

## Maternal weight gain in second and third trimesters and their relationship with birth weights in Morogoro Municipality, Tanzania

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**Abstract:** A prospective study was carried out to determine the relationship between weight gain in the second and third trimesters with the corresponding birth weights in Morogoro, Tanzania. A total of 270 pregnant women who gave birth to singleton deliveries and their consecutive newborns were randomly selected from among women who were attending one antenatal clinic. Average weight gains in second and third trimesters were  $2.45 \pm 0.68$  and  $2.14 \pm 0.43$  kg, respectively (a total of  $4.59 \pm 1.11$  kg) for the two trimesters. Weight gains per week were  $0.47 \pm 0.16$  and  $0.33 \pm 0.13$  kg for the second and third trimesters, respectively. Weight gain in the two trimesters was lower than the expected value for the same period. Results from Pearson correlation analysis found a positive correlation ( $P < 0.001$ ) between birth weight and variables such as maternal age, gestational period, parity, weight gain in both second and third trimester, birth length and sex of an infant. Multiple regression analysis indicated that birth weight (dependent variable) was significantly affected by maternal weight gain in the third trimester, maternal age (both at  $P < 0.05$ ) and birth length ( $P < 0.001$ ). The incidence of low birth weight was about 8% and was significantly higher among infants of teenager mothers. It appears that despite of possibility of some physiological adaptations, which tend to protect the foetus when the woman is subjected to inadequate weight gain during pregnancy, weight gains in the second and third trimesters are important in determining the birth weight.

**Key words:** maternal weight, birth weight, pregnancy, Tanzania

### Introduction

Maternal weight gain during pregnancy has been found to be an important indicator of pregnancy outcome in both developed and developing countries (Moller *et al.*, 1989). Relationships between maternal anthropometric variables and infant birth weight have been demonstrated in many studies of populations with different social and economic characteristics (Abrams & Laros, 1986, Durnin, 1987). A pregnant woman usually increases in weight from the first week of pregnancy to last week before delivery. A total weight gain of 12.5 kg has been recommended with the distribution being 650 g at ten weeks, 4000 g at twenty weeks, 850 g at thirty weeks and 700 g at term (Moller *et al.*, 1989).

The timing of a woman's pregnancy weight gain is also important whereby weight gain in the second and third trimesters is of great importance for ensuring foetal growth than weight gain during the first trimester. Weight gain earlier in pregnancy primarily contributes to maternal reserves, and is secondarily due to the growth of the placenta, breasts, uterus and increased amniotic and extra-cellular fluids. Not until after twenty weeks does the foetus begin to increase dramatically in size (Hyttén & Leitch, 1971).

The main objective of this study was to determine the relationship between weight gain in the second and third trimesters with their corresponding birth weights among pregnant women in Morogoro

Municipality in Tanzania. Other factors that influenced the resulting birth weights were also investigated.

### Materials and Methods

#### Study subjects

The study was conducted at Morogoro Regional Hospital in Tanzania. The sample was derived from pregnant women who were attending ante-natal clinic at the hospital from October 2004 to March 2005. Women who were included were those pregnant at the beginning of second trimester according to date of first day of their last menstrual period. Weights and heights of the women were taken in each visit to the clinic whereby weight was measured to the nearest kilogram using beam balance while height was measured to the nearest centimetres.

Maternal weight gains at the second and third trimesters were calculated by subtracting the lowest recorded weights for the period from the highest ones. Weight increase per week was calculated by dividing the weight gain by the number of weeks in the respective trimester. Babies were weighed by using the normal hospital weighing scales to obtain the birth weights. Lengths of the babies were measured using appropriate calibrated length boards with fixed headboard and movable footboard perpendicular to the face of the table. The lengths were recorded to the nearest centimetres.

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Information on parity and socio-economic status were obtained by interviewing the mothers. Records kept in the antenatal clinic cards were used to crosscheck the responses given. Two hundred and eighty one subjects were initially recruited but only 270 were able to comply fully. Among the excluded were those who delivered outside the hospital or had moved to other places away from Morogoro. Also excluded were those who gave birth prematurely, those who gave birth to twins and those who experienced pregnancy loss.

### Data analysis

Data were statistically analysed using computer software Statistical Package for Social Sciences to determine the descriptive statistics. Multiple linear regression analysis was used to determine the relative contributions of some selected maternal variables (independent variables) to the infant's birth weight (dependent variable). The selected maternal variables included age, height, weight, gestational period and weight gain at second and third trimesters.

### Results

Average birth weight was 2.97 kg and average weight gains in second and third trimesters were 2.45 and 2.14 kg, respectively (a total of 4.59 kg for the two trimesters) (Table 1). Results of correlation analysis revealed that birth weight was significantly correlated

with maternal age, parity, gestational period, and birth length (Table 2).

