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Low Birth Weight Babies under Village Conditions : Feeding Pattern, Growth and Motor Development

by

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Abstract

Feeding, growth and motor development of low birth weight babies (LBW) were assessed among infants born from September 1982 through December 1984 in 3 villages in Madura. Mean birth weight of Madurese infants ranged from 2850 - 2950 g and the incidence of LBW from 9.5 - 12.2 %. A larger percentage of the very small LBW babies (birth weight 2.0 - 2.2 kg) received breastmilk as the sole food in the first 6 months. Yet, force-feeding was also practiced for LBW babies. Infants remained in their growth channel according to birth weight, however, relative to the NCHS centiles at birth, LBW infants grew better in the first 6 months than normal birth weight (NBW) infants. Growth deteriorated conspicuously in the second half of infancy, irrespective of birth weight. There was no difference in motor development between LBW and NBW infants. Once they had survived, LBW infants appeared to do as well as NBW under village conditions.

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Introduction

Low birth weight (LBW = weight at birth less than 2500 g) is a major public health problem in developing countries (WHO, 1984). If an LBW incidence above 10% is suggestive for a large number of growth retarded newborns (Villar and Belizan, 1982), such a situation likely exists in Indonesia (Bernard et al., 1980; Alisyahbana et al., 1983; Kardjati et al., 1988). The higher mortality risk of LBW babies is well-known (Bergner and Susser, 1970; Bhargava et al., 1979; McCormick, 1985; Hermansen and Hasan, 1986; Arora et al., 1987). The long-term effect of LBW on postnatal growth and development will obviously vary according to the level of infant care, feeding practices and environmental conditions. An extensive literature search on the future growth and fate of LBW infants disclosed only a few from developing countries and these covered very short follow-up periods (Hofvander, 1982). To our knowledge no published information is available from Indonesia. In this publication the preliminary results are presented of a prospective, longitudinal study on infant nutrition and growth in Madura.

Materials and methods

An experimental study was started in August 1981 in 3 villages in Madura and continued till December 1985 to assess the relationship between maternal nutrition during pregnancy and birth weight (Kardjati et al., 1988), breast milk output (Steenbergen et al., 1989), infant survival (Kusin et al., 1989) and postnatal growth. The sample used for this investigation concerns all singleton infants, born from September 1982 through December 1984. They were scheduled to be examined from birth to 12 months of age. In one village the field study was terminated in December 1983. Hence, only a small number of babies from this village had been examined throughout infancy. Home visits were made within 24 hours after birth, weekly in the first month and 4-weeks thereafter. Feeding practices were recorded by a 24-hour recall method. Mothers were also interviewed about the infant's motor development. Weight was measured with a salter scale to the nearest 50 g and length with a locally made length board to the nearest 0.1 cm.

Coverage

Under village conditions growth monitoring is not always acceptable to mothers and complete coverage is impossible, particularly in a longitudinal study. A total of 741 single births were born in the study period. Birth weight could be measured in 687 newborns (93%). The unknown birth weights were due to stillbirths (N = 20) and refusals (N = 34). In this sample coverage in the first month of age was 91% (N = 620) for weight and 85% (N = 582) for length. A total of 561 newborns could be observed up to the age of 12 months. About 76% had at least 7 measurements in weight and about 65% in length over the period of infancy. Drop-outs can be attributed to infant deaths (12%), migration and refusals.

Results

Feeding pattern

Figure 1 shows the type of foods given to the infants. A very small percentage of infants were exclusively breastfed as force-feeding from as early as the first week after birth as is traditionally practiced. The 15% or so recorded as given only breast milk in the 12 months, were not necessarily the same infants. After the age of 24 weeks, the majority were infants who returned to the breast temporarily because they refused any other food. Mashed "nasi-pisang" (rice + banana) was the first infant food. It was gradually replaced by "nasi-lontong" (soft boiled rice). "Tajin" (rice gruel) was only given to about 5% of the infants. Part of the family diet, of which the staple food was "nasi-jagung" (rice + maize) was introduced late : about 30% had it by the age of 52 weeks. Mother appeared to feed the small babies differently. More babies with a birth weight of 1.8 - 2.2 kg were exclusively breastfed and for a longer period. Additional foods were "tajin" (rice gruel) in the first weeks, complemented with "nasi-pisang" or "nasi-lontong". There was no clear difference between birth weight cohorts 2.3 - 2.4 kg and 2.5 kg or more. "Nasi pisang" was the food of choice at early infancy, gradually being replaced by "nasi-lontong". It is interesting to note that other foods, usually biscuits or bread were only given to bigger infants (Figure 2).

