Weight-gain patterns from prepregnancy until delivery among women in Central Java, Indonesia[1–3]

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ABSTRACT
Background: Representative data on pregnancy weight-gain patterns from developing countries are scarce. The reasons include difficulties in obtaining population-based samples and in collecting data before and throughout pregnancy.
Objective: The objective was to measure weight-gain patterns from prepregnancy until after delivery in a population-based sample of rural Indonesian women.
Design: Two cross-sectional surveys of nutritional status among nonpregnant women of reproductive age were carried out through a surveillance system in Purworejo District, Central Java, Indonesia, in 1996 and 1997. Between 1996 and 1998, 846 newly pregnant women were enrolled in a cohort study in which weight was monitored monthly throughout pregnancy.
Prepregnancy weights and other anthropometric measures were available for 251 of the women who had live births.
Results: Before pregnancy, 16.7% of the women had chronic energy deficiency and 10.0% were obese. The mean total pregnancy weight gain for all the women was 8.3 ± 3.6 kg, and 79% did not meet the international recommendation regarding weight gain for their prepregnant body mass index. The rate of weight gain was highest during the second trimester (0.34 kg/wk). In the first and third trimesters, it was 0.08 and 0.26 kg/wk, respectively. Total weight gain was associated with prepregnant body mass index, education, and socioeconomic status.
Conclusions: Many women in rural Central Java, Indonesia, enter pregnancy with suboptimal nutritional status. For most of these women, total weight gain during pregnancy is insufficient. It is likely that this contributes to adverse health outcomes for both the mothers and their newborns. *Am J Clin Nutr* 2002;75:1072–7.

KEY WORDS Pregnancy, weight gain, Indonesia, prepregnancy, nutritional status, prenatal nutrition, body mass index

INTRODUCTION

Maternal nutritional status is important for the health and quality of life of women and for the health of their newborn infants (1). Maternal prepregnancy nutritional status and pregnancy weight gain both affect the survival and health of the newborn. Consequently, various recommendations about pregnancy weight gain have been made. A better understanding of the complex interrelations between mother and fetus has led to many improvements in these recommendations. The latest improvement was the set of US recommendations published in 1990 by the Institute of Medicine (IOM); these recommendations take into account maternal prepregnancy body mass index (BMI) (1). Nonetheless, the optimal weight gain during pregnancy remains controversial (2).

Unfortunately, information on the patterns of weight gain in pregnant women from developing countries is scarce. The reasons include the difficulty in obtaining population-based samples, in measuring weight before pregnancy, and in continuously monitoring weight throughout pregnancy (3).

Between 1996 and 1997, we observed both chronic energy deficiency and obesity in a population-based sample of nonpregnant women of reproductive age in rural Central Java, Indonesia (4, 5). From 1996 to 1998, women in this population who became pregnant were enrolled in a pregnancy cohort and followed until 24 mo postpartum. In this article, we describe the weight-gain patterns of these women from prepregnancy until 2 wk postpartum. To evaluate the weight-gain patterns and background factors associated with different amounts of weight gain, we used a multilevel modeling approach that accounts for correlations between observations within subjects.

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SUBJECTS AND METHODS

Study setting

The research was conducted in Purworejo District, Central Java, Indonesia, which consists of 16 subdistricts and 494 villages with a total population of ≈730 000. The total area of the district is 1035 km^2, including coastal, lowland, highland, and hilly areas. Although urban centers are found in the district, 85% of the population lives in rural areas. Most people are Muslim and the major occupation is farming.

Since 1994, a surveillance system has been in place in the district through an initiative by the Community Health and Nutrition Research Laboratory, Gadjah Mada University, Yogyakarta, Indonesia, in collaboration with the Ministry of Health, Indonesia, and supported by the World Bank. A two-stage cluster sampling method with probability proportional to the estimated size of the cluster was used to select ≈10% of the households from the district (6). All family members in these households were included. From 1994 to 1997, these households were visited every third month and data on demographics, vital statistics, and health were collected.

