ORIGINAL ARTICLE

Patterns of Birth Weight in Rural Tanjungsari, West-Java

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ABSTRACT Few population studies on birth weight distribution are available in Indonesia. This report is the result of a cohort of pregnant women who were followed from early pregnancy through delivery until the child is two years of age in a rural area Tanjungsari, about 45 km from Bandung. The infants were born between January 1, 1988 - December 31, 1989. A total of 3818 liveborn infants were available for analysis. The birthweight was grouped into low birth weight (<2500 g), deficient birth weight (2500-<3000 g), and favorable birthweight (>3000 g). The percentages were 13.9, 45.5 and 40.6 percent, respectively. The percentage of favorable birth weight in this study was lower compared with that in developed countries, it was even lower compared with other studies in Indonesia. The Tanjungsari has shown that the pattern of birth weight of live born infants have a distinct relationship to survival. Taken into consi- deration that most of low birth weight infants died in the neonatal period, improvement in birth weight may result in decline in infant mortality. **[Paediatr Indones 1995; 35:31-40]**

Introduction

Birth weight is the weight of the infant measured within 48 hours after birth and is expressed in grams[1] alive or stillborn. Some authors and program officers prefer to separate total and liveborn infants with the purpose that the latter is more useful for program evaluation. This has been used in a collaborative survey in six countries (volume 2 of the World Health Organization publication on perinatal mortality). Other reasons are that official country statistics provide data for all live births, and infant mortality and maternal mortality ratios are also calculated on the basis of all live births.[2]

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The cutoff point for defining low birth weight also varies depending upon one's purpose. For screening infant at very high risk of dying under condition of scarce resources, a lower cutoff (less than 2000 g) will give a higher specificity (fewer false positive). Alternatively if a high sensitivity is desired (that is identification of all births for whom birthweight is a risk factor for mortality), then a higher cutoff point is more suitable. Puffer and Serrano[2] use different classification and recommend the prevalence of deficient birth weight (DFW, birth weight 2500 and 3000 g) be recorded for this reason, since such infants may have twice as high a risk of dying as compared to optimal birthweight babies those between 3000 and 4000 g. Nonetheless the cutoff point of <2500 g remains the accepted international standard for both screening and surveillance purposes. It appears to reflect an appropriate tradeoff between sensitivity and specificity in screening for mortality risk, while for surveillance purposes as long as the distribution remains stable the choice of cutoff point does not really matter.

Preterm infants with normal intrauterine development are determined as the weight between the 10th and 90th percentiles of Lubchenco's intrauterine growth curve, they are defined as appropriate for gestational age (AGA). Small for gestational age infants (SGA) are defined as those with a birth weight below the 10th percentile of Lubchenco's. The reliability of gestational age calculated from the last menstrual history is debatable especially in developing countries where women in rural areas have long breastfeeding periods and women do not usually relate birth size to the last menstrual period.

For the pediatrician as well as for the epidemiologist, distinguishing a preterm infant from a SGA infant is equally important. Not only does mortality risk vary, but specific clinical problems can be anticipated by infants' birth weight and gestational age. A definite gestational assessment is important in view of unreliability of obstetric dates. Therefore various techniques for the clinical prediction of gestational age have been developed.[3,4] However the assessment of gestational age using both physical and neurological variables remains a subjective one, despite efforts to quantify this process. Interobserver error can be significant even if a specific system is used regularly.

Methods

Infants available for the present study were the result of a population based study in Tanjungsari, a rural subdistrict in West Java with a total population of about 87 000 people. These infants were the product of a cohort study "the Risk Approach as a Primary Health Care Strategy by Traditional Birth Attendants".[5] The intervention study was directed to improve traditional birth attendants (TBAs) skills and knowledge to identify risk pregnancies and refer risk cases to appropriate centers for further care. For this purpose the study area was divided in two; the northern part is the intervention area and the southern part the control area. The children coming from families ranging from middle class and lower to those in borderline low socioeconomic showed a relatively homogenous group. Nearly 90% of deliveries were attended by traditional birth attendants (TBAs). For the purpose of recording all TBAs in the study were trained in how to use a colored weighing scale for weighing the newborn infant. Research interviewers rechecked birth weight of the child within 48 hours after birth.

