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THE INFLUENCE OF ECONOMIC DETERIORATION IN BRAZIL ON THE NUTRITIONAL STATUS OF CHILDREN IN RIO DE JANEIRO, BRAZIL

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Weight and height data were obtained from the clinic records for children from 0 to 60 months of age from a free, public health-post serving a *favela* (shanty town) community of 24,000 persons in Rio de Janeiro. Attendance during the first year of life was over 90%, but it fell to around 50% for the second year, and progressively toward a 30% annual consultation rate thereafter. In the first two years, over two thirds of children had their anthropometric indices duly recorded. This frequency also declined with age. The trend in prevalence of malnutrition in the clinic-users from 0 to 24 months was examined, using weight-for-age (Gomez), height-for-age and weight-for-height (Waterlow) as indicators. Deficits were found in up to 6% of the population. A severe economic deterioration affecting employment, family income and purchasing power accompanied by inflation occurred in the years following 1978, but no increase in anthropometric deficits was observed in the four years 1980 through 1983. Persistence of breast-feeding increased slightly during this period. The reasons for the lack of response of nutritional status of under-two-year-olds and the utility of using clinic record anthropometric data for nutritional surveillance are discussed.

KEY WORDS: growth, anthropometrics, height, weight, protein-energy malnutrition, economy, nutritional surveillance.

INTRODUCTION

Throughout Brazil, the government provides free a network of public health-posts. Services include infectious disease surveillance, prenatal and post-natal care of mothers, infant care, and vaccinations and general medical attention for patients of all ages and sexes. Monitoring of the growth and development of children is also a routine function of the health-post system (Almeida and Abrantes, 1983). The present study had three sequential objectives. The primary aim was to assess the frequency and reliability with which anthropometric data were obtained and duly recorded in the clinic records. This was done in the belief that a well-functioning system of data collection could be incorporated into a program for nutritional surveillance of the under-five-year-old population.

A second component of our study was a detailed, retrospective analysis of serial data on the nutritional status of children below five years of age, as measured by the anthropometric data in a health-post serving a shanty town (*favela*) population in

Rio de Janeiro. The worldwide economic recession of the first half of the 1980s had severe repercussions in the developing countries. The increasing burden of external financial debt has wrought a perceptible deterioration in the living standard of all sectors of the populations of debtor nations. Brazil presently has the largest external indebtedness of any developing country, and a measurable erosion of earning and purchasing capacity of the populace has occurred during this decade. Finally, we sought to use the health-post data to determine what reflection the economic reversals might have had in the prevalence of malnutrition during a 48-month period of notable deterioration in the economic situation of the nation as a whole.

METHODS

Population Studied

A single health-post of the Unidade de Treinamento Germano Sinval Faria (UTGSF) was selected as the base of operations for the study. It is located in the 10th Administrative District of the municipality of Rio de Janeiro. The 10th district had an estimated total population in 1980 of 254,952 inhabitants (IPLANRIO, 1984). It contains many slum areas with shanty towns (*favelas*) which have been established between the turn of the century and the 1940s. In 1980, about half of its population, that is 128,530 individuals, were classified as *favelados* (slum dwellers) by the city census bureau (IPLANRIO, 1984). The UTGSF health-post serves an area of 3 km^2; this area includes seven *favelas*, one residential area and an industrialized area. One-fifth of the population of *favelados* in the 10th district fall into the catchment area of our health-post base. In 1980, this population numbered about 24,000 persons and has grown at an estimated rate of 0.85% *per annum* since then (Gaspar, 1980).

The *favelas* are located on an open plain bordered by two rivers. The rivers are polluted with wastes from the sewages of the population and with industrial run-off from factories along the shores. Houses in the shanty town are substantial and permanent, with electrical current and intradomiciliary running water. The supply of water, however, is intermittently suspended, sewage disposal is precarious, and garbage collection is irregular.

The global population of interest were the children from 0 to 60 months of age who received a medical visit and/or a routine immunization between November 1, 1979, and October 30, 1983, a period of 48 consecutive months. Although there is a two-month overlap to the previous calendar year, the clinic visits from November 1, 1979, to October 31, 1980, have been designated as "1980," those from November 1, 1980, to October 31, 1981, as "1981," and so on. Although an official edict mandated the collection of weight and height information at clinic visit by children in this age range, the data recording has been inconsistent and anthropometric information was missing for some children. These individuals were excluded from subsequent analyses.