Study population

Women of reproductive age in the surveillance sample (n = 13 094 in 1995) were selected for a longitudinal study on their nutritional status during reproduction, starting before pregnancy. To obtain prepregnancy measurements, cross-sectional surveys were carried out in January–March 1996 and May–July 1997. Women who were aged 15–49 y, married, and currently not pregnant or sterilized were invited to attend measurement sessions at local health posts (*see* details below). The nutritional status of these women was described previously (4, 5).

With support from the surveillance infrastructure, a monthly pregnancy monitoring system was established in the district in 1996. Women were excluded from intensive pregnancy monitoring if they were *1*) unmarried or without a life-partner (hence, culturally unsuitable for pregnancy monitoring); *2*) pregnant beyond the first trimester; *3*) currently using oral contraceptives, an IUD, injectable contraceptives, or contraceptive implants; or *4*) starting menopause. Informed consent for pregnancy monitoring was obtained from the eligible women.

At the home visits, the date of the last menstrual period (LMP) was recorded and suspected pregnancies were confirmed with pregnancy tests in the field. Women who were < 120 d pregnant were invited to participate in the nutrition study. An additional consent procedure was used for these women. Between April 1996 and October 1998, a cohort of 846 newly pregnant women was enrolled; 275 of these women had prepregnancy measurements of nutritional status. In this group of 275 pregnant women, there were 5 pregnancies that ended in stillbirths, 9 that ended in spontaneous abortions, and 10 for which we had no information about the pregnancy outcome. Thus, the analyses presented here include 251 women with confirmed live births. The mean number of days between the prepregnancy measurement and the LMP was 173 ± 132 d (range: 0–521 d). Only 24 women had an interval > 1 y. For the analyses, we assumed that the prepregnancy weight represented the weight at conception. This may lead to a slight underestimation of true weight at conception. Previously, we showed a mean increase of only 0.6 kg during a 1-y period among nonpregnant women of reproductive age in this area (5). Ethical approval was received from the research ethics committees of the medical faculties of Gadjah Mada University, Yogyakarta, Indonesia and Umeå University, Umeå, Sweden.

Measurements

Trained fieldworkers visited the women at home every month during their pregnancies to conduct interviews and take anthropometric measurements. Body weight was measured with a calibrated electronic Seca scale accurate to 0.1 kg (CMS Weighing Equipment, London) while subjects were wearing the lightest possible clothing. Midupper arm circumference (MUAC) was measured on the left arm with an insertion-type arm circumference tape accurate to 0.1 cm (UNICEF, Jakarta, Indonesia). Height was measured once with a stadiometer accurate to 0.1 cm (CMS Weighing Equipment). The same anthropometric measurement methods had been used for the prepregnancy measurements in 1996 and 1997. Training and standardization of anthropometric measurements were carried out every 3 mo.

Most women were visited by the research team within 24 h of delivery. A team of field workers made daily visits to the villages and to birth attendants of all women who were within 1 mo of their expected delivery date to monitor for the onset of labor. Maternal weight was also measured at 2 wk postpartum.

Demographic and socioeconomic data were collected during a 1997 household survey by trained Community Health and Nutrition Research Laboratory fieldworkers who used precoded questionnaires. The information collected included age, parity, family size, education, occupation, area of residence, housing conditions, and ownership of electricity, radio, television, bicycle, or motorcycle. These variables were categorized primarily on the basis of the Indonesian demographic and health survey categorization scheme (7). A variable for socioeconomic status was created; it combined information on housing conditions and ownership of electricity, radio, television, bicycle, or motorcycle. None of the women smoked.

Standards and reference values

Women were classified as chronically energy deficient or obese according to the criteria of James et al (8). The Canadian standards were used as reference values for height because they do not require estimated frame size (9). The US National Health and Nutrition Examination Survey (NHANES) norms were used as reference values for MUAC (10). Total weight gain was compared with the recommended weight gains from the IOM (1), which take prepregnancy BMI into account.