All infants were revisited postnatally for anthropometric measurements on day 7, day 28, day 42, and 3, 6, 9, 12 months. After this age regular visits were carried out every 6 months until the child is 3 years of age, followed by yearly visits on the birthday of each child. For the purpose of this report only birth weight measurements will be presented.

Birth weight is the weight of the infant measured within 48 hours after birth and is expressed in grams.[1] In most of the cases this weight was measured directly after birth; however in some cases weighing of infants by research interviewers was delayed, due to difficulties in reaching the infant's house. Birth weight within 48 hours after birth was not available in less than 5% of liveborn infants. For stillbirth, birth weight was collected from the TBAs, who attended the delivery and had weighed the infant. Other sources of information was from the field doctor who visited the LBW infant immediately after receiving the information from the interviewer or from the TBA. Infants were weighed on a simple spiral scale. The accuracy of the scales were checked regularly using a standardized weight of one kilogram. All infants were weighed without clothing or diapers. Several cross checks during weighing were done by the principal investigator and research team. Special attention was also given to the way the weighing scales were held at eye level and read. The study was approved by the National Re- search and Development Board of the Ministry of Health, Indonesia.

Results

Between January 1, 1988 to December 31 1989, 4400 pregnant women were registered and 4108 singletons born. The incidence of low birth weight infants (<2500 g) was 14%. Birth weights reported here were the result of interviewer's recordings. To evaluate the accuracy of data collection, it was considered important to know the time the interviewer measured the birth weight. The nearer to the time of birth, the more accurate was the result. It showed that 91.1% of infants were measured within 48 hours after birth, in 150 infants (3.9%) the time of weighing was not reported (Table 1).

Distribution of birth weight is presented for total singleton live births, both study years combined. In Tanjungsari study, the birth weight of 252 infants (6.1%) was not recorded; most of them were stillborn, some died directly after birth and some were not recorded at all.

The mean birth weight of liveborn infants born in the intervention and control area can be seen in Table 2. A difference of 18.6 grams between the mean birth weight was not significant ($p>0.05$); the same result was found for LBW rate (a difference of 2.0 percent), it was higher in the intervention area ($p>0.05$).

Table 1. Distribution of the time of weighing after birth (singleton and liveborn infants)

Hours after birth	No of infants	Percent
< 24	3323	87.1
24 - <48	179	4.7
48 - <72	40	1.0
≥ 72	126	3.3
Unknown	150	3.9
Total	3818	100

Table 2. Mean birth weight in the intervention and control area in Tanjungsari

Area	N	Mean BW	SD	% of LBW
Intervention	2300	2844.7	420.92	14.3
Control	1518	2863.2	416.48	12.3
Total	3818	2852.0	419.24	13.5

Table 3. Birth weight distribution in Tanjungsari (singleton and live born infants)

Birth weight category (g)	Number infants	Percent age	SD	X Birth weight
<1500	16	0.4	1234.4	419.2
1500-	500	13.5	2196.0	199.8
2500-	1747	45.5	2713.1	141.6
3000 +	1535	40.9	3235.6	242.6
Total	3,818	100	2852.1	419.2

Table 4. Birth weight distribution and gestational age

Birth weight (g)	Gestational age						
		<37 weeks			>37 weeks		
	N	n	n(+)	NDR	n	n(+)	NDR
< 2500	515	221	43	194.	294	11	37.4
2500-	1737	489	4	6	1248	11	8.8
3000-	1549	333	1	8.1	1216	7	5.7
3000 +				3.0			
Total	3,801	1,043	48	46	2,758	29	10.5

NDR = neonatal death rate per thousand live births

Gestational assessment on all low birth weight infants using the Ballard method was done within the first 48 hours of life. Four hundred sixty six infants were revisited for assessment. The result showed that 77.3% of these LBW infants were small for date.