Growth in the first month

Birth weight was on average 2951 grammes. Table 1a illustrates the average weight increments in the first 4 weeks by birth weight cohort. There was a distinct inverse relationship with birth weight. Light babies gained weight immediately after birth, while heavy babies gained less or even lost weight. Over the 4 week periods babies with a birth weight less than 2.5 kg (LBW) relatively tended to catch-up the normal birth weight (NBW) babies (Table 1b). Table 2 shows that babies who were undersized in weight at birth were also shorter and they had a smaller head circumference. The median Ponderal Index (weight in grammes/length in cm × 100) of normal birth weight healthy babies is 2.50 (Miller and Hassanein, 1971). The values of Madurese infants were particularly low in the birth weight categories below 2.7 kg. Length increment between week 1 and 4 did not differ as much by birth weight cohort as weight increments, although the tendency was similar.

Growth between 4-52 weeks

On average babies remained in their growth channel for weight as well as length (Figures 3-4). At 48-51 weeks, the mean weight for birth cohorts 2.0 - 2.2 kg, 2.3 - 2.4 kg, 2.5 - 2.6 kg, 2.7 - 2.8 kg and 3.1 - 3.2 kg were 7460 g, 7690 g, 7855 g, 8165 g and 8320 g respectively. The corresponding values for mean length were 68.4 cm, 69.4 cm, 69.5 cm, 70.2 cm and 70.9 cm. Towards the end of infancy attained weight and length of babies with a birth weight of 2.9 kg or more were comparable. A better illustration of the growth process of LBW and NBW infants is by plotting weight- and length-for-age against the third, twentieth and fiftieth centiles (P3, P20, P50) of the NCHS reference (Figures 5-6). There was a distinct catch up growth in LBW infants during the first 20-27 weeks, in weight as well as in length, in NBW infants the magnitude of accelerated weight gain was far less than in LBW infants while the length curve deviated before the 8th week. In the second half of infancy both groups faltered in weight and length growth, but the deflection from the reference level at birth was much more severe in NBW infants.

Motor development

A crude assessment of motor development was made by interviewing mothers about what the infant could already do. No specific examinations were done. The variation in milestones was large and there were minor differences between LBW and NBW babies (Table 3).

Table 1a : *Mean weight increments (g per week) in the first 4 weeks by birth weight categories*

Birth weight category (kg)	N	Birth weight (g)		Weight increment, g per week				Weight increment, g. 0 - 4 week
		Mean	SD	0–1 wk	1–2 wk	2–3 wk	3–4 wk	
<2.0	5	1840	89	50	165	185	198	598
2.0 - 2.2	22	2105	68	133	141	250	282	806
2.3 - 2.4	29	2359	60	161	213	240	236	850
2.5 - 2.6	101	2572	60	103	220	208	238	769
2.7 - 2.8	103	2776	53	70	212	198	252	732
2.9 - 3.0	168	2980	44	75	186	192	225	678
3.1 - 3.2	119	3169	49	21	204	224	228	677
3.3 - 3.4	59	3353	52	-30	174	229	241	614
≥3.5	61	3657	161	-45	171	180	273	579
ALL	667	2951	385	55	196	209	240	700

Table 1b : *Weight increments (g per week) in the first 4 weeks as percentage of birth weight by birth weight categories*

Birth weight category (kg)	N	Birth weight (g)		Weight increment, (% of birthweight)				Weight increment (% of birhtweight)
		Mean	SD	0–1 wk	1–2 wk	2–3 wk	3 –4 wk	
< 2.0	5	1840	89	2.7	9.0	10.1	10.8	32.5
2.0 – 2.2	22	2105	68	6.3	6.7	11.9	13.2	38.3
2.3 – 2.4	29	2359	60	6.9	9.1	10.2	10.0	36.0
2.5 – 2.6	101	2572	60	4.0	8.6	8.1	9.2	29.9
2.7 – 2.8	103	2776	53	2.5	7.6	7.2	9.1	26.4
2.9 – 3.0	168	2980	44	2.5	6.3	6.4	7.6	22.8
3.1 – 3.2	119	3169	49	0.7	6.4	7.1	7.2	21.4
3.3 – 3.4	59	3353	52	–0.9	5.2	6.8	7.2	18.3
≥ 3.5	61	3657	161	–1.2	4.6	4.9	7.5	15.8
ALL	667	2951	385	1.9	6.6	7.1	8.1	23.7