Anthropometric Indices

The principal data were the height (in cm) and the weight (in kg) as obtained from the clinic records for the children of 0 to 60 months of age who had a medical examination or vaccination at the health-post during the 48 months' interval. The data had been obtained and recorded by various members of the health-post staff.

They received initial specialized training in the procedures and techniques of anthropometric determinations and had retraining and restandardization on an annual basis. Birthweights are not included in our data sample.

Weights for children who would not stand were taken with the child seated on a Filizola infant scale wearing only a cotton shirt. Children who could stand without assistance were weighed fully clothed without shoes on a Filizola standard balance graded in divisions of 10g. The length of children who could not stand was measured in the recumbant, supine position on a plain table with a headboard. A metallic tape-measure was affixed to the headboard, and the supine length to the heels was measured by the anthropometrist with the assistance of the mother using the free end of the tape-measure. Children who could stand also had a determination of supine length, but performed with a more conventional anthropometric table with a fixed headboard and an adjustable heelboard. These instruments and procedures were in operation throughout the entire 48-month period.

The data were related to the height and weight standards of the United States National Center for Health Statistics (NCHS) in accordance with the recommendation of the World Health Organization (WHO, 1981; Waterlow *et al.*, 1977). It was felt that the national Brazilian reference standards (Marques *et al.*, 1975; Marcondes *et al.*, 1971) did not fulfill the criteria for a growth standard (Knight, 1979; FINEP, 1980; MPAS, 1983). The data were transformed into weight-for-age (Gomez *et al.*, 1956), height-for-age and weight-for-height (Waterlow, 1972). Although the Gomez classification does not distinguish between low weight due to long-term stunting versus short-term wasting (Monteiro and Rea, 1977; Gueri, Gurney and Jutsum, 1980), it is still a widely used classification tool for detecting children at risk (Acciari *et al.*, 1977).

Child Alimentation

In addition to the anthropometric items, data on the type of alimentation received during the first nine months of life were obtained from the clinic records. This information had been obtained on the dates of immunization or on other visits to receive attention at the health-post through the first nine months of life. We calculated the number of children reportedly receiving *some maternal milk* in the diet at each age.

Additional Data

We also noted and included in our data set for each visit the reason for having consulted the UTGSF health-post as recorded in the clinic records by the health-post staff.

Data Processing and Analysis

Data were processed at the computer center of the Federal University of Rio de Janeiro. The anthropometric data were processed and analysed using computer software developed by the Center for Disease Control of the U.S. Public Health Service for use in the evaluation of the adequacy of nutritional status of children (Staehling, 1978). Findings in anthropometric classification analyses were expressed as the percentage of the population studied (population with complete data sets entered) falling below a cut-off percentage specified as the median value of the NCHS reference population standards.

Tests of specific derivative subhypotheses were performed. Since groups were of unequal sizes in different yearly attendance groups — age-specific and total — we used the Chi squared test and/or the student T test for independent samples, accepting in both instances, a probability at a level of 5% as indicative of statistical significance. Some bias in the sample was also accepted because the same individual might be included in more than one year. The trend in breast-feeding persistence was tested first by treating time-dependent frequency as an exponential "decay" curve and determining the "best-fit" equations. All statistical tests were done by the statistical package of Hewlett Packard HP 97.

RESULTS

Coverage of Population by Health-Post

As shown in Table I, a total of 9,883 child visits of children from 0 to 60 months of age occurred during the 48 months of study. It should be remembered that only the *first* visit of any study-year on which a set of anthropometric indices were recorded — or *could have been* collected but were not — were included in our analysis of population coverage. Thus, the data in Table I *under*reports the total number of consultations at the UTGSF health-post for children up to age 60 months in any given year.

The completeness of coverage for the target age-group in the catchment area of the health-post has been determined as the ratio of the different children attending to that of the total number of children of a specific age estimated to be living in the target area according to available census data (IPLANRIO, 1984). A yearly adjustment of the denominator for a 0.85% population growth rate in the community was included. Expressed as efficiency ratios, the attendance rate approached nearly 100% of the children born and registered in the six *favelas* under study in the first year of life. This attendance rate fell to below 50% in children beyond the first year of life.