All live born infants were classified according to the classification proposed by Puffer and Serrano.[2] The results showed that LBW infants constituted for 13.9%, while favorable birth weight infants prevalence was more than 40%. The mean birth weight for each category is also shown. All infants (n=15) with a birth weight of <1500 grams died in the neonatal period. Hypothermia was recorded in more than 70% of these infants.

Length of gestation

The period of gestation from the first day of the last menstrual period to the date of delivery is recommended for this measurement. This kind of information will give better understanding of the problems of birth weight distribution and reproduction. However in many developing countries this information could not be collected due to reasons mentioned earlier. This study did however collect information of mothers who knew the first day of the last menstrual period; 17 mothers (0.4%) could not report the date. This figure was quite low; however the accuracy of gestational age was debatable especially because 333 infants (31.9%) with a birth weight of >3000 g were reported as premature (less than 37 weeks). When gestational age was cross tabulated to birth weight the following result was

Table 5. Distribution of birth weight of total live births in selected countries (in percentage)

Birth weight (grams) N	Other countries			Indonesia			
	USA (1984) 3 611 316	Cuba (1983) 164 094	India (1979) 3040	Ujungberung (1980)* 2303	Tanjungsari (1990) 3829	Sidoarjo (1989)* 6082	Madura (1988) 687
< 2500	6.8	7.9	19.9	14.7	13.9	4.9	9.4
2500-	16.1	24	48.8	34.8	45.5	94.1	37.4
3000+	77.1	68.1	31.3	50.5	40.6	-	53.2

* based on total births; N = number of live births

Table 6. Early neonatal mortality of singleton live births of low birth weight (<2500 g) in 7 selected countries

Country	Total		Preterm (<37 weeks)		Term (≥37 weeks)	
	n	ENDR	n	ENDR	n	ENDR
WHO, 1973						
Hungary	15 902	164.7	11 417	215 7	4 485	34.8
Cuba	14 842	130.9	4 952	316 6	9 890	37.9
New Zealand	5 546	111.6	2 660	210 9	2 886	20.1
Sweden	3 793	111.8	1 984	175 9	1 719	37.8
United States	4 367	107.2	2 191	185 8	2 176	28.0
Tanjungsari (1993)	515	77.7	212	149	294	24

ENDR = Early Neonatal Death Rate

Table 7. Early neonatal mortality of singleton live births of deficient birth weight (2500-<3000 g) in 7 selected countries

Country	Total		Preterm (<37 weeks)		Term (≥37 weeks)	
	n	ENDR	n	ENDR	n	ENDR
WHO, 1973						
Hungary	36 142	6.9	7 101	10.7	29 023	5.9
Cuba	41 149	10.2	4 226	22.7	36 923	8.7
New Zealand	17 802	5.3	1 272	13.4	16 530	4.7
Sweden	12 215	5.2	1 473	14.3	10 742	4.0
United States	13 971	4.2	1 535	7.8	12 436	3.7
Tanjungsari (1993)	1 737	4.2	489	8.2	1248	4

ENDR = Early Neonatal Death Rate

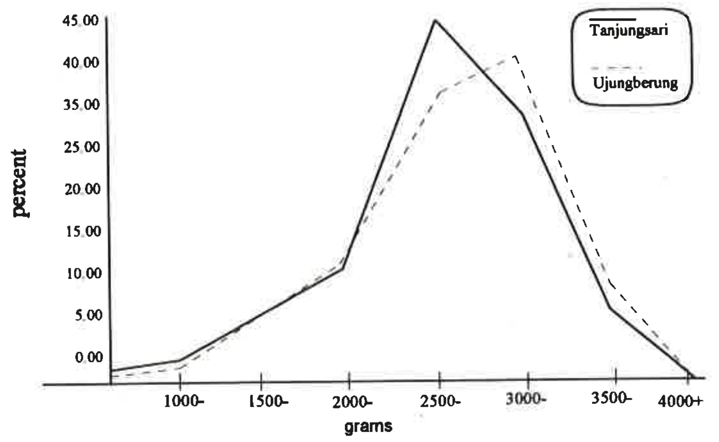

Figure 1. Birthweight distributionof singleton infantsin Tanjungsari (1988-1989) and Ujungberung (1978-1981)

shown (Table 4). Out of 515 infants with a birth weight of <2500 g, 294 infants (57.1%) were term infants and most probably small for date. This is lower than the percentage of small for date infants in the low birth weight infants assessed using the Ballard Score. One of the reasons is probably the accuracy of calculating gestational age based on mothers' report. Also some women who continued breastfeeding could not report the first day of the last menstrual period. For those reasons the number of preterm infants in the higher weight group was probably not correct.