Statistical analyses

Data were entered into computer files at the Community Health and Nutrition Research Laboratory in Yogyakarta by using the Household Registration System (version 2, 1995; Population Council, New York) and dSURVEY (1990; Survey Research System, copyright by Geof Corner, Helkon Pty Ltd, Australia). The data were entered twice on a 5% random sample of all forms. Logical checks were carried out at data entry and any inconsistencies were sent back to the field within a few days. Data cleaning and statistical analyses were performed with SPSS (version 9.0, 1999; SPSS Inc, Chicago).

In the descriptive analyses, to minimize the effects of different lengths of time between the available anthropometric measurements and the LMP, values for weights at exactly 30, 60, 90, 120, 150, 180, 210, 240, and 280 d were interpolated from the

TABLE 1
Nutritional status of Indonesian women before pregnancy

Characteristic	Value
Height (cm)	150.3 ± 4.8[1]
Weight (kg)	47.5 ± 8.0
Midupper arm circumference (cm)	25.5 ± 2.9
BMI (kg/m^2)	21.0 ± 3.1
BMI categories (%)[2]	
Chronically energy deficient	16.7
Normal	73.3
Obese	10.0

[1] $\bar{x}$ ± SD; n = 251.

[2] Classified according to James et al (8): BMI <18.5, chronic energy deficiency; 18.5–24.9, normal; and ≥25.0, obese.

closest available values below and above the missing value. It is indicated in the text where these equidistant values have been used in the analyses.

Total weight gain was calculated as the difference between the prepregnancy weight and weight at 8 or 9 mo of pregnancy. Net weight gain was calculated in 2 ways: total weight gain minus the infant's birth weight, and the difference between prepregnancy weight and weight at 2 wk postpartum. Total weight gains were compared among subgroups of women by using analysis of variance.

Sources of variation in weight-gain patterns were evaluated by using a multilevel modeling technique. The first level was measurement occasion and the second level was each woman (11). The analyses were performed in 2 steps. The first step was aimed at identifying a suitable model of weight gain by using days since the LMP as the explanatory variable. Both second- and third-degree polynomials were evaluated, because the weight gain curve during pregnancy was expected to be approximately sigmoid (1). In the second step, various background factors were entered into the model (prepregnant BMI, age, parity, education, occupation, area of residence, housing condition, and ownership of different items). The purpose of this step was to identify factors associated with different weight-gain patterns by using interaction terms between these factors and days since the LMP. The software MLwiN 1.02 (Multilevel Models Project, Institute of Education, London) was used to estimate the multilevel models. $P < 0.05$ was considered significant.

RESULTS

Characteristics of the Indonesian women

The mean (±SD) age of the women was 30.3 ± 4.9 y. Excluding the index pregnancy, 5.2% were nulliparous, 67.8% had parity 1–2, 21.5% had parity 3–4, and 5.6% had parity ≥5. Most women (92.8%) came from the rural areas. In total, 2.4% had no education, 62.5% had finished primary school, 19.9% had 7–9 y of education, and 15.1% had ≥10 y of education. In terms of occupation, 34.7% were housewives or unemployed, 47.8% were farmers, and the remainder (17.5%) worked in other sectors.

The 251 women included in the longitudinal study did not differ significantly in terms of occupation or area of residence from the 595 women in the pregnancy cohort who were excluded because prepregnancy measurements were not available. However, excluded women were more likely to have ≥10 y of education (23.7%; $P < 0.05$) and more likely to have parity ≥5 (26.7%; $P < 0.001$).