Table 2 : *Length, length increment, Ponderal Index and head circumference in the first 4 weeks by birthweight categories*

Birth weight category (kg)	N	Length at 1 week (cm)		Length-increment week 1– 4		Ponderal index at week 1		Head circ. at week 1 (cm)	
		Mean	SD	mean (mm)	as % of week 1	mean	SD	mean	SD
< 2.0	5	45.1	1.6	17	3.8	2.06	0.30	32.0	4.2
2.0 – 2.2	18	45.6	2.9	23	5.0	2.36	0.30	32.0	2.3
2.3 – 2.4	29	48.2	1.9	28	5.8	2.25	0.20	33.3	1.2
2.5 – 2.6	88	48.3	1.9	26	5.4	2.40	0.24	33.6	1.3
2.7 – 2.8	94	48.9	1.8	28	5.7	2.45	0.26	33.9	1.6
2.9 – 3.0	147	50.3	2.2	25	5.0	2.43	0.37	34.7	1.4
3.1 – 3.2	110	50.4	1.9	28	5.6	2.51	0.31	34.8	1.2
3.3 – 3.4	53	51.6	1.6	30	5.8	2.43	0.26	35.2	1.3
≥ 3.5	54	52.5	2.1	22	4.2	2.50	0.29	35.8	1.4
ALL	598	49.8	2.0	26	5.2	2.44	0.30	34.4	1.4

$$\text{Ponderal index} = \frac{\text{weight in grammes}}{\text{length in cm}} \times 100$$

Table 3 : *Cumulative percentage frequency distribution of motoric development in birth weight category ≤ 3.0 kg and 2.0 – 2.4 kg.*

Age weeks	Holds object	Tries to turn	Turns to prone position	Crawls	Sits with assistance	Sits alone	Stands with assistance	Stands alone	Walks with assistance	Walks alone
4 - 07	38 (25)	41	-	-	-	-	-	-	-	
8 - 11	65 (58)	70 (53)	6	-	10	-	6	-	-	-
12 - 15	87	91 (88)	28	1	51	-	34 (13)	-	-	-
16 - 19	93 (82)	98	66 (59)	1	76	1	57 (41)	-	-	-
20 - 23	98	99	85	2	90	6	73 (76)	-	*	-
24 - 27	100 (100)	100 (100)	94 (100)	8	96	25 (20)	88	*	1	-
28 - 31			98 (100)	22 (20)	100 (100)	60 (50)	94 (100)	*	5	-
32 - 35			100	43 (35)		81 (71)	97	*	13 (6)	-
36 - 39				65 (63)		92 (89)	98	4	21 (21)	*
40 - 43				82 (74)		97	100	5 (11)	33 (32)	*
44 - 47				89 (84)		98		17 (21)	48 (47)	2
48 - 51				96		99 (100)		26 (39)	62 (67)	5 (6)
52 - 55				98 (94)		100		37 (50)	79 (93)	8 (21)

Between parentheses birth weight category 2.0 – 2.4 kg.

