Maternal anthropometry and pregnancy outcomes in Indonesia

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Background

The study was conducted in Bogor, West Java, Indonesia from April 1983 to March 1985. In the study area, the maternal mortality rate was 4.5 per 1000 live births, with an infant mortality rate of 71 per 1000 live births and low birth weight of 14%. The prevalence of anaemia among pregnant women was 50–70%; malaria was not endemic in the study area (*1*). The subjects of the study were pregnant women residing in the city of Bogor and rural areas close by. Most of the women came from lower to middle socioeconomic classes and represented a social, economic, and educational stratum that usually receives the services of community health centres.

The main objective of the study was to identify indicators of maternal risk at delivery and to develop anthropometric indicators useful for predicting mother and infant outcomes of pregnancy. Data were obtained from women living in 13 non-randomly selected villages and communities in rural and urban areas of Bogor. The villages selected were the most populous in the area. In each village the data were collected from all pregnant women during their first trimester. A total of 2500 deliveries were studied in order to ensure at least 250 LBW infants.

All anthropometric measurements were carried out according to the techniques described by Jelliffe (*2*). Technicians (with at least 5 years experience) carried out joint reliability exercises in the field before the start of the data collection to ensure adequate precision and accuracy of measurements. Maternal weight was measured using a spring Detecto balance (120 kg in units of 0.1 kg). Maternal height was measured using a wall-mounted microtoise height measure (200 cm in units of 0.1 cm). Both maternal and infant arm circumferences were measured using a flexible insert tape (60 cm in units of 0.1 cm). Skinfold thickness was measured with a Harpenden anthropometer (40 mm in units of 1 mm). Infant weight was measured using a beam balance scale (25 kg in units of 0.01 kg). Infant length was measured using a locally constructed length board (100 cm in units of 0.1 cm).

As a quality check, the data for all the women were reviewed by the senior researchers in consultation with a senior gynaecologist, and the data on infants were reviewed by a paediatrician.

Data were collected in both central locations and in the homes of pregnant women. The women came to central locations for interviews, anthropometric measurements and blood sampling. Data collected in the homes included environmental information. A total of 47 central locations were geographically distributed so as to provide easy access for households in all 13 villages. These data collection centres were set up for the purpose of the study and located in the office or house of a local leader or administrator. The centres served as antenatal health examination centres. The selection of sites and volunteers for the data collection centres was arranged by local leaders, following community meetings on the activities and the purpose of the work.

Eight teams of three people each were employed in data collection: a midwife, a nutritionist and a technician. The midwife carried out all the antenatal examinations and collection of blood samples. The technician carried out the anthropometric measurements and the nutritionist completed the interview schedule for social and environmental data. Each team worked in the same centres throughout the period of data collection and recorded the attendance and dropout rate in their group of women. Data collection was assisted by cadres (women) from the locality of the respective centre, working as volunteers to maintain contact with the pregnant women, ensure attendance at data collection times, and report births within 48 hours. These women had generally completed primary education, with a variable number of years of secondary education.

Monthly data were obtained from the time of pregnancy identification until one month after delivery. Hence maternal data were available over a variable number of months. Neonatal data were collected

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twice, once at birth and again when the infant was one month old. At the first visit to the centre the teams recorded: age, parity, gestational age, reproductive history, history of obstetric complications, history of acute or chronic diseases, maternal height, number of cigarettes smoked, employment status, and education of husband and wife. Gestational age was determined using the maternal estimate of the last menstrual period and physical examination of the level of the uterine fundus.

At the first and all subsequent visits to the centre, the teams recorded: maternal weight, skinfold thickness, mid-upper-arm circumference, health habits, and complications of the current pregnancy. In addition, the teams collected a fingerprick capillary blood sample for the determination of haemoglobin and haematocrit by the laboratories of the Nutrition Research and Development Centre in Bogor. At any time during the pregnancy, the team technician would visit the home once and describe environmental characteristics, such as household size, house construction, facilities, water sources, waste disposal and house ownership.

Within 72 hours following delivery the teams recorded: the type of delivery, the person assisting with the delivery, complications of both the mother and infant during delivery, and the infant's sex, weight and length. A month following delivery the maternal and infant anthropometric measurements were again recorded.