In addition, there were several differences between the sample of women included in the longitudinal study and the district surveillance sample of 13 094 women of reproductive age (4). In the longitudinal study, a significantly higher proportion of women were from rural areas (92.8%, compared with 85.9% of the surveillance sample; $P < 0.001$). Also, in the longitudinal study, a higher proportion of women worked in the agricultural sector (47.8%, compared with 38.5% of the surveillance sample; $P < 0.001$) but there were fewer women without work (34.7%, compared with 41.2% of the surveillance sample; $P < 0.001$). In addition, the longitudinal study included fewer nulliparous women (5.2%, compared with 30.3% of the surveillance sample; $P < 0.001$) but more women with parity 1–2 (67.8%, compared with 31.2% of the surveillance sample; $P < 0.001$). Mean age and educational attainment did not differ significantly between the 2 samples.

Prepregnancy nutritional status

The nutritional status of the Indonesian women before pregnancy is shown in **Table 1**. The sample included women with chronic energy deficiency (16.7%) and women with obesity (10.0%). In total, 27.5% were below the 5th percentile of the Canadian reference population for height, but only 2.8% were below the 5th percentile of the US reference population for MUAC.

Prepregnancy weight was compared among women who differed in terms of socioeconomic or demographic characteristics. The results showed that prepregnancy weight was significantly higher among women with more than a secondary school education ($P = 0.029$) and women who owned a television ($P = 0.047$) or a motorcycle ($P = 0.015$). A positive relation between prepregnancy weight and the combined variable of socioeconomic status was also seen ($P = 0.052$). However, area of residence, occupation, age, and parity were not significantly associated with prepregnancy weight.

Maternal weight gain

The mean duration of gestation was 39.1 ± 2.6 wk. Total and net weight gains and weight gains per trimester are shown in **Table 2**. The median weight gain and the 5th and 95th percentiles of the study subjects' values throughout pregnancy are shown in **Figure 1** (interpolated equidistant values were used).

Only 21% of the women in the sample had a total weight gain that reached the recommended amount for women in their category of prepregnancy BMI. Among women with a low prepregnancy BMI (<19.8), only 17.6% reached the recommended total weight gain (1).

Weight gain was best modeled by a second-degree polynomial (basic multilevel model) in days of pregnancy:

$$
\begin{aligned}
y_{ij} &= \beta_{0ij} + \beta_{1ij}x_{1ij} + \beta_{2j}(x_{1ij})^2 \\
\beta_{0ij} &= \beta_0 + u_{0j} + e_{0ij} \\
\beta_{1ij} &= \beta_1 + u_{1j} + e_{1ij} \\
\beta_{2j} &= \beta_2 + u_{2j} \qquad (1)
\end{aligned}
$$

The model considers between-subject variation in prepregnancy weight (β_0) and weight-gain patterns (β_1 and β_2). Thus, the model is the equivalent of individually modeling a weight

TABLE 2
Actual and interpolated weight gain throughout pregnancy for Indonesian women[1]

Time period	Actual weight	Interpolated weight[2]
Total weight gain (kg)		
Prepregnancy to 9th mo of pregnancy ($n = 81$)	8.3 ± 3.6	8.4 ± 3.7
Prepregnancy to 8th mo of pregnancy ($n = 217$)	7.2 ± 4.0	6.9 ± 3.9
Net weight gain (kg)		
(Prepregnancy to 9th mo) − birth weight ($n = 77$)	5.0 ± 3.4	5.2 ± 3.5
(Prepregnancy to 8th mo) − birth weight ($n = 207$)	4.1 ± 4.0	3.7 ± 3.9
Prepregnancy to 2 wk postpartum ($n = 203$)	1.5 ± 3.6	—[3]
Weight gain per trimester (kg/wk)		
First trimester (prepregnancy to 3rd mo) ($n = 221$)	0.08 ± 0.26	0.07 ± 0.26
Second trimester (4th mo to 6th mo) ($n = 229$)	0.34 ± 0.23	0.33 ± 0.22
Third trimester (7th mo to 9th mo) ($n = 79$)	0.26 ± 0.21	0.26 ± 0.20

[1] $\bar{x}$ ± SD; $n = 251$.
[2] Weights interpolated to exactly 30, 60, 90, 120, 150, 180, 210, 240, and 280 d.
[3] Interpolation was not possible for weight at 2 wk postpartum.

gain curve of second-degree order for each woman. The variance components [$V(u_{0j}) = \sigma^2_{u0}, V(u_{1j}) = \sigma^2_{u1}$, and $V(u_{2j}) = \sigma^2_{u2}$] capture the variation in prepregnancy weight and weight gain. Finally, the terms e_{0ij} and e_{1ij} represent the within-subject variation. Results from estimating the model are shown in **Table 3**.