TABLE I
Percentage of population covered by the service of the Unidade de Treinamento "Germano Sinval Faria" — U.T.G.S.F.[a] in Rio de Janeiro, Brazil

Age in months	1980		1981		1982		1983	
	Coverage ratio and rate (as percentage)							
0-12	865/946[b]	(91)[c]	936/954	(98)	960/962	(99)	922/970	(95)
13-24	393/856	(46)	469/863	(54)	401/870	(46)	378/877	(43)
25-36	335/814	(41)	319/821	(39)	386/828	(47)	345/835	(41)
37-48	300/727	(41)	279/733	(38)	269/739	(36)	330/745	(44)
49-60	242/772	(31)	256/779	(33)	281/786	(36)	254/793	(32)
Total	2135/4115	(52)	2259/4150	(54)	2238/4185	(55)	2229/4220	(53)

[a]Not included are the industrial sector and the Perereca slum area.
[b]Coverage ratio constituted. The numerator represents child-visits (first per year) from the clinic record and the denominator represents the total number of children in the population as estimated from birth registrations and census bureau (IPLANRIO) records, assuming an annual growth rate of 0.85%.
[c]Coverage rate as a percentage of first child-visits over eligible population.

Collection and Recording of Anthropometric Data at Health-Posts

Somewhat less than two-thirds of all attending children, however, had anthropometric data during a consultation at the health-post in each of the study years (Table II), contributing to a further reduction in the capture of data. Thus 6,375 child visits throughout the entire age-range had anthropometric entries made in their clinic records. The number of children attending the clinic with missing height and weight data augmented with increasing age. The efficiency of completing the anthropometric examination was highest in the population below 24 months of age. Thus, for the later evaluation of interaction of nutritional status with economic trends, only 4,392 child-visits were accompanied by height recordings in the charts in children from 0 to 2 years of age in our sample. Ninety-eight of these children had a stature of less than 49 cm, below the trigger-level threshold in the computer program (Staehling, 1978) to calculate wasting indices.

It should be noted that general coverage of the whole population with respect to regularity of anthropometric assessment improved in the last two years of the study period, namely in 1982 and 1983. Moreover, direct observation in the health-post by one of the authors (M.S.) was made in the last three months of 1984, one year after the termination of new data enrollment. It was confirmed that the procedures for anthropometric measurements were still being performed as prescribed in the Methods section.

Anthropometric Status of the Population

For our assessment of the prevalence of deficits in anthropometric indices, the faltering attendance rate (Table I), combined with diminished frequency of height and weight measurements with age (Table II), forced restriction of the examination of the subpopulation from 0 to 24 months. In these analyses, data for both sexes have been combined. The main data for height/length (in cm) and weight (in kg) by age group for the entered 4,932 child-visits is shown in Table III. By T test, there were no statistical differences across the years 1980 through 1983 for every age group.

TABLE II

Percentage of population covered by the anthropometric survey of Brazilian infants attending public health clinics[a]

Age in months	1980		1981		1982		1983	
	Coverage ratio and rate (as percentage)							
0-12	785/946[b]	(83)[c]	870/954	(91)	909/962	(94)	890/970	(92)
13-24	218/856	(25)	238/863	(28)	253/870	(29)	273/877	(31)
25-36	118/814	(14)	98/821	(12)	165/828	(20)	198/835	(24)
37-48	75/727	(10)	56/733	(8)	113/739	(15)	194/745	(26)
49-60	31/772	(4)	51/779	(7)	106/786	(14)	124/793	(16)
Total	1227/4115	(32)	1313/4150	(32)	1546/4185	(37)	1679/4220	(40)

[a]Not included are the industrial sector and the Perereca slum area.

[b]The numerator represents the child-visits (first per year) from the clinic record. The denominator represents the children in the population from birth registrations and cenus bureau (IPLANRIO) records, assuming annual growth rate of 0.85%.

[c]Coverage rate as a percentage of first child-visits over eligible population.

TABLE III
Mean heights and weights by age-groups in Brazilian health-post clinics for 4,932 children (visits) from 1980 through 1983

Age in months		Height and weight 1980 (cm)	1980 (kg)	1981 (cm)	1981 (kg)	1982 (cm)	1982 (kg)	1983 (cm)	1983 (kg)
0-3	x̄	54.5	4.26	54.2	4.40	53.5	4.38	51.8	4.41
	sd	3.1	0.74	3.1	0.76	3.1	0.97	3.6	0.72
4-6	x̄	62.9	6.73	63.0	6.84	64.0	6.67	62.5	6.91
	sd	3.3	1.01	3.8	1.09	3.9	1.00	3.3	1.04
7-9	x̄	68.8	8.39	67.8	8.33	66.7	8.12	67.9	7.93
	sd	3.2	1.15	3.1	1.09	4.5	1.40	3.4	1.31
10-12	x̄	73.1	9.10	72.3	0.05	71.8	9.00	70.2	8.78
	sd	4.2	1.27	3.7	1.32	3.6	1.48	3.6	1.20
13-24	x̄	78.8	10.44	77.4	10.35	79.0	10.52	78.5	10.51
	sd	4.6	1.40	4.4	1.49	4.1	1.42	4.2	1.44
Total	x̄	64.5	6.92	63.5	7.00	63.6	6.73	63.9	7.06
	sd	5.6	1.02	3.5	1.11	2.9	1.04	3.4	1.01

