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Mother's health card: A simple technology for use in primary health care

Husaini MA, Husaini YK, Sandjaja, Gunawan N, Hudono T, Odang R and Karyadi D

Nutrition Research & Development Centre, Dr. Sumeru Street No. 63, Bogor, 16112 Indonesia

ABSTRACT

The incidence of low birth weight in Indonesia as well as other developing countries is high. This can be reduced, if at risk pregnant women can be identified and their risks lowered. A 2-year cohort prospective study of 1,281 pregnant women found that maternal nutrition, including height and weight during pregnancy affected the birth weight of infants. On the basis of these findings, a Mother's Health Card was developed to monitor maternal weight during pregnancy and to observe factors affecting low birth weight. The validation study of the use of this card in four different ethnic and geographic areas found that the prediction values for identifying women who were at risk of delivering low birth weight infants was adequately high. The card proved simple, usable by village cadres, action oriented, and facilitated health nutrition education as well as persuading women to use available health care services. It also promoted better maternal and foetal nutrition by increasing the level of awareness of the women, the cadres, and the health personnel.

INTRODUCTION

A high prevalence of low birth weight (LBW) infants, a characteristic of many developing societies, can be significantly reduced through health monitoring and intervention programmes (Lechtig *et al.,* 1976; Shah, 1978). To increase the efficiency of these programmes, pregnant women at risk of delivering LBW infants must be identified (Lechtig *et al.,* 1976; Shah, 1978; Rosso, 1985; Kramer, 1987). The risk scales that have been developed for use in urban population in developed countries are of little use in poor communities, since most of them require expensive laboratory techniques (Lechtig *et al.,* 1976). The present paper describes a Mother's Health Card (MHC) based on a 2-year cohort prospective study of pregnant women in Bogor, West Java, Indonesia (Husaini *et al.,* 1986). It was developed for use in areas with inadequate health resources. This paper describes a validation study in four provinces confirming it to be useful and appropriate for identifying women at risk of delivering LBW.

METHODS

The subjects were pregnant women residents of the City of Bogor (West Java, Indonesia) and its suburbs. Most represented the social, economic, and educational stratum who usually sought the services of community health centres.

The subjects were followed from the eighth to sixteenth week of pregnancy (calculated from the first day of the last menstruation) until delivery. Height and weight were measured on 2,457 pregnant women at the first visit and every 4 to 6 weeks thereafter. Most were weighed monthly until the 36 to 40 week of pregnancy. Height was measured with a microtoise and weight was recorded with a Detecto scale. Subjects wore underclothes only. All anthropometric measurements were carried out according to the techniques described by Jelliffe (1966). Technicians carried out joint reliability exercises in the field before the start of data collection to ensure adequate precision and accuracy of measurements.

Information on age, education, parity, history of the previous delivery, chronic diseases, and interval since last pregnancy were recorded at the first visit. Other information were obtained in each trimester on dietary intake (using 24-hour recall, twice), haemoglobin concentration (by the cyanmethemoglobin method), protein in urine, oedema, and blood pressure as reported elsewhere (Husaini *et al.,* 1986). Places and methods of delivery, and birth weight were also recorded. Infants' were weighted by midwives or skilled research assistants between 3 and 72 hours after delivery on a beam balance scale that could be read to the nearest 10g.

The data analysis only included singleton, live born gestations that lasted from 36 to 42 weeks where three or more recorded weights. Excluded were cases with any of the following factors: 1) birth weight not recorded; 2) pregnant women who had moved to her parent's home in another area; a) abortion; 4) stillborn; and 5) preterm (less than 37 weeks of gestational age). Women who developed complication capable of influencing foetal growth were also excluded. These complications included maternal diabetes mellitus, preeclampsia, and eclampsia. After these exclusions there were 1,281 subjects. The mean age of the women in the sample on the first visit was 25 years, with a range of 14 to 44 years. Twenty seven percent (346) of the women were nulliparous and 13.2% (169) were grandiparous (equal to and above six parities). The mean height of the women was 149.6 ± 4.88 cm.