All 3 β coefficients in the basic multilevel model were significant, as were their associated variance components. A sigmoid curve, which is approximately captured by a third-degree polynomial model, was expected. Hence, the latter also was evaluated but found to be unstable. The basic multilevel model estimate of the average prepregnancy weight was 46.8 ± 0.5 kg. The weight gain values described by the linear and quadratic terms were 17.6 ± 2.4 g/d and 0.06 ± 0.008 g/d^2, respectively. The model predicted a total weight gain of 9.5 kg over a 280-d pregnancy, which should be compared with the interpolated total weight gain of 8.4 kg from prepregnancy until 280 d of pregnancy (Table 2).

Only prepregnancy BMI and ownership of a television were significantly related to measured total weight gain (**Table 4**), although a tendency toward higher total weight gain with ownership of a motorcycle or bicycle was observed. No effects of area of residence, occupation, education, parity, or age were seen. When interaction terms between these background factors and days since LMP were added, one at a time, to the basic multilevel model described above, prepregnancy BMI, education, ownership of a television or motorcycle and the combined socioeconomic variable each had a significant positive influence on the weight-gain pattern. When interaction terms for prepregnancy BMI and the combined socioeconomic variable were added simultaneously to the model, only the former remained significant. When interaction terms for prepregnancy BMI and education were added simultaneously, again only BMI remained significant. Finally, when interaction terms for the combined socioeconomic variable and education were added simultaneously, only the socioeconomic variable remained significant.

DISCUSSION

Many of the study subjects began their pregnancies with suboptimal nutritional status; 1 of 6 women had chronic energy deficiency. The 251 women in the study had an average total weight gain of 8.3 kg. Only 1 of 5 women had a total weight gain that met the recommendation of the IOM (1) for women in their category of prepregnancy BMI. The proportion that met the recommendation was even lower among women with low initial BMIs. Low pregnancy weight gains (in the range of 4.1–11.7 kg) have been reported in many developing countries (3, 12, 13). This is of concern, because weight gains outside of the IOM ranges are associated with twice as many poor pregnancy outcomes as are weight gains within the IOM ranges (2).

Three other Indonesian community-based studies on pregnancy weight gain have been published; 1 was conducted in East Java and 2 were conducted in West Java. The East Java Pregnancy Study (14) was carried out on the island of Madura from 1981 to 1989. In total, 972 women gave birth to 1782 infants. These women had a mean height of 150 cm and a mean prepregnancy weight of 42 kg. Total weight gain averaged 6.6 kg. The first West Java study was carried out in the city of Bogor and its suburbs and included 2457 women who were recruited at 8–16 wk of pregnancy (15). The average height of these women was 149.5 cm and the estimated average prepregnancy weight was 46.0 kg. The difference between weight at 9 mo of pregnancy and estimated prepregnancy weight was 9.4 kg for a subset of the women. In the second West Java study, a population-based sample of 845 women in Indramayu, West Java, was

