4,885	29.9	12,519	66.4	18,870	25.7
55–59	856	6.1	3,306	23.6	9,822	70.3	13,984	19.0
60–69	653	5.1	2,375	18.7	9,693	76.2	12,721	17.3
≥ 70	151	4.1	546	14.7	3,010	81.2	3,707	5.0
Total	5,800	7.8	19,001	25.9	48,730	66.3	73,531	100.0

Association test: calc χ^2 = 2,328.60; crit χ^2 = 18.307.
Contrasts study:
≤ 2,500g = (< 45) >(45–49) > (50–54) > (55–59) > (60–69) > (≥ 70) // (60–69) = (≥ 70).
2,501–3,000g = (<45) > (45–49) > (50–54) > (55–59) > (60–69) > (≥ 70).
> 3,000g = (< 45) < (45–49) < (50–54) < (55–59) < (60–69) < (≥ 70).

TABLE 3. *Distribution of birthweight according to maternal height*

Maternal height (cm)	Birthweight (g) ≤ 2,500 n	%	2,501–3,000 n	%	> 3,000 n	%	Total n	%
< 145	215	17.7	539	34.4	815	51.9	1,569	2.1
145–149	680	13.1	1,679	32.5	2,813	54.4	5,172	6.8
150–154	1,748	9.8	5,430	30.4	10,700	59.9	17,878	23.7
155–159	1,732	8.3	5,661	27.1	13,497	64.6	20,890	27.6
160–169	1,726	6.4	6,136	22.8	19,025	70.9	26,887	35.6
≥ 170	168	5.4	576	18.5	2,364	76.1	3,108	4.1
Total	6,269	8.3	20,021	26.5	49,214	65.3	75,504	100.0

Association test: calc χ^2 = 1,214.21; crit χ^2 = 18.307.
Contrasts study:
≤ 2,500 = (< 145) > (145–149) > (150–154) > (155–159) > (160–169) > (≥ 170) // (160–169) = (≥ 170).
2,501–3,000 = (<145) = (145–149) = (150–154) > (155–159) > (160–169) > (≥ 170).
> 3,000 = (< 145) = (145–149) < (150–154) < (155–159) < (160–169) < (≥ 170).

TABLE 4. *Distribution of birthweight according to the maternal adequacy of weight/height (W/H, % of standard values)*

Maternal W/H adequacy (%)	Birthweight (g) ≤ 2,500 n	%	2,501–3,000 n	%	> 3,000 n	%	Total n	%
70 ⊣ 80	431	9.9	1,249	8.6	1,958	5.2	3,638	6.4
80 ⊣ 90	1,247	28.6	3,838	26.6	7,970	21.1	13,055	23.2
90 ⊣ 100	1,371	31.5	4,561	31.6	11,564	30.6	17,496	30.9
100 ⊣ 110	778	17.9	2,867	19.9	8,673	22.9	12,318	21.9
> 110	525	12.0	1,880	13.0	7,588	20.0	9,993	17.6
Total	4,352	7.7	14,395	25.5	37,753	66.8	56,500	100.0

Cases without information about socioeconomic level omitted.
Association test: calc χ^2 = 945.23; crit χ^2 = 15.507.
Contrasts study:
≤ 2,500 = (70 ⊣ 80) > (80 ⊣ 90) > (90 ⊣ 100) > (100 ⊣ 110) > (> 110).
2,501–3,000 = (70 ⊣ 80) > (80 ⊣ 90) > (90 ⊣ 100) > (100 ⊣ 110) > (> 110).
> 3,000 = (70 ⊣ 80) < (80 ⊣ 90) < (90 ⊣ 100) < (100 ⊣ 110) < (> 110).

Table 5 shows the distribution of birthweight according to the level of prenatal care. It was found that 82% of this population attended three or more prenatal visits. Mothers of infants weighing <3,000 g were more likely to have had inadequate prenatal care than mothers of infants weighing >3,000 g.