A multiple regression analyses was used to establish which of the variables (height, weight, age, parity, haemoglobin, blood pressure, level of education, and interval since last pregnancy) had a significant effect on birth weight of the infants. Women were grouped into two categories according to the birth weight. Group 1 comprised of women who delivered low birth weight infants (<2,500 g), and group 2 those who delivered adequate birth weight infants (≥ 2,500g).

The discriminant analysis was used to determine variables which had significant effects on delivery of low birth weight (LBW) infants. Then, the weight trend according to the stage of pregnancy was calculated. Multiple regression analysis was undertaken to determine variable which had any correlation with maternal weight at different stages of pregnancy. The next step was to determine the regression pattern for weight of women who delivered of LBW infants and those who delivered of adequate birth weight (LBW) infants. Analyses were then undertaken to determine the cut-off points between the two groups by test for sensitivity and specificity as described by Habitch (1980). Finally, the cut-off curves for each height were smoothed by using overlapping regression.

RESULTS

Of the 1,281 women in the study, 20 (1.4%) had height below 140 cm and 40 (3.1%) had heights equal to or above 160 cm. Seventy seven (6%) of the women in the study had no education and 242 (18.9%) had only 1 to 3 years of primary school. Only 5 (0.4%) had graduated from university with a B.Sc. degree.

The delivery types were: 1,332 (83.8%) spontaneous delivery; 25 (1.6%) stillbirth; 19 (1.2%) abortion, and 216 (13.6%) not reported. Of the 1,281 women included in the final analysis, 95 (7.4%) of the infants weighed less than 2,500 g at birth (low birth weight).

The matrix of correlation between medico-obstetric factors with birth weight is shown in Table 1, and between socio-demographic factors with birth weight is shown in Table 2. Among medico-obstetric factors, the highest correlation with birth weight was maternal weight at the third trimester (R2=0.3397), followed by maternal weight at the second trimester (R2=0.3280) and maternal height (R2=0.2502). Other factors that is, haemoglobin concentration and blood pressure (diastolic) were much less correlated. The socio-demographic factors: age, education,

parity, and pregnancy interval also had very low correlation with birth weight.

Table 1. Matrix correlation between maternal medico-obstetric factors with birth weight.

No. Variable	1	2	3	4	5	6	7	8
1. Height	-	.567	.571	.250	-.023	.009	-.013	-.003
2. Weight, 2nd TM		-	.978	.328	.003	.063	.077	.085
3. Weight, 3rd TM			-	.340	.002	.057	.067	.096
4. Birth weight				-	-.037	.041	-.034	-.029
5. Hemoglobin, 2nd TM					-	.403	-.012	-.035
6. Hemoglobin, 3rd TM						-	.068	.052
7. Diastolic, 2nd TM							-	.434
8. Diastolic, 3rd TM								-

Table 2. Matrix correlation between socio-demographic and birth weight.

No. Variables	1	2	3	4	5
1. Age	-	-.042	.603	.200	.103
2. Education		-	-.184	-.003	.019
3. Parity			-	.072	.088
4. Pregnancy interval				-	.037
5. Birth weight					-

Table 3 shows the results of the discriminant analysis on the association of maternal factors (age, education, parity, weight, height, arm circumference, triceps skinfold, blood pressure, and haemoglobin) with low birth weight (LBW). Maternal weight at the second trimester, weight at the third trimester, and height were highly significant associated with LBW. Diastolic blood pressure was also significantly correlated.

The maternal weight data are shown in Figure 1. An increase in the median maternal weight with gestation age is clearly demonstrated. The factor that is mostly associated with weight gain of the mother is height. The taller the women, the greater the weight gain. The correlation between weight and height was the highest significance at any gestational age. For example at the gestational age of (25-28 weeks) the correlation between weight and height was the strongest (R2=0.28, n=1303) than that between weight and age (P2=0.020; n= 1,303), and between parity and weight (R2=0.007; N=1,052). The median of weight of women who delivered of LBW infants were constantly below the medians of weight of women who delivered of ABW infants in any stages of pregnancy as shown in Figure 2.