The Gomez classification for the population is presented in Table IV. The overall percentage of under-two-year-olds with second or third degree malnutrition, that is with a weight-for-age adequacy of $< 75\%$, was 5.1% in the 4,932 child-visits analysed over 48 months using the Gomez classification. Descriptive data (by age-groups) for the Waterlow classification system is shown in Table V. Some 1.8% of recordings in the target age-group of under-two-year-olds revealed a deficit in weight-for-height (wasting) (n=4,834). A 5.7% prevalence of height-for-age deficits, or stunting, was observed in the 0 to 24 months group (n=4,932). The annual frequency for anthropometric deficits from 1980 through 1983 is presented in Table VI. The time-dependent trends were analysed by χ^2 analysis of the underlying numerical ratios. For Gomez score and stunting, no time-dependent trend was observed. The abrupt fall in the degree of wasting, from 2.0% to 2.5% in the first three years, to 0.7% in the last year, was significant ($p < 0.05$). But it represents a change *opposed* to what could be expected from deterioration of economic conditions (Tables VII and VIII) which were aggravated with time.

Pattern of Infant Feeding

Focusing on the subgroups of attending children up to nine months of age in each study year's immunization cycle, we find the patterns illustrated in Figure 1. By "best fit" modeling of the curves for exponential equations, we found an expression of 4=123e−0.38x for the 1980 curve and 4=135e−0.31x for 1983. These patterns are distinctly nonidentical. Moreover, by χ^2 analysis, an interyear difference of statistical significance was found ($p < 0.05$).

TABLE IV
Distribution by the Gomez classification of a sample of 4,834 Brazilian children attending government health-post clinics

Age in months	Number and percentages							
	Normal > 90.0%		1st Degree 75.0-90.0%		2nd Degree 60.0-74-9%		3rd Degree < 60.0%	
0-3	1689[a]	(78.2)[b]	361	(16.7)	93	(4.3)	16	(0.7)
4-6	509	(82.5)	84	(13.6)	20	(3.2)	4	(0.6)
7-9	509	(79.9)	104	(16.3)	13	(2.0)	11	(1.7)
10-12	339	(74.7)	93	(20.5)	16	(3.5)	6	(1.3)
13-24	667	(62.6)	326	(30.6)	60	(5.6)	13	(1.2)
Total	3713	(75.3)	968	(19.6)	202	(4.1)	50	(1.0)

[a]Number in respective age-group so classified.
[b]Percentage of total age-group so classified.

TABLE V
Number and percentage of Brazilian children attending health clinics who were below the conventional cut-off points for two indicators (weight/height and height/age) by the Waterlow classification

Age in months	Ratio and percentage of children			
	Weight-for-height < 80.0% wasting	(N=4,834)	Height-for-age < 90.0% stunting	(N=4,932)
	n	%	n	%
0-3	42/2061[a]	(2.0)[b]	107/2158	(5.0)
4-6	8/617	(1.3)	33/617	(5.3)
7-9	6/637	(0.9)	29/637	(4.6)
10-12	8/453	(1.8)	25/454	(5.5)
13-24	24/1066	(2.3)	86/1066	(8.1)
Total	88/4834	(1.8)	280/4932	(5.7)

[a]Ratio in which numerator represents children in age-group classified as wasted or stunted and the denominator represents children with the appropriate measurements recorded.
[b]Percentage of total sample with wasting or stunting.

DISCUSSION

The primary concern of this study was with the status and wider applicability of the data derived from routine collection of height and weight measurements in children under five years of age living in selected *favelas* of Rio de Janeiro and voluntarily attending a free, public community health-post. It was established by direct observation that the prescribed methods and procedures for obtaining the measurements were being followed, but the retrospective nature of the study design precludes any direct assessment of the accuracy and precision of the determinations themselves.