Figure 1 : *Feeding pattern of infants*

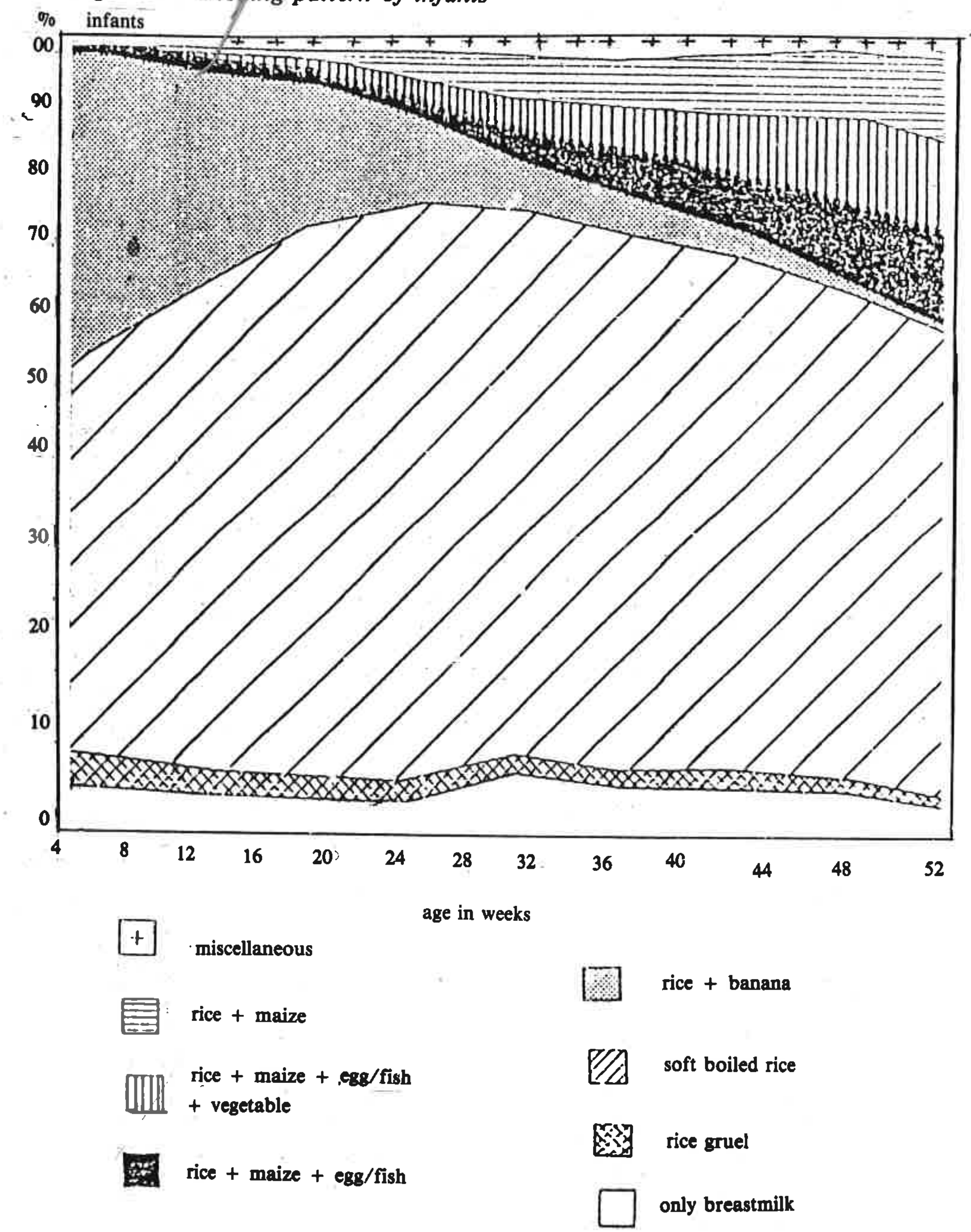


Figure 2 : *Percentage of infants, given specified foods in the first 6 months by birth weight cohort*