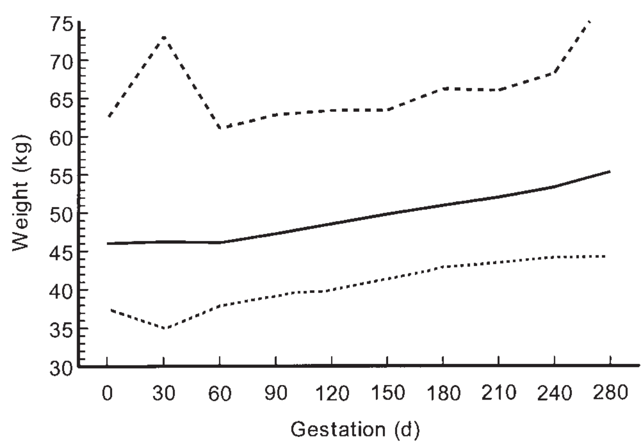

FIGURE 1. Median weight gain of Indonesian women (solid line; $n = 251$) derived from interpolated equidistant values. The 5th and 95th percentiles of the study subjects' values are represented by the dashed lines. The time point labeled 0 d is the prepregnancy weight.

TABLE 3
Results from evaluating a multilevel model of weight gain among Indonesian pregnant women[1]

Variable	β Coefficient	SE
Intercept: prepregnancy weight, β_0 (g)	46 840	515
Linear term: weight gain, β_1 (g/d)	17.6	2.4
Quadratic term: weight gain, β_2 (g/d^2)	0.06	0.008
Variance component: prepregnancy weight, u_{0j}	62 427 190	5 947 377
Variance component: linear term of weight gain, u_{1j}	761	135
Variance component: quadratic term of weight gain, u_{2j}	0.008	0.001
Covariance between prepregnancy weight and weight gain	−68 789	21 182

[1] $n = 251$.

followed from 20 wk gestation until postdelivery during the years 1991 and 1992 (16). Their average height was 152 cm, estimated prepregnancy weight was 46 kg, and estimated total weight gain was 8.9 kg. In short, the results of 4 community-based studies in East, West, and Central Java, Indonesia, all show suboptimal prepregnancy nutritional status in combination with suboptimal weight gains during pregnancy in a substantial proportion of the women. This warrants further attention.

Among the women in Central Java, rates of weight gain differed between the trimesters; gains averaged 0.08, 0.34, and 0.26 kg/wk in the first, second, and third trimesters, respectively. These values should be compared with the recommended value of 0.40 kg/wk for the second and third trimesters (1). The low weight gain during the first trimester is most likely partially explained by low dietary intake resulting from nausea in a large proportion of the women. All women reporting a daily intake <240 kJ were revisited; many of these women reported nausea. This was most common during the first trimester, when the reported mean energy intake was only 82% of the reported mean energy intake during the third trimester (17). Also, daily deposition of protein and fat and plasma volume expansion are all much smaller during the first 10 wk of gestation; the largest daily deposition of fat occurs from 10 to 30 wk gestation (1).

Studies from other countries also reported higher rates of weight gain during the second trimester than during the third trimester (13, 18, 19). Unfortunately, few studies report on weight gain during the first trimester and this is especially true for developing countries. In Taiwan, prepregnancy information was obtained for a sample of 125 women monitored during pregnancy (20). In these women, who had an average height of 154.7 cm and a prepregnancy weight of 48.7 kg, the total weight gain amounted to 7.63 kg. By trimester, weight gain equaled 0.07, 0.33, and 0.25 kg/wk in the first, second, and third trimesters, respectively. In the Philippines, information from the first trimester to the third trimester was obtained for a sample of 877 women (3). On average, these women had a height of 150.4 cm and a prepregnancy weight of 45.6 kg. Total weight gain was 8.4 kg and weight gain rates during the first, second, and third trimesters were −0.04, 0.35, and 0.27 kg/wk, respectively. These results are surprisingly similar to those found in the present study. In addition, a chart review was performed in 1981 on a sample of 370 of 5486 pregnant women who attended an antenatal clinic and delivered at Mangkuyudan Maternity Hospital in Yogyakarta, Central Java, Indonesia, between 1971 and 1980 (S Hasibuan, M Hakimi, and MS Sofoewan, unpublished observations, 1981). Total weight gain equaled 8.4 kg and the pattern of weight gain followed a bell-shaped curve with a deceleration phase after 28 wk gestation; these findings further confirm the results of the present study.