With this limitation in mind, neonatal mortality was calculated for each birth weight group. Neonatal death rate was premature and had a birth weight of less than 2500 g. For small for date infants (>37 weeks and <2500 g), neonatal death rate (NDR) is more than 5 times lower. Interesting is the result for infants in the deficient weight group; the result clearly showed that NDR was more than 2 times higher for the premature group and one and half higher in term infants (>37 weeks gestation).

The relationship between birth weight and survival of infants in the neonatal period is important to search, as has been reported by Puffer and Serrano.[2] They found the same results as in ours, i.e., infants with a birth weight of 2500-<3000 g had higher mortality rates when compared with those infants who had a birth weight of more than 3000 g.

Discussion

The most important determining factor of survival and quality of life is the condition of the child at birth. Great concern regarding low birth weight was acknowledged by many authors and governments especially in developing countries. However pattern of birth weights of all live born infants deserve investigation in

relation to necessary action.[2] Variation in the incidence may be the result of several factors determining the weight of the newborn, namely; (a) the reproductive pattern and life style of the mothers; (b) types and successes of various methods of interventions; (c) the organization and capacity of health systems to meet needs in the prenatal period.

This report is the result of a prospective longitudinal study in a rural area Tanjungsari. The study itself was not directed to decrease low birth weight, the main purpose was to train traditional birth attendants identify high risk mothers and conduct appropriate action, in this case referral. Birth weight of all infants born during the study period were collected to study pregnancy outcome and the relation of perinatal mortality of referred and non referral cases. However it was not expected that the study itself will effect birth weight in the control as well as in the intervention area, as could be seen in the difference of mean birth weight in both areas which was not significantly different.

Comparison between the birth weight distribution in Tanjungsari study and the Ujung Berung survey conducted 10 years ago is shown in Figure 1. It shows that the distribution birth weights of infants of the Tanjungsari cohort is more skewed to the left compared to the Ujung Berung infants. Reason for this difference is probably the socioeconomic condition. In Tanjungsari there were more farmers, and geographically the area is more difficult because of the mountains and isolated villages. While Ujung Berung at the time of the survey was already in transition to industrial area and could be more or less considered as a periurban area.

Birth weight distribution of live born infants in three selected countries is compared as can be seen in Figure 2. The skewing to the left is found in the Tanjungsari intervention study, the birth weight distribution for the USA infants is skewed more to the higher birth weights. Birth weight distribution of Cuba's infants is found between the USA infants and the Tanjungsari infant.

Birth weight is also the outcome of a complexity of several biological and sociodemographic variables. The Sigtuna workshop rightly conclude that birth weight distribution could be useful indicator of overall health conditions of a particular community.[1] It can also be used to assess major health problems in less developed countries, specially malnutrition (e.g., mother's nutrition during early childhood and during gestation), common infection, unfavorable fertility and suboptimal mental development.

Table 5 shows the difference in birth weight distribution of live born infants in selected areas based on prospective studies. The Tanjungsari study showed an incidence of favorable birth weight of more than 40%. For Indonesia 4 other studies were compared showing different results. Two studies in West Java were reported, the Ujung Berung study[4] and Tanjungsari study. Although there was a difference of 10 years between both studies, the results were similar. Better findings were reported from the Madura study after food supplementation to pregnant women.[6]

The Sidoardjo study (East Java) reported only 4.9 percent of LBW.[7] Unfortunately the study did not report the kind of weighing scales and the percentage of infants favorable weight. The USA (1984) report was based on total births, both black and white population combined, LBW was 6.8% while favorable weight was 77.1%[2] In Europe, the country which has the highest incidence of favorable birth weight is Sweden (85%). At other extreme India reported only 31.1% favorable birth weight.