Tables 6–10 show the distribution of birthweight in relation to the combined effects of prenatal care and socioeconomic level. It was found that in the high and medium socioeconomic levels, there were no birthweight differences related to the

TABLE 5. *Distribution of birthweight according to prenatal care*

Prenatal care	Birthweight (g) ≤ 2,500 n	%	2,501–3,000 n	%	> 3,000 n	%	Total n	%
Yes	5,011	7.5	17,080	25.6	44,734	66.9	66,825	81.8
No	1,807	12.2	4,401	29.6	8,652	58.2	14,860	18.2
Total	6,818	8.3	21,481	26.3	53,386	65.4	81,685	100.0

Association test: calc χ^2 = 533.96; crit χ^2 = 5.99.
Contrasts study:
≤ 2,500 = (prop yes) < (prop no).
2,501–3,000 = (prop yes) < (prop no).
> 3,000 = (prop yes) > (prop no).
prop, proportion.

TABLE 6. *Distribution of birthweight according to socioeconomic level (SEL) in mothers without prenatal care*

	Birthweight (g)							
	≤ 2,500		2,501–3,000		> 3,000		Total	
SEL	n	%	n	%	n	%	n	%
1	2	9.1	4	18.2	16	72.7	22	0.1
2	20	8.5	55	23.3	161	68.2	236	1.6
3	1,785	12.2	4,342	29.7	8,475	58.1	14,602	98.3
Total	1,807	12.2	4,401	29.6	8,652	58.2	14,860	100.0

Association test: calc χ^2 = 12.0; crit χ^2 = 9.49.
Contrasts study:
≤ 2,500 = without contrast.
2,501–3000 = without contrast.
> 3,000 = (prop SEL 2) > (prop SEL 3).
prop, proportion.

TABLE 7. *Distribution of birthweight according to socioeconomic level in mothers with prenatal care*

	Birthweight (g)							
	≤ 2,500		2,501–3,000		> 3,000		Total	
SEL	n	%	n	%	n	%	n	%
1	86	4.7	397	21.8	1,336	73.5	1,819	2.7
2	421	5.0	1,732	21.0	6,130	74.0	8,283	12.4
3	4,504	7.9	14,951	26.4	37,268	65.7	56,723	84.9
Total	5,011	7.5	17,080	25.5	44,734	67.0	66,825	100.0

Association test: calc χ^2 = 278.27; crit χ^2 = 9.49.
Contrasts study:
≤ 2,500 = { (prop SEL 1) = (prop SEL 2) } < (prop SEL 3).
2,501–3,000 = { (prop SEL 1) = (prop SEL 2) } < (prop SEL 3).
> 3,000 = { (prop SEL 1) = (prop SEL 2) } > (prop SEL 3).
prop, proportion.

TABLE 8. *Distribution of birthweight according to presence or absence of prenatal care in socioeconomic level 1*

Prenatal care	Birthweight (g) ≤ 2,500 n	%	2,501–3,000 n	%	> 3,000 n	%	Total n	%
Yes	86	4.7	397	21.8	1,336	73.5	1,819	98.8
No	2	9.1	4	18.2	16	72.7	22	1.2
Total	88	4.8	401	21.8	1,352	73.4	1,841	100.0

Association test: calc $\chi^2 = 1.0$; crit $\chi^2 = 5.99$.
Contrasts study: without contrast.

TABLE 9. *Distribution of birthweight according to presence or absence of prenatal care in socioeconomic level 2*

Prenatal care	Birthweight (g) ≤ 2,500 n	%	2,501–3,000 n	%	> 3,000 n	%	Total n	%
Yes	421	5.1	1,732	20.9	6,130	74.0	8,283	97.2
No	20	8.5	55	23.3	161	68.2	236	2.8
Total	441	5.2	1,787	21.0	6,291	73.8	8,519	100.0

Association test: calc $\chi^2 = 6.77$; crit $\chi^2 = 5.99$.
Contrasts study: without contrast.

TABLE 10. *Distribution of birthweight according to presence or absence of prenatal care in socioeconomic level 3*

Prenatal care	Birthweight (g) ≤ 2,500 n	%	2,501–3,000 n	%	> 3,000 n	%	Total n	%
Yes	4,504	7.9	14,951	26.4	37,268	65.7	56,723	79.5
No	1,785	12.2	4,342	29.7	8,475	58.1	14,602	20.5
Total	6,289	8.8	19,293	27.1	45,743	64.1	71,325	100.0

Association test: calc $\chi^2 = 396.98$; crit $\chi^2 = 5.99$.
Contrasts study:
≤ 2,500 = (*prop presence of prenatal care*) < (*prop absence of prenatal care*).
2,501–3,000 = (prop presence of prenatal care) < (prop absence of prenatal care).
> 3,000 = (prop presence of prenatal care) > (prop absence of prenatal care).
prop, proportion.

presence or absence of adequate prenatal care. In the lowest socioeconomic group, however, it was shown that a greater number of mothers of infants <3,000 g did not attend antenatal care, while the opposite was observed for babies weighing >3,000 g. It became clear that for this low socioeconomic group prenatal care was an important factor in obtaining favorable conditions for fetal growth.