The next step was to compare the weight regression at different gestational ages for women delivered of lBW or ABW infants. The sensitivity and specificity tests for predicting LBW were carried out to determine the cut-off point at different weeks of pregnancy between the women who delivered of lBW infants and the women delivered of ABW infants. On the basis of these findings, a Mother's Health Card was then developed. (Figure 3)

Since the large part of the population in this country is not accustomed to weighing themselves before pregnancy, the prepregnancy weights are mostly unknown. Furthermore, many women come to their first prenatal visit rather late, mostly in the third trimester. For these reasons, the

chart was developed not using weight gain criteria but on the weight curves observed during pregnancy.

Table 3. Discriminant analysis on the relationship between maternal factors with delivering of low birth weight infants

Variable	Wilks' lambada	F	Significance
Age	.99989	.6613E-01	.7971
Education	.99736	1.575	.2100
Parity	.99920	.4766	.4902
Weight, 2nd TM	.97324	16.39	.0001
Weight, 3rd TM	.97105	17.77	.0000
Height	.98685	7.940	.0050
Arm Circ., 2nd TM	.99555	2.663	.1033
Arm Circ. 3rd TM	.99371	3.773	.0526
Triceps skinf., 2nd TM	.99995	.3071E-01	.8610
Triceps skinf., 3rd TM	.99991	.564E-01	.8122
Diastolic, 2nd TM	.99960	.2399	.6244
Diastolic, 3rd TM	.98848	6.949	.0086
Hemoglobin, 2nd TM	.99978	.1300	.7185
Hemoglobin, 3rd TM	.99997	.1526E-01	.9017