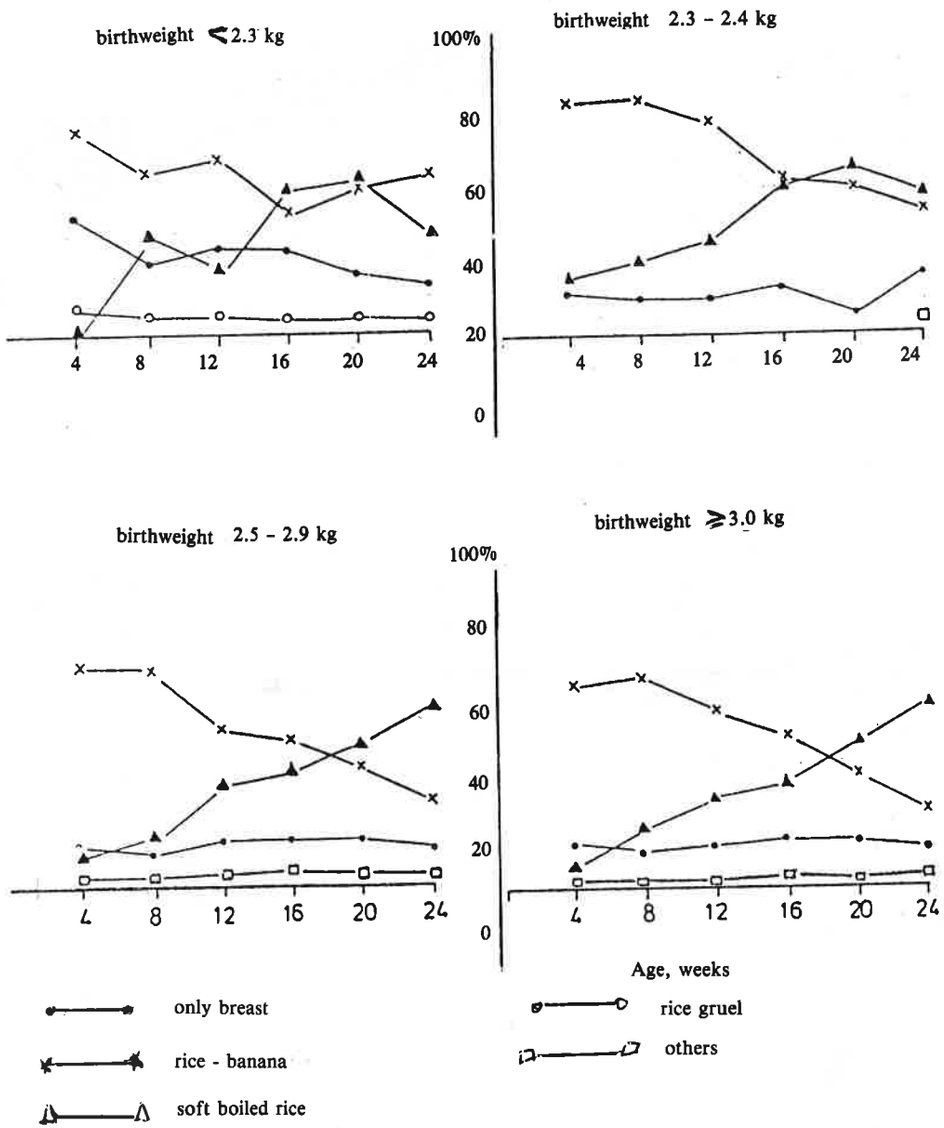


Figure 3 : *Mean weight (kg) by birth weight cohort, sexes combined*

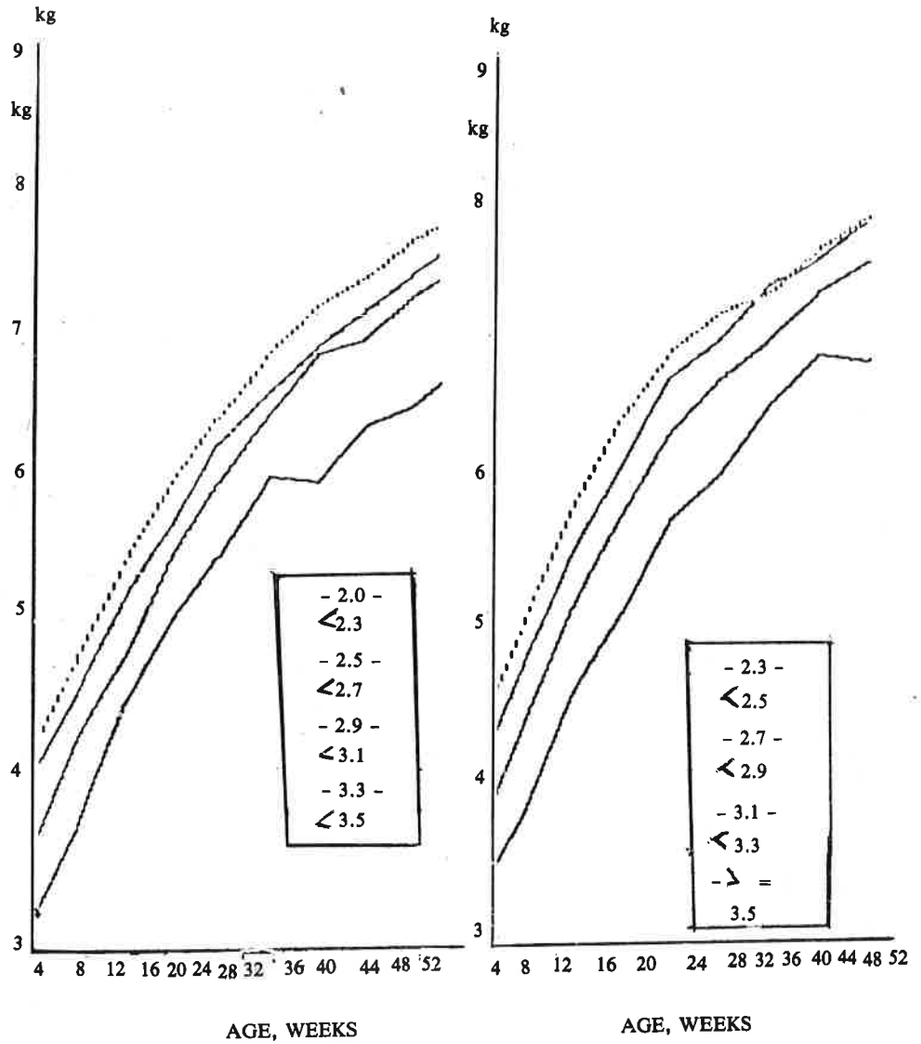


Figure 4 : Mean length (cm) by birth weight cohort, sexes combined