Coverage of the population is a function both of the spontaneous and voluntary consultation by the populace, and of the regularity with which the anthropometric data were recorded. We found that, as expected, attendance was highest in infancy,

TABLE VI
Prevalence of deficits in anthropometric standards of Brazilian infants from birth to 24 months attending health clinics

	Prevalence in percent of total population			
	1980	1981	1982	1983
Prevalence of second and third degree malnutrition (Gomez classification by weight-for-age deficit)[a]	5.2	5.3	5.3	4.7
Prevalence of wasting (Waterlow classification by weight-for-height deficit)[b]	2.1	2.0	2.5	0.7[c]
Prevalence of stunting (Waterlow classification by height-for-age deficit)[a]	5.4	4.9	6.0	6.4

[a]Based on N=4,932, the two-year-olds and under on whom height and weight data were recorded.
[b]Based on N=4,834, the two-year-olds in whom weight and height were recorded but whose heights fell between 49 cm and 101 cm in girls, or between 49 cm and 103 cm in boys. The computer program used to classify subjects excluded all individuals with height values below these limits.
[c]Statistical significance of difference ($p < 0.05$).

when mothers take advantage of the services of well-baby care and immunization; rates of attendance fall off sharply thereafter. Over the four-year period of study, however, there was a notable trend toward increased participation with older children. It is a matter of speculation how much the level of participation was modulated by the economic recession itself, which presumably made *free* services more attractive than medical services for fee. Other factors such as increased public consciousness or confidence in the UTGSF center might have played a role. It is also unknown how much further the level of participation can be raised; but given the present burden of work borne by the staff of the health-post, increasing participation merely for the secondary benefit in anthropometric data collection is of dubious merit.

Within the health-post operation, a progressive improvement in the regularity with which anthropometric data were entered into the clinic records was observed, especially during the last two years of the study period. This was a promising development, but a much greater collection rate, approaching 100%, could theoretically be achieved with appropriate motivation of the staff. An official directive requiring anthropometric measurements was passed down prior to the beginning of our study period. In practice, factors such as time pressures on the staff, the nature of an individual patient's consultation, etc., may influence the probability that weighing and measuring will take place at a given visit. It is already clear that *age* is a factor, and an effort should be made to emphasize to the staff the importance of completing anthropometric measurements in the three- to five-year-olds as well. Clearly, the data demonstrate a small, but finite, occurrence of serious malnutrition in the marginal slumdwellers (Tables III-V) of the *favelas* of Rio de Janeiro. The degree to which the data collected routinely would make useful contributions to systems of nutritional surveillance of the urban poor depends on other considerations to be discussed below.

It was not unreasonable to assume that the families of the children in the *favelas* served by the UTGSF health-post in the 10th district of Rio were experiencing economic adversity during the 48 months of observation. This cannot be based on

TABLE VII
Variation in labor and monetary cost of living in the municipality of Rio de Janeiro from 1978 through 1983

Date	Working time necessary per month to purchase individual food-basket ration[a] (hours)	Index relative to 1978	Cost individual foodbasket ration[b] (Cruzeiros)	Index relatative to 1978	Minimum wage[c] (Cruzeiros)	Index relative to 1978	Cost of food-basket as a percentage (%) of minimum wage	Real minimum wage index relative to 1978
Dec. 1978	96.6	100	619	100	1539	100	40.2	100
Dec. 1979	132.2	137	1316	212	2387	155	55.1	73
Dec. 1980	133.3	138	2499	404	4500	292	55.5	72
Dec. 1981	115.0	119	4379	707	9144	594	47.9	84
Dec. 1982	122.1	126	9241	1493	18172	1181	50.9	79
Dec. 1983	171.2	177	28197	4555	39524	2568	71.3	56

[a]Individual foodbasket ration is the amount of foodstuffs to satisfy the monthly intake needs of an adult Brazilian, as defined by the law decree 339, 30.4.38.

[b]Based on estimates of median price for foodstuffs of the municipality of Rio Je Janeiro, as published by the Getúlio Vargas Foundation of Rio de Janeiro in October, 1983.

[c]Minimum wage for the municipality of Rio de Janeiro. Source: Getúlio Vargas Foundation of Rio de Janeiro (October, 1983).