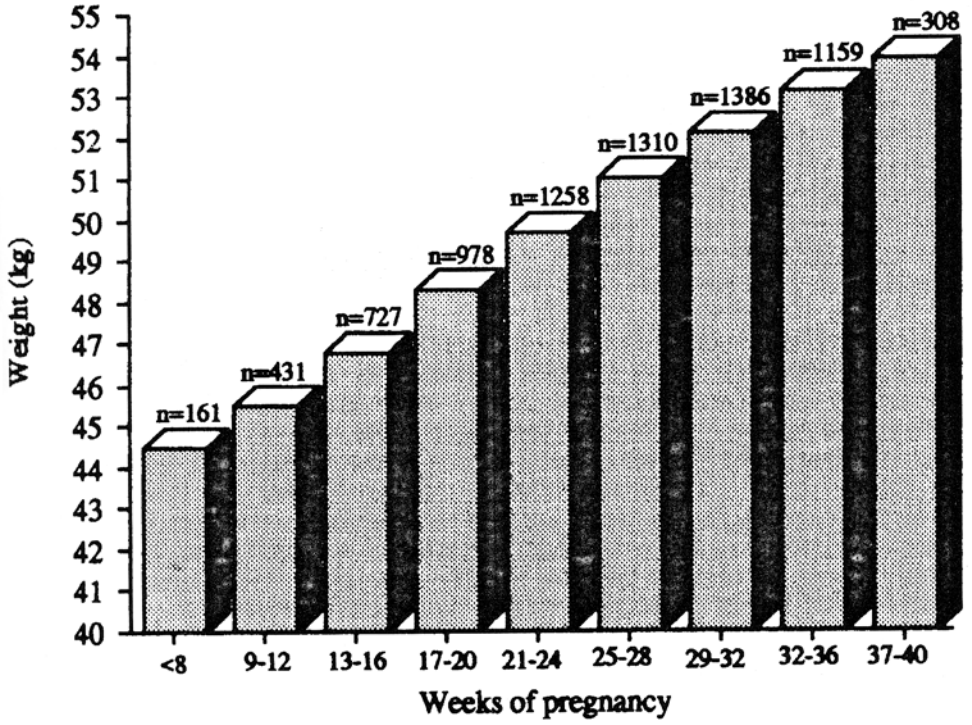


Figure 1. Medians of Maternal Weight at Diffferent Stages of Pregnancy

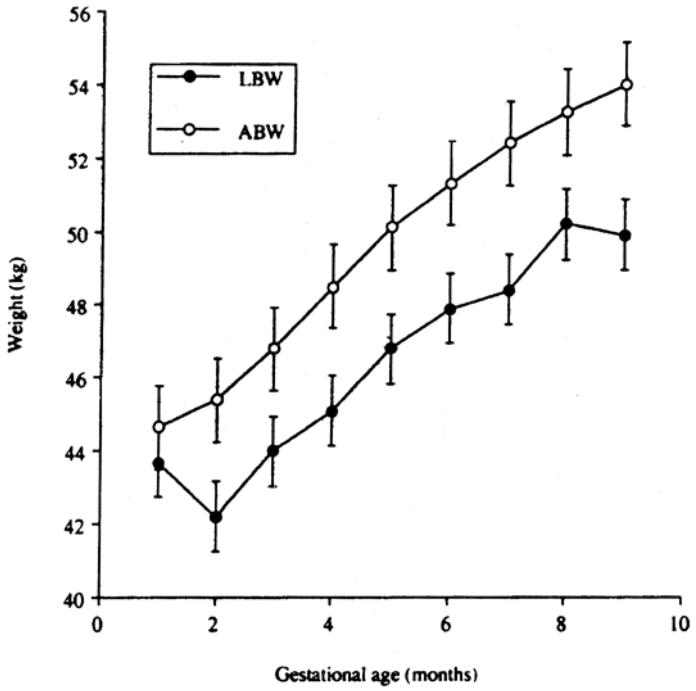


Figure 2. Medians of weight of women delivered of LBW and ABW infants

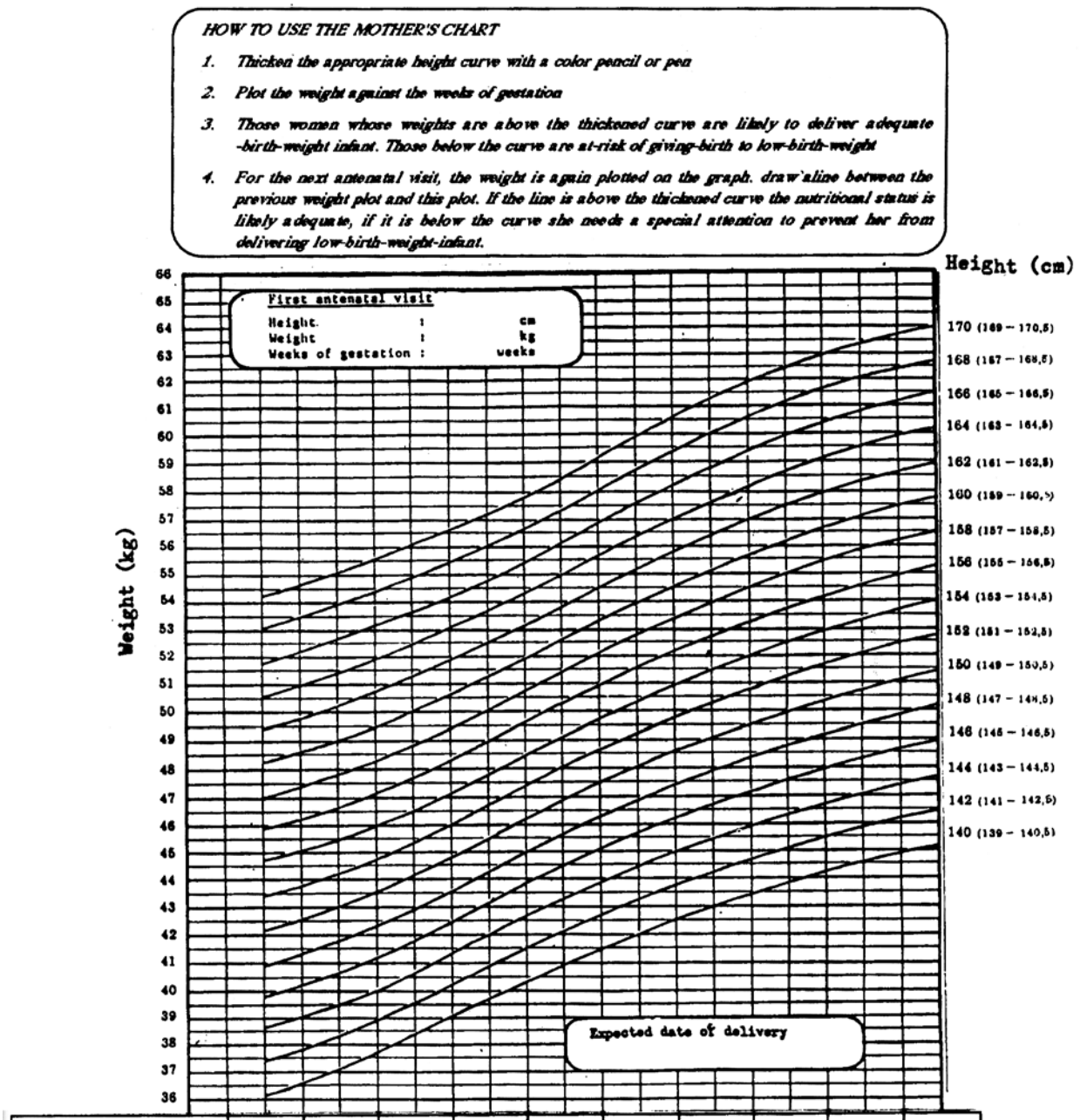
The curves may be inappropriate for women suffering from diabetes mellitus or women who has twin infants, since both these cases were excluded from the statistical analysis when the chart was made. By using this chart the field workers or cadres need not perform a mathematical operation each time, but only plot the information of weight against weeks of pregnancy in the graph. The cadre thickens the appropriate available curve for a women's height with a colour pencil or pen.

For the next antenatal visit, the weight is again plotted on the graph against weeks of pregnancy. A line is then drawn between the point representing the previous weight and the current weight. If the line is above the appropriate curve, it means that the nutritional status of that woman is likely to be adequate; if the line is below the appropriate curve, the woman needs special attention or intervention to prevent her from delivering a low birth weight infant.

The validation study in four Provinces

The study was conducted in four different ethnic and geographic areas. A total of 1,862 pregnant women (395 in West Java, 620 in East Java, 404 in West Sumatera, and 443 in East Nusa-Tenggara) with the gestational age ranged from 12 to 28 weeks at the first visit, mostly from middle - lower social economic group, in rural and urban areas, were studied.

The anthropometric measurements consisting of height and weight on all pregnant women and newborn infants were done by trained cadres. The information on age, chronic diseases, history of the previous delivery, interval since last pregnancy, and family background were also collected by cadres. The measurements of haemoglobin and blood pressure along with clinical examination were carried out by trained midwives. The weeks of pregnancy was accurately



Weeks of gestation	8	12	16	20	24	28	32	36	40	44
Date of examination										
Weight (kg)										
Head position										
Fetal's pulse rate										
Blood pressure (mm Hg)										
Oedema										
Hemoglobin (g/dl)										
Tetanus toxoid										
Iron tablets										
Food supplement										
Symptoms										

Figure 3. Mother's Health Card

calculated during each measurement by midwives. Their works were supervised by the head of Puskesmas (Community Health Center). A staff member of local Sub District Health Office (Dinas Kesehatan Kotamadya or Kabupaten) acted as the coordinator of these activities. All local personnel involved in this study were trained by the researchers from the Nutrition Research and Development Center in Bogor. The new Kroep Bathroom Scale, Baby's Balance Scale, and microtoise were used for anthropometric measurements.