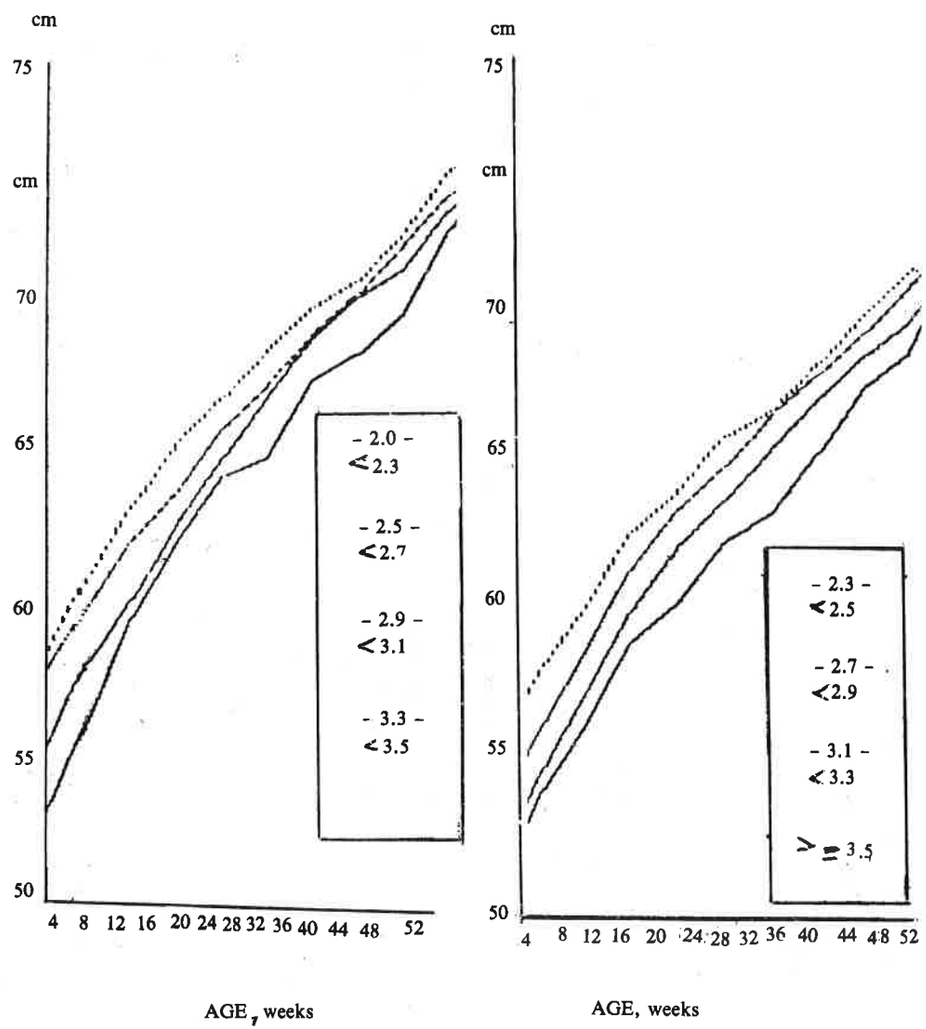


Figure 5 : *Weight curves of low and normal birthweight infants, compared to the 3rd, 20th and 50th centile of NCHS, sexes combined.*