TABLE VIII
Family income distribution in the urban municipality of Rio de Janeiro (1980 to 1983)[a]

Minimum wages	Families	1980	1981	1982	1983
1/2	N	47,506[b]	80,680	140,177	99,180
	%	(1.7)[c]	(2.6)	(4.4)	(3.0)
1/2 – 1	N	176,138	324,081	457,436	347,781
	%	(6.1)	(10.6)	(14.4)	(10.5)
1 – 2	N	532,292	697,054	819,830	798,354
	%	(18.3)	(22.8)	(25.8)	(24.2)
2 – 5	N	1067,968	1090,289	988,338	1065,346
	%	(36.8)	(35.6)	(31.1)	(32.3)
5 – 10	N	559,667	399,855	350,704	482,672
	%	(19.3)	(13.1)	(11.0)	(14.6)
10	N	447,135	313,806	277,325	354,469
	%	(16.0)	(10.2)	(8.7)	(10.7)
Without income	N	40,530	140,843	128,090	128,746
	%	(1.4)	(4.6)	(4.0)	(3.9)
Without declaration	N	31,658	15,918	18,581	21,678
	%	(1.1)	(4.6)	(0.6)	(0.7)
Total	N	2902,894	3062,526	3180,481	3298,220
	%	(100.0)	(100.0)	(100.0)	(100.0)

[a]Source: Pesquisa Nacional por Amostra de Domicílios (PNAD) 1981, 1982, 1983 by Instituto Brasileiro de Geografia e Estatística (IBGE) Cenus Demogr. 1980 (IBGE).
[b]Total number of families living in uban municipality of Rio de Janeiro in specified year.
[c]Percentage of families of Rio de Janeiro with corresponding level of income.

direct, household economic survey data, of course; such data were *not* available from health-post clinic records. Our assumption is based rather on the global statistics on economic trends and changes in purchasing capacity derived from and for the Rio de Janeiro population as a whole. The 10th district is an impoverished part of that whole, and the likelihood it existed as a protected island, untouched by the general malaise, is remote indeed.

A retrospective analysis of key economic indicators from 1974 through 1978 revealed that the minimum wage had kept pace with the cost of food rations, with the adjusted minimum-wage-index remaining stable between 2.37 and 2.49; during that time, the individual cost of rations was 40 to 42% of the minimum wage. A precipitous change in the economic well-being of the population of Brazil as a whole, and of Rio de Janeiro in particular, began around 1978. Using the 1978 level as a standard, the cost of rations increased 45-fold through 1983 (Table VII), while the minimum wage rose by only 25-fold. Real disposable income, as reflected by the minimum-wage-index, fell from 2.49 to 1.40, and the cost of a family's basic food-basket represented 71.3% of the minimum wage by the close of the study period. Over this same interval (Table VII), economic recession had a profound effect on household income distribution within the municipality of Rio de Janeiro.