Two community surveys to study the percentage of LBW was conducted in Central and West Java. Wibowo[8] reported a prevalence of LBW of 16.1% in her study in Bogor (West Java), while Hakimi[9] (1988) in Central Java reported a prevalence of 13.4%. Both studies were using almost the same methodology and instruments to measure birth weight as the Ujung Berung and the Tanjungsari study. From these figures we can conclude that low birth weight is still a problem in rural Java and the variation between each area is considerable.

A study on hospital deliveries in Makassar (Central Sulawesi) was conducted by Barron[10] to study mean birth weight of local Indonesian newborns and newborns of Chinese origin. He found a lower mean birth weight for Indonesian newborns compared to the Chinese newborns (3200 g and 3287 g, respectively). He concluded that the difference could not be accounted for the differences of social class, maternal status or birth rank. Unfortunately he did not mention the prevalence of low birth weight in his study. Compared to his result, the mean birth weight in Tanjungsari was considerably lower (2854 g). The difference may be due to the fact that the study population were predominantly women of low risk who delivered in the hospital or maternity clinics in Makassar.

Data on length of gestation are incomplete as this information was not well recorded in this study, this was also the constrains of collecting gestational age. Gestational age is valuable for understanding the health condition and the chances of survival of the newborn. The WHO Study of Perinatal mortality 1 reported that the percentage of singletons live births with unknown length of gestation in the six countries surveyed varied from 0.001 to 30.1 percent.[3,7] Compared to these numbers the percentage of unknown gestational age in Tanjungsari was lower; however, the accuracy of gestational age remained debatable.

In order to study the reliability of the variations in preterm births early neonatal death rates have been calculated for the Tanjungsari study and compared to 6 selected countries in the WHO study (1973). Early neonatal mortality for the low birth weight infants has been divided into those preterm and those term of at least 37 weeks of gestation (Table 6). Death rate in low birth weight infants was very high in preterm infants but much lower in term infants. It is expected that many of the babies in this group have had intrauterine growth retardation. Compared to the WHO report in 1973 of the early neonatal mortality rates in 6 selected developing countries, Tanjungsari showed lower rates.

Deficient birth weights are responsible for high proportions of live birth in many developing countries. This was also true for developed countries in the early 1970's. In Tanjungsari deficient birth weight infants constituted for 45.5% of total number of infants. Intrauterine retardation may be one of the reasons for this high percentage (this group was not assessed using the Ballard method). The combination of birth weight and gestation indicates that in the weight group of preterm births early neonatal death rate is two to three times higher than of infants born at term (Table 7).

The percentage of preterm babies with low and deficient birth weight varies among countries and contributes to a larger extent to early neonatal mortality than do term infants. This indicates that preterm babies carry a greater risk of death than term babies of the same weight groups. Our findings revealed the need for searches for factors and causes of not only low and deficient birth weight but also those of preterm infants.

The causes of preterm births may have an effect on the health condition of the baby at birth and in early infancy. Preterm infants have diminished matur- ity which would hamper physiologic functions including the defense mechanisms.[2] Both facts signify the need for early recognition of those factors and the need for timely and appropriate use of technology to prevent sequel and death in such infants.

Conclusions

The classification of birth weight in this study used the recommendation suggested by Puffer and Serrano.[2] Instead of making two categories the classification of pattern of birth weight uses a three category. This has the advantages to show that infants with a birth weight of more than 2500 g is also a heterogenic group which can be seen in the higher mortality of infants with a birth weight of 2500-3000 g compared to infants with a birth weight of 3000 g and more.

The Tanjungsari study has shown that the pattern of birth weights of liveborn infants have a distinct relationship to survival. Favorable birth weight in the study area is lower compared to developed countries, it is even lower compared with other studies in Indonesia. Taken into consideration that most of low birth weight infants died in the neonatal period, improvement in birth weight may result in declines in the overall infant mortality.

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