During the collection of data in the field, researchers from Bogor visited the areas and supervised the activities such as accuracy of the measurements, interpretation of the findings, coverage and others. Rough tabulation of data was done in the field, in order that the local staff knew the initial results. The data were analyzed using SPSS Plus in IBM PC computer for arithmetic means, standard deviation, sensitive and specificity tests.

Table 4 shows the information of maternal factors and pregnancies outcome of this study as compared to Bogor data (Bogor data was used to develop the Mother's Health Card). The four provinces data and the Bogor data are very similar, except for the education and the parity >5 in the four provinces was clearly seen lower than the Bogor data.

Sensitivity and specificity tests were used for data analyses to estimate the proportion of Low Birth Weight (LBW) infants for categories of the variables of anthropometric measurements.

Table 4. Characteristics of samples and outcome of pregnancies in four provinces as compared to Bogor study

Characteristics	Four provinces (n = 1862)	Bogor study (n = 1281)
Average height (cm)	151.2 ± 5.6	149.6 ± 4.9
Height <140 cm (%)	1.7	1.7
Height >160 cm (%)	6.0	3.1
Age <20 yrs (%)	8.3	14.5
Age >40 yrs (%)	0.9	1.8
Has no formal educ. (%)	1.5	5.9
Grad. Primary school (%)	55.7	59.1
Pregn. Interv. <6 mos (%)	3.5	8.9
Pregn. Inter. >20 mos (%)	40.5	37.9
Primipara (%)	29.4	27.0
Parity <5 (%)	8.1	17.5
Average birth weight (g)	3107 ± 467	2939 ± 418

Figure 4 illustrates the sensitivity and specificity of predicting LBW by women weight plot and weight line. It appears that the sensitivity is getting higher when the gestational age is becoming older; in contrast, the specificity is almost horizontal except during the weeks near labour. Therefore, the women weight plot during the third trimester has a stronger power of prediction than the second and the first trimester. In the third trimester, on 28th week, the weight plot in the chart has sensitivity of 55.5% and specificity of 70.1%. The values of sensitivity and specificity on 32nd week of gestational age were 61.1% and 69.8% and on 36th week were 62.1% and 80.0%, respectively.

To examine whether the women weight line is appropriate to predict LBW, Table 5 shows this relationship. A line was drawn between the point representing the previous weight (the previous weight plot) and the current weight (the current weight plot). If the line is above the appropriate curve in the chart, the maternal nutritional status is likely adequate, on the other hand, if the line is below it means that the woman needs special attention to prevent her from delivering LBS. As shown in Table 5, the line starting from first trimester, second trimester, up to third trimester, has a strongest correct prediction (Se=66.7%; Sp=75.4%). If the line drawn from second to third trimester (Se=60.4%; Sp=7l .6%), or from first to second trimester only (Se=50.0%; Sp=75.1%), the prediction power are less strong.

Table 5. Sensitivity and specificity values of weight line in predicting low birth weight (LBW) infants.

Trimester	Weight line	Birth weight <2500g	Birth weight ≥2500g	Se	Sp
		n	n	(%)	(%)
I - II	aa	6	163	5	75.1
	bb	6	154		
	ab	1	9	25.0	69.0
	ba	3	20		
II - III	aa	19	941	60.4	71.6
	bb	29	273		
	ab	2	43	59.8	60.4
	ba	1	64		
I – II - III	aaa	3	129	66.7	75.4
	bbb	6	42		
	abb	2	7	50.0	70.8
	baa	2	17		

Notes:

a	= above the appropriate curve
b	= below the appropriate curve
I-IIaa	= weight during the first and second TM were above the appropriate curve
I-II-III bbb	= weight during the first, second and third TM were below the appropriate curve
I-II-III baa	= weight during the first TM was below the appropriate curve, but during the second and third TM was above the curve.
Se	= sensitivity
Sp	= specificity