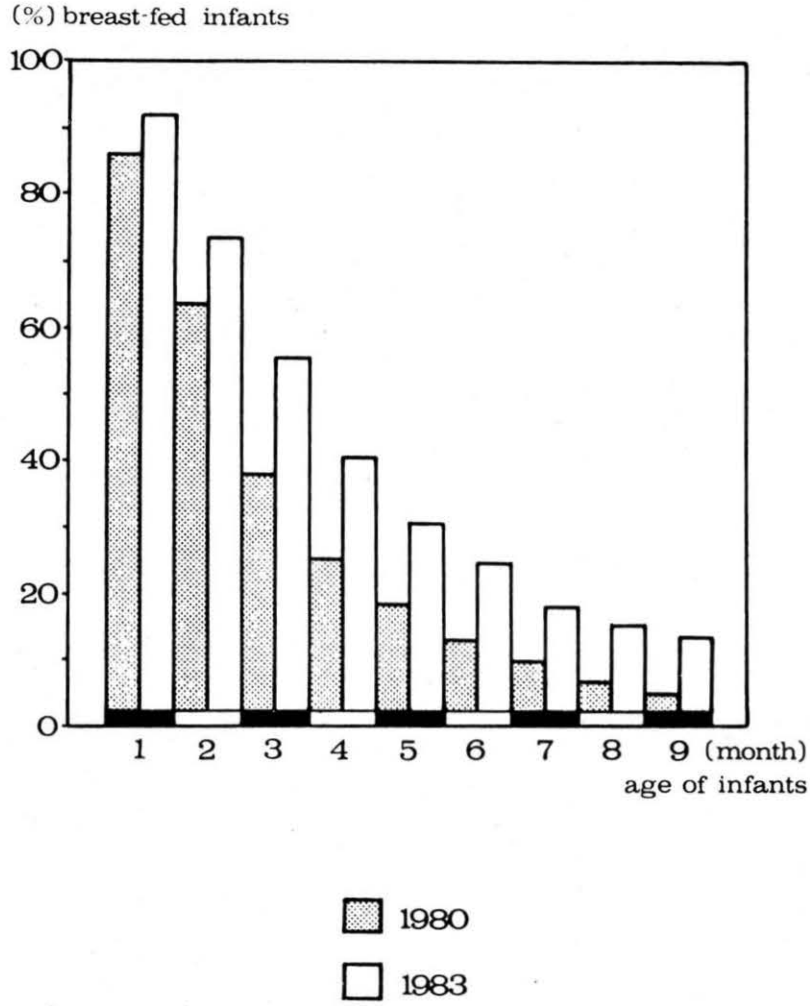

FIGURE 1 The histogram distribution of infants, seen at the health-post, reporting *some* amount of dietary intake as breast milk. The data are distributed by age in months for 1980 (shaded bars) and 1983 (open bars).

The percentage of families earning less than twice the minimum wage increased from 26.1% in 1980 to 37.7% in 1983. Over the same period, families without incomes increased three-fold, from 1.4 to 3.9% of all households.

The juxtaposition of these city-wide economic trends and the portrait of nutritional status derived from the routinely collected data in the 10th district health-post is not at all straight-forward. Overall, one would have to conclude that the economic disruption did not alter the frequency of malnutrition following either the Gomez or the Waterlow diagnostic criteria. As reviewed by Valverde *et al.* (1981), the study of the influence of family income on anthropometric measurements in children from developing nations has led to inconsistent findings. An apparent relationship of family income to preschool children's growth was found in

Ethiopia (Dodge and Demeke, 1970) and Nigeria (Janes, 1974), but not in Mexico (Chávez *et al.*, 1978). In none of these studies, however, was a *change* in income the paradigm under consideration.

One explanation for our finding of no effect of economic deterioration, remote possibility indeed, is that the populace of the *favelas* of the 10th district had somehow been impervious to the overall downturn in the municipality of Rio de Janeiro. Another is the existence of an age-specific vulnerability. The pattern of participation by mothers and of examinations by the staff of the health-post excluded most of the children over 24 months in the catchment area from coverage. Our data analysis on nutritional status indicators has been confined to under-two-year-olds (Tables III-V). In the study by Valverde *et al.* (1981) of the families of rural Guatemala coffee workers, household income was most predictive of the nutritional status of children aged 30 to 60 months. Children below this age exhibited little influence on their anthropometric indicators from family income. In light of this, we evaluated our data on malnutrition prevalence in the *favela* children from 25 to 60 months in our health-post sample. The inconsistency of coverage makes this admittedly a less robust observation, but as in the younger groups, no change in anthropometric indices with time was found in these older attendees either (data not shown).

However, an age-dependent explanation of the non-effect of economic deterioration on our study population from 0 to 24 months (as well as that of Valverde) only begs the questions of why the nutritional status of this youngest segment of the preschool population is apparently protected against economic adversity. Given their higher nutrient requirements and their rapid growth velocity, this age-group would be expected to be, *biologically*-speaking, more vulnerable than their older siblings. A possible explanation rests in the notion of the operation of a homeostatic regulatory mechanism and a series of buffering factors in the determination of growth in the first two years of life, and perhaps well beyond.

The nature of such a homeostatic process is illustrated in hypothetical schematic form in Figure 2. Curve "a" represents a response in anthropometric deterioration that might logically be expected to occur in an unbuffered, steady-state situation when the impact of economic deprivation, that is, the negative forces of the 1980 to 1983 period, reached the family of the index child below two years of age. However, various modulating or buffering factors could postpone the deterioration in a child's nutritional status in the face of economic adversity. Thus, a set of "b" curves, displaced to the left, represent the operation of homeostatic regulatory factors tending to maintain the child's anthropometric status.

In the face of a budget deficit within the household, the family may respond by purchasing less expensive commodities, may alter distribution of food among family members, and/or may increase even further the proportion of the budget spent on food. At the level of the index child, a biological adaptive response might include the reduction of energy expenditure (Chávez and Martínez, 1984; Viteri and Torun, 1981) or increasing the efficiency of nutrient utilization (Suknatme and Margen, 1982), or both. External factors, planned or unplanned, impinging on the *favela* community, such as improved sanitation, programs promoting child-spacing, government food subsidies, etc., may also act as buffers. Even the health-posts programs themselves — immunizations, treatments of infections, nutrition and hygienic education, and breast-feeding promotion — might help the under-two-year-old to weather the effects of increasing monetary contraction. In this context of adaptation, the longitudinal trend in persistence of breast-feeding (Figure 1) merits discussion. The prolongation of breast-feeding could have represented a