We used a multilevel modeling approach that handles correlation between observations within women to evaluate weight-gain patterns and associated background factors. Another advantage of this approach is that original data can be used because the model does not require equidistant observations and because missing data can be handled, meaning that women with some information lacking do not need to be excluded from the analyses. Further, the approach provides a tool for analyzing variability and its different sources within a given context.

Initially, a third-degree polynomial was fitted in our multilevel model because of the consistent findings of highest weight gain rate during the second trimester, suggesting a sigmoid-shaped curve of weight gain. However, the fitted model was unstable and the final model was instead represented by a second-degree polynomial. The predicted 280-d total weight gain (9.5 kg) was higher than that obtained through interpolation (8.4 kg). It is likely that our second-degree polynomial model only captured the lower part of the sigmoid curve, thus assuming a constant rate of weight gain during the third trimester. The decrease in weight gain rate during the third trimester was small compared with that during the first trimester. Hence, with a small sample size, the former is more difficult to capture than the latter.

Several background factors affected weight gain in the women in Central Java. Women with low prepregnancy BMI had higher weight gains, although their total weight gain rarely corresponded to that recommended for women with their low prepregnancy BMI (1). Higher weight gains in women with lower prepregnancy BMI were found in many other studies (3, 14, 16, 20, 21). Further, low education and poverty predicted lower weight gains, and these associations were also found in other studies (2, 16). Also, several previous studies from Purworejo District, Central Java, found positive associations between indicators of socioeconomic status and health indicators such as weight and weight changes

TABLE 4
Total weight gain for women in different subgroups

Characteristic	Total weight gain[1]	P (ANOVA)
	kg	
Prepregnancy BMI categories		
Chronically energy deficient ($n = 42$)	9.1 ± 5.9[2]	<0.001
Normal ($n = 184$)	7.2 ± 3.1	
Obese ($n = 25$)	4.2 ± 4.0	
Ownership of a television		
No ($n = 93$)	6.8 ± 3.3	0.037
Yes ($n = 155$)	7.9 ± 4.7	

[1] Actual weight gain from prepregnancy to 8th month of gestation.
[2] $\bar{x}$ ± SE.

over time among nonpregnant women and good breast-feeding practices among lactating women (4, 5) (C Nordenhäll, S Ramberg, unpublished observations, 1997).

Only 251 of 846 women in the pregnancy cohort were included in the present analysis because these were the women with a measured prepregnancy weight. Excluded women were of higher education and higher parity; however, these characteristics were not associated with weight-gain pattern in our sample. Also, because a surveillance system existed in the district, the background characteristics of the included women could be compared with those of the representative surveillance sample of 13 094 women of reproductive age. Because of the large sample size, relatively small differences between the samples were significant. However, there were several important differences between the 251 women and the 13 094 women: the former included fewer nulliparous women and fewer unemployed women or housewives. Again, neither of these characteristics was associated with weight-gain pattern in the studied sample. Thus, we believe that the weight-gain pattern found in our study sample most likely represents that of pregnant women in rural Central Java.

In conclusion, we observed that many women in a population-based sample from Purworejo District, Central Java, Indonesia, were undernourished when they began pregnancy. The total weight gain from prepregnancy to 9 mo gestation was 8.3 kg, and pregnancy weight gain was inadequate in 79% of the women. High prepregnancy BMI, low education, and low socioeconomic status were all associated with lower weight gain in pregnancy. The results underscore the need for nutrition policy and programs targeted to women of reproductive age. Perhaps nutrition education could be included in the existing premarital counseling in Indonesia.