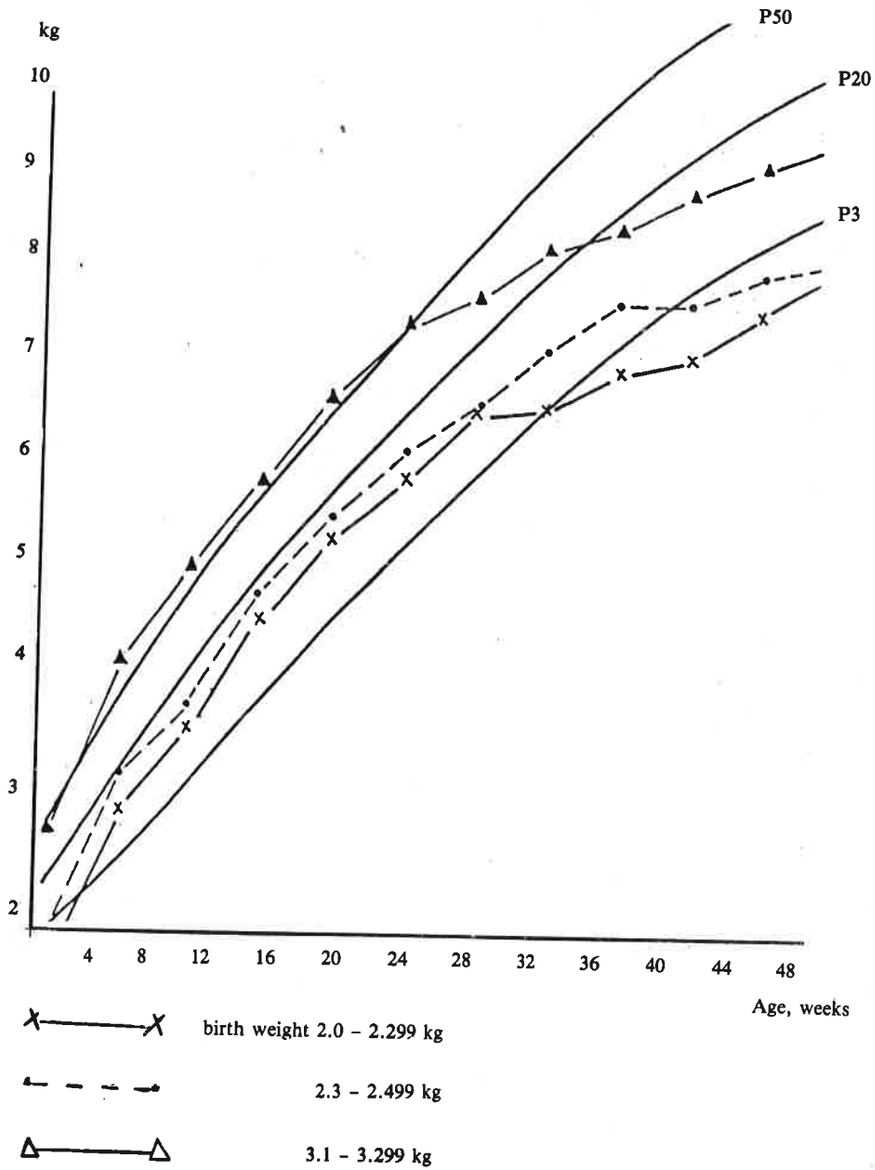
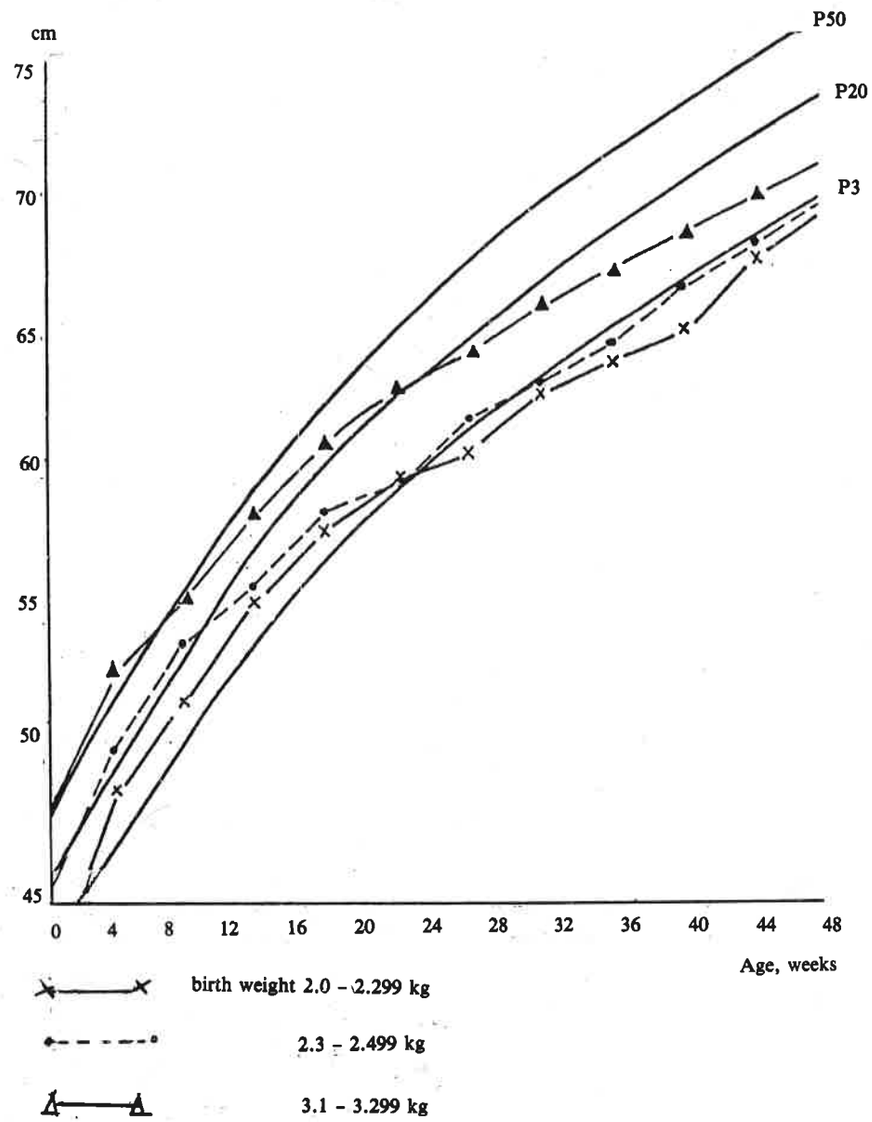