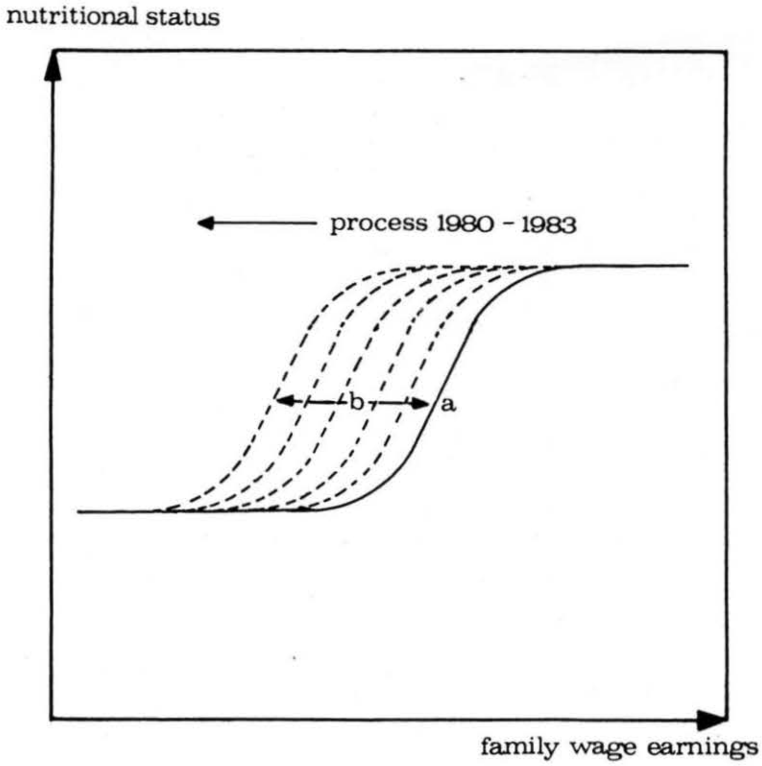

FIGURE 2 Hypothetical model of homeostatic reaction of nutritional status of children of an urban community considering a decrease of family wage earnings without (a), and with (b) health interventions.

response to the decreasing household purchasing power, whereby mothers sought to decrease expenditures by providing maternal nutrition. Mata (1978) has shown that the real costs of additional food for the mother are less than those for commercial infant formulas. Thus, the most viable explanatory hypothesis for the failure of a recognizable impact of the Brazilian economic trauma of the early 1980's on prevalence of anthropometric deficits in *favela* children below two years of age is some combination of individual, family and community adaptations.

Our initial objectives proposed to explore a linkage of routinely collected anthropometric data from health-posts serving the poor to nutritional surveillance. Would not the cataclysmic deterioration of the economic fabric in Rio de Janeiro in the 1980's represent a model of a situation requiring vigilance? Clearly, as demonstrated both by the hard data and embodied in the foregoing discussion of homeostatic regulation, caution must be exercised in relying on measures of weight or height — routinely collected or otherwise obtained — to monitor the environmental determinants of nutritional decline. The data recorded in the health center appear to have been collected in the prescribed manner, and coverage and regularity could theoretically both be improved. The findings reveal a small prevalence of severe malnutrition. It is unlikely, however, that changes in this prevalence would be a sensitive enough monitor for any pre-alert warning system for impending nutritional risk. The risk factor came in force to Rio de Janeiro and remained, but during four years, the anthropometric indicators failed to signal the alarm. Undoubtedly, some indicator — perhaps a functional index of nutritional status (Beaton, 1983) — could have been found which changed, if not with a direct, linear unbuffered trajectory relative to economic deterioration, at least which moved *earlier* in the course. For a surveillance program, such an indicator would seem to be of far greater utility than anthropometric ones.

In conclusion, our inquiry revealed insights not only into the availability of anthropometric measures on a population of voluntary users of a health center serving a *favelado* community, but also on the intrinsic responsiveness of this index to an adverse economic situation. The limitations of not having direct intrahousehold economic data restrict comparison of our data to other related studies such as that of Valverde *et al.* (1981) in Guatemala. Adaptation by young (0 to 24 months-old) children, their families and their communities are all probably important facts of life of which anthropometricians should be acutely aware when projecting the potential of weight and height determinations to relate to or warn of deteriorating economic conditions in a community.

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