Tables 11–13 show the distribution of birthweight according to maternal smoking habits and socioeconomic level. Analysis of the influence of smoking showed that in the low birthweight and inadequate birthweight categories there was a greater number of smoking mothers than non-smoking mothers. The opposite was true for

TABLE 11. *Distribution of birthweight according to maternal smoking habit*

Maternal smoking	Birthweight (g) ≤ 2,500 n	%	2,501–3,000 n	%	> 3,000 n	%	Total n	%
Yes	3,063	11.1	8,505	30.9	15,922	58.0	27,490	34.2
No	3,653	6.9	12,649	23.9	36,579	69.2	52,881	65.8
Total	6,716	8.4	21,154	26.3	52,501	65.3	80,371	100.0

Association test: calc χ^2 = 1,077.24; crit χ^2 = 5.99.
Contrasts study:
≤ 2,500 = (prop yes) > (prop no).
2,501–3,000 = (prop yes) > (prop no).
> 3,000 = (prop yes) < (prop no).
prop, proportion.

TABLE 12. *Distribution of birthweight in smoking mothers according to socioeconomic level (SEL)*

SEL	Birthweight (g) ≤ 2,500 n	%	2,501–3,000 n	%	> 3,000 n	%	Total n	%
1	28	5.5	125	24.4	359	70.1	512	1.9
2	190	7.7	621	25.1	1,664	67.2	2,475	9.0
3	2,845	11.6	7,759	31.7	13,899	56.7	24,503	89.1
Total	3,063	11.1	8,505	31.0	15,922	57.9	27,490	100.0

Association test: calc χ^2 = 141.14; crit χ^2 = 9.79.
Contrasts study:
≤ 2,500 = { (prop SEL 1) = (prop SEL 2) } < { (prop SEL 3) }.
2,501–3,000 = { (prop SEL 1) = (prop SEL 2) } < (prop SEL 3).
> 3,000 = { (prop SEL 1) = (prop SEL 2) } > (prop SEL 3).
prop, proportion.

TABLE 13. *Distribution of birthweight in nonsmoking mothers according to socioeconomic level (SEL)*

	Birthweight (g)							
	≤ 2,500		2,501–3,000		> 3,000		Total	
SEL	n	%	n	%	n	%	n	%
1	55	4.4	253	20.3	936	75.3	1,244	2.3
2	249	4.2	1,165	19.5	4,545	76.3	5,459	11.3
3	3,349	7.3	11,231	24.6	31,098	68.1	45,678	86.4
Total	3,653	7.0	12,649	24.1	36,579	69.9	52,881	100.0

Association test: calc χ^2 = 207.93; crit χ^2 = 9.49.
Contrasts study:
≤ 2,500 = { (prop SEL 1) = (prop SEL 2) } < (prop SEL 3).
2,501–3,000 = { (prop SEL 1 = prop SEL 2) } < (prop SEL 3).
> 3,000 = { (prop SEL 1) = (prop SEL 2) } > (prop SEL 3).
prop, proportion.

infants weighing >3,000 g. However, when these results were analyzed according to socioeconomic level it was shown that smoking habit did not appear to influence birthweight in the higher socioeconomic group. This suggests that the influences of smoking habits are somehow compensated for in higher social groups, perhaps by factors related to better economic conditions.

CONCLUSIONS

The findings of this study show that the main factors related to intrauterine growth in Brazil are:

1. Low socioeconomic conditions found in 86% of the population. The chronic effects of social deprivation can limit maternal weight and height, and hence affect birth size in the next generation.
2. Lack of prenatal care, affecting 18% of the population, particularly those of low social class (98% of the pregnant women in this particular group).
3. Smoking habits, particularly in the lowest socioeconomic group.

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