The study reported here focuses only on liveborn, singleton births. Pre-pregnancy weight was recorded based on a measurement early in pregnancy (before 10 weeks of pregnancy). Data analysis carried out previously showed that weight appeared unchanged during the first two months of gestation and the weight at first visit (if less than 10 weeks gestational age) was taken as the pre-pregnancy weight. Analysis was confined to singleton, liveborn deliveries with gestations that lasted from 28 to 42 weeks, during which three or more maternal weights were recorded. Excluded from the analysis were cases with any of the following factors: (1) birth weight not recorded; (2) subject moved to another area; (3) abortion; and (4) stillbirth. In addition, women who developed complications capable of influencing fetal growth were also excluded. These complications included maternal diabetes mellitus, pre-eclampsia, and eclampsia.

Results

The mean age of the women at first visit was 25 years (range, 14–44 years). Overall, of the 1647 pregnant women in the study, 96.5% (n=1589) were live births, 1.4% (n=23) were aborted, and 2.2% (n=35) were stillborn. Preterm births were 18.6% (n=302), full-term births were 81.4% (n=1322), and perinatal deaths were 2.6% (n=43). Of the 1589 live births, 8.9% (n=141) were low birth weight and 5.6% (n=89) were IUGR (intrauterine growth retardation) infants.

The mean (± standard error) weight gain during pregnancy was 8.8 ± 2.6 kg; BMI gain was 3.9 ± 1.6, and arm circumference gain was –0.2 ± 0.13 cm (effectively unchanged). The mean weight gain in the first trimester was 1.5 ± 1.32 kg; in the second trimester, 4.5 ± 2.06 kg; and during the third trimester, 3.2 ± 1.85 kg. The mean BMI gain at the first trimester was 0.7 ± 0.58; the second trimester 2.0 ± 0.85 and the third trimester 1.2 ± 0.76. In contrast to maternal weight and BMI, maternal arm-circumference did not on average increase over the pregnancy period.

The median weight curve during pregnancy for the women who delivered adequate birth weight infants (≥2500 g) was consistently above the 50th percentile of the population studied, and for the women delivering low-birth-weight infants (<2500 g) this curve was consistently below the 50th percentile of the population studied. The same pattern was also observed for BMI and arm circumference.

Height appeared to be associated with IUGR, full-term LBW, and LBW. After controlling for weight, the women of height <145 cm, had a risk of delivering a low-birth-weight infant 1.59 times greater than the women of height ≥145 cm. However, after controlling for multiple maternal factors, the effect was not statistically significant. In this population, with an average maternal height of 150 cm, low maternal height (<145 cm) had an effect on low birth weight independent of maternal weight during pregnancy.

Low pre-pregnancy weight — particularly in women of below average height — appeared to be a potential predictor of IUGR, full-term LBW, and LBW, but no direct effect was demonstrated in relation to assisted delivery. In this study, attained weight by month 5 appeared to be the strongest independent predictor of IUGR, full-term LBW, and LBW, but again there was no direct relationship to assisted delivery even after controlling for below average height. Since heavier women are generally taller than lighter women, isolation of the effect of maternal weight requires control for the confounding effect of maternal height (*3*). After controlling for below average height, maternal weight becomes a stronger predictor of IUGR, full-term LBW, LBW, and preterm birth. The results of the study demonstrate that maternal weight is the most sensitive predictor in relation to infant outcomes when compared with other maternal anthropometric measures.

In developing countries, where there are limited resources and health workers at community level have little education, there is a need for very simple screening/monitoring technology. The measurement of arm-circumference has been used quite successfully as a tool for monitoring nutritional status of infants and children. Its utility as an indicator of nutritional status in women is beginning to gain attention, primarily in research settings (*4*).

Arm-circumference was found to be relatively stable during pregnancy. The cut-off points of 22.5 cm — after adjusting for low maternal height (<145 cm) — had an odds ratio of 1.73 for IUGR, and for an arm-circumference with a cut-off point of 23.7 cm an odds ratio of 1.84 was calculated.

BMI, particularly at 5 months gestation appeared to be an important determinant of IUGR, full-term LBW, and LBW, but there was no evidence to show that BMI had a significant effect on preterm birth or assisted delivery.

References

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