REFERENCES

1. Institute of Medicine. Nutrition during pregnancy. Weight gain and nutrient supplements. Washington, DC: National Academy Press, 1990.
2. Abrams B, Altman SL, Pickett KE. Pregnancy weight gain: still controversial. Am J Clin Nutr 2000;71(suppl):1233S–41S.
3. Siega-Riz AM, Adair LS. Biological determinants of pregnancy weight gain in a Filipino population. Am J Clin Nutr 1993;57:365–72.
4. Nurdiati DS, Hakimi M, Wahab A, Winkvist A. Concurrent prevalence of chronic energy deficiency and obesity among women in Purworejo, Central Java, Indonesia. Food Nutr Bull 1998;19:321–33.
5. Winkvist A, Nurdiati DS, Stenlund H, Hakimi M. Predicting over- and undernutrition among women of reproductive age: a population-based study in Central Java, Indonesia. Public Health Nutr 2000;3:193–200.
6. Wilopo S, Community Health and Nutrition Research Laboratory (CHN-RL) Research Team. Key issues on the research design, data collection and management. Yogyakarta, Indonesia: Community Health and Nutrition Research Laboratory, Faculty of Medicine, Gadjah Mada University, 1997.
7. Central Bureau of Statistics Indonesia, State Ministry of Population, National Family Planning Coordinating Board, Ministry of Health and Macro International. Indonesia Demographic and Health Survey 1994. Calverton, MD: Central Bureau of Statistics and Macro International, 1995.
8. James WPT, Ferro-Luzzi A, Waterlow JC. Definition of chronic energy deficiency in adults. Eur J Clin Nutr 1988;42:969–81.
9. Nutrition Canada. Anthropometry report: height, weight and body dimensions. Ottawa: Bureau of Nutritional Sciences, Health Protection Branch, Health and Welfare, 1980.
10. Frisancho AR. New norms of upper limb fat and muscle areas for assessment of nutritional status. Am J Clin Nutr 1981;34:2540–5.
11. Goldstein H. Multilevel statistics models. 2nd ed. New York: John Wiley & Sons Inc, 1995.
12. Durnin JVGA. Energy requirements of pregnancy: an integration of the longitudinal data from the five-country study. Lancet 1987;2: 1131–3.
13. Kelly A, Kevany J, de Onis M, Shah PM. A WHO Collaborative Study of maternal anthropometry and pregnancy outcome. Int J Gynaecol Obstet 1997;57:1–15.
14. Kusin JA, Kardjati S, Renqvist UH. Chronic undernutrition in pregnancy and lactation. Proc Nutr Soc 1993;52:19–28.
15. Husaini YK, Husaini MA, Sulaiman Z, et al. Maternal malnutrition, outcome of pregnancy and a simple tool to identify women at risk. Food Nutr Bull 1986;8:71–6.
16. Achadi EL, Hansell MJ, Sloan NL, Anderson MA. Women's nutritional status, iron consumption and weight gain during pregnancy in relation to neonatal weight and length in West Java, Indonesia. Int J Gynaecol Obstet 1995;48(suppl):S103–19.
17. Persson V, Winkvist A, Hartini TNS, Greiner T, Hakimi M, Stenlund H. Variability in nutrient intake among pregnant women in Indonesia: implications for the design of epidemiological studies using the 24-hr recall method. J Nutr 2001;131:325–30.
18. Hytten FE, Leitch I. The physiology of human pregnancy. 2nd ed. Oxford, United Kingdom: Blackwell Scientific Publications, 1971: 265–85.
19. Dawes MG, Grudzinkskas JG. Patterns of maternal weight gain in pregnancy. Br J Obstet Gynaecol 1991;98:195–201.
20. Adair LS. Marginal intake and maternal adaptation: the case of rural Taiwan. In: Pollitt E, Amante P, eds. Current topics in nutrition and disease. Vol 11. Energy intake and activity. New York: AR Liss, 1984: 33–55.
21. Allen LH, Lung'aho MS, Shaheen M, Harrison GG, Neuman C, Kirksey A. Maternal body mass index and pregnancy outcome in the Nutrition Collaborative Research Support Program. Eur J Clin Nutr 1994;48(suppl):S68–77.