Figure 6 : *Length curves of low and normal birhtweight infants compared to 3rd, 20th, and 50th centile of NCHS.*



Discussion

The LBW incidence in our population ranged from 9.5 - 12.2 % but it may be higher as no birth weight could be measured in stillbirths (Kardjati et al., 1988). As elsewhere a strong association was found between birthweight and infant mortality. The risk to die in the neonatal period was 8 times higher and in the post-neonatal period 2 times higher than among NBW babies (Kusin et al., 1989). What is the fate of LBW survivors, living in a hostile environment? In industrialized countries LBW-preterm, appropriate- for gestational age infants catch up well. They reach normal value for weight and length by the age of 12 months. LBW-term infants remain smaller, even up to 7 years. (Babson, 1970; Neligan et al., 1976; Garn et al., 1977; Tenovuo et al., 1987; Binkin et al., 1988). Less information is available from developing countries, particularly from community studies. The few publications documented poorer growth of LBW infants (Morley et al., 1968; Mc. Gregor et al., 1968; Mata et al., 1975; Srivastava et al., 1978), except for one study in Tanzania where the infants followed for only 3 months (Singh, 1979). Gestational age could not be determined accurately in our population. We could, however, reasonably assume that the Madurese LBW babies were not preterms but small-for-dates. There are no reports of an effect of maternal undernutrition on gestational age, while maternal nutrition influences birth weight (Kardjati et al., 1988). The distance growth curves (attained weight- and length-for-age) of Madurese infants were in agreement with published reports. Infants remained in their growth channel by birth weight cohort. However, LBW infants grew distinctly better than NBW infants relative to the NCHS centiles at birth in the first 6 months. It may be due to the fact, that the LBW infants were wasted i.e. they had a low Ponderal Index. Tenovuo et al., (1987) from Finland and Villar et al., (1982°) from Guatemala observed that small-for-date LBW babies with a low Ponderal Index did catch-up, while those with an adequate Ponderal Index did not. It is, therefore, gratifying to note that surviving LBW infants can grow at an acceptable rate under village conditions, without special interventions. It is particularly important that no differences in motor development were observed. It is interesting to note that mothers only fed the smallest babies differently. Also that apparently the very premature introduction of additional foods did not pose a health hazard. From these longitudinal data it is obvious, that while growth retardation started before 6 months of age, the nutritional status of infants deteriorated significantly in the second half year, both in LBW and NBW infants.

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