DISCUSSION

Sensitivity and specificity tests have been used in this study analysis. Sensitivity refers to the proportion of women who delivered 1BS infants and who were correctly detected by the indicators. Specificity refers to the proportion of women who did not deliver LBW infants and who were correctly classified as such by the indicator. The higher the sensitivity, the better the effectiveness of the indicator, while the higher the specificity, the greater the efficiency of the

indicator for use in the programme. The test is used for two purposes: 1) to find the association between maternal weight plot in the chart with delivering LBW infants, and 2) to find the association between weight line with 1BW infants. Regarding those women whose weight plot were above the appropriate curve were likely to deliver adequate birth weight infants, and those below it were at risk of delivering LBW infants. The problem is to determine whether the prediction was adequately correct.

As shown in Figure 3 and Table 5, the prediction values for identifying women at risk of delivering LBW were adequately high. The values of Se and Sp for the weight plot on 32nd week of gestational age were 61.1% and 69.8% and on 36th week were 62.1% and 80.0%, respectively. For the weight line, the highest values for Se and Sp were found for a line drawn from first trimester, second trimester up to third trimester (Se=66.7%; Sp=75.4%). Unfortunately by the third trimester it is maybe too late for intervention to be effective.

Card observed in the four Province Study are as follows:

1. *Motivating factor.* The women were motivated to visit the Posyandu (Integrated Post Services) or Puskesmas (Community Health Center) to have health examination and weighing regularly. Completion rates of over 70% were obtained for each visit. The women were also motivated to have antenatal care earlier. In Indonesia as well as other developing countries, women may not seek care until rather late in pregnancy. By having the Mother's Health Card and the women kept the record at home, they had more frequently visits for antenatal care. On the average each woman had 4 to 5 times antenatal visits, and this may have affect on lowering risk for intrauterine growth retardation among woman in the study.

2. *Improving weight gain.* The women realized that they should have weight above the appropriate curve, therefore the women attempting to have adequate weight gain particularly for those whose weight below the curve. We observed that 19 among 49 women improve their weight status from below the curve in the first trimester to be above the curve in the second and third trimester. We felt that the low incidence of LBW in this study (6.4%) compared to national rate of 14.0%, may be influenced by using the Mother's Health Card. The use of the card was likely to have a beneficial effect in decreasing the number of LBW infants.

3. *As a channel for mediating the distribution of iron pills and tetanus vaccination.* The Mother's Health Card had been designed for pregnant women to provide information on the state of nutrition during pregnancy, risk during pregnancy, labour, and also information on iron supplementation and immunization against tetanus. The findings show that 100% of the women in the study received adequate iron pills and has completed tetanus toxoid vaccination. Before the card was implemented, the Puskesmas had difficulties to distribute iron pills, and had difficulties to reach the target group for tetanus vaccination. But since the card is used for pregnancy monitoring, the task became easier and the coverage could be reached. Therefore, the Mother's Health Card could also served as a tool for mediating iron pill supplementation and tetanus vaccination.

4. *A useful guide to cadres and health personnel.* The cadres and health personnel became aware of the problem and could interpret the information they collected. By this understanding the cadres were highly motivated to work. When they found women who were underweight, the cadres gave nutrition education based on guideline available in the card in an attempt to help her to attain a weight above the appropriated curve. If the cadres found the women with high risk, they referred them to the medical officer for further services. Therefore, the card became a useful

guide to the medical officers for the referred cases.

5. *A source for recording health statistics.* There are several information available in the Mother's Health Card such as birth weight, place of labour, birth attendant, iron pill supplementation, tetanus vaccination, risk factors, and family planning measures. This data can be further analyzed for research purposes or for evaluation of the programme from time to time.

The Mother's Health Card offers several distinct practical advantages. This very recent study on the validity tests of the use of this card at primary health care level in four different areas, demonstrated that the card was found very useful, informative, action oriented, and increase the level of awareness of the women, cadres, and health personnel through the graphic presentation of weight and height measurement.

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