To find whether the weights of babies born to teenager mothers (< 20 years of age) were statistically different from those born to older women ( $\geq 20$  years), cross-tabulation was performed using chi-square statistic. The infants' weights were grouped into two groups. The first group consisted of babies with birth weights of 2.5 kg and above (or good birth weights) while the second group consisted of babies with birth weights below 2.5 kg (or low birth weights) – according to WHO definition (Kramer, 1987). Greater proportion of the teenager mothers (14%) had their babies with low birth weights compared to less than 6% of the older mothers. The difference was statistically significant at  $P < 0.05$ . The overall prevalence of low birth weight was 7.8% (Table 4).

Other variables that were also significantly correlated with birth weight included weight gains of the mother in the second and third trimesters, and sex of an infant. Also significant were the correlations between birth length and gestational period, and between birth length and maternal height. All these correlations were at  $P < 0.001$  level of significance.

Multiple linear regression analysis was done after controlling for confounding factors on some of the independent variables that were correlated. The results confirmed existence of significant positive correlation between birth weight and birth length, weight gain of the mother in third trimester, and maternal age (Table 3).

**Table 1: Characteristics of mothers and babies**

Variable	Range		Means $\pm$ S.D.
	Minimum	Maximum	
Parity	1.00	8.00	2.54 $\pm$ 1.47
Maternal age (years)	17.00	45.00	25.89 $\pm$ 6.32
Weight of mother in 2 <sup>nd</sup> trimester (kg)	41.00	102.00	60.08 $\pm$ 10.19
Weight of mother in 3 <sup>rd</sup> trimester (kg)	41.00	98.00	63.66 $\pm$ 10.06
Weight gain of mother in 2 <sup>nd</sup> trimester (kg)	-3.00	11.20	2.45 $\pm$ 2.25
Weight gain of mother in 3 <sup>rd</sup> trimester (kg)	-1.50	9.00	2.14 $\pm$ 1.84
Weight gain per week in 2 <sup>nd</sup> trimester (kg)	-0.41	1.50	0.47 $\pm$ 0.34
Weight gain per week in 3 <sup>rd</sup> trimester (kg)	-0.67	6.50	0.33 $\pm$ 0.49
Maternal height (m)	-1.40	1.85	1.55 $\pm$ 0.06
Gestation period (weeks)	29.00	40.00	36.96 $\pm$ 1.83
Birth length (cm)	42.00	51.00	46.96 $\pm$ 1.81
Birth weight (kg)	2.00	5.00	2.97 $\pm$ 0.42
Weight of male babies (kg)	2.10	3.80	3.08 $\pm$ 0.36
Weight of female babies (kg)	2.00	5.00	2.88 $\pm$ 0.45

**Table 2: Multiple linear regression analysis of birth weight and birth length of the candidates**

Variables	r	Significance
<b>1. Birth weight and:</b>		
Maternal age	0.30	$P < 0.001$
Parity	0.23	$P < 0.001$
Gestational period	0.33	$P < 0.001$
Birth length	0.40	$P < 0.001$
Weight gain in the second trimester	0.25	$P < 0.001$
Weight gain in the third trimester	0.31	$P < 0.001$
Sex of an infant	0.30	$P < 0.001$
<b>2. Birth length and:</b>		
Gestational period	0.24	$P < 0.001$
Maternal height	0.43	$P < 0.001$

**Table 3: Regression analysis when the dependent variable is birth weight (N= 270)**

Independent	Coefficient	Standard error	t-value	Significance
Costant	-	0.833	-1.514	0.133
Birth leght	0.377	0.016	4.902	0.000***
Maternal age	0.228	0.006	2.038	0.044*
Weight gain (2nd trimester)	0.117	0.016	1.416	0.122
Weight gain (3rd Trimester)	0.157	0.015	2.149	0.034*
Parity	-0.022	0.031	-0.019	0.985
Gestational period	-0.022	0.18	-0.280	0.780

**Key:** \*  $P < 0.05$  ; \*\*\* $P < 0.001$

**Table 4: Cross-tabulation of subject mothers according to age and birth weight of their babies**

Category of Mother's Age	Type of birth weight	
	Low birth weight (<2.5 kg) N (%)	Normal birth weight (>2.5 kg) N (%)
Teenager mothers (<20 years of age)	9 (14%)	55(86%)
Older mothers ( $\geq 20$ years of age)	12 (5.8%)	194 (94.2%)

Chi-square value = 4.619; df = 1;  $P = 0.052$  ; n = 270

## Discussion

The World Health Organization recommends that women in the developing countries gain at least 1 kg per month during the last two trimesters of pregnancy, resulting in a weight gain of at least 6 kg (Kramer, 1987). However, the weight gained in the current study was only 4.59 kg. Similarly, the average weight gains per week in both the second and third trimesters were also lower than the recommended rate (Hytten, 1990). Another study done elsewhere in Tanzania also reported lower weight gain among pregnant women (Moller *et al.*, 1989).

The above-mentioned observations of low weight gain in pregnancy are not surprising. Most women in Tanzania, like in other developing countries, are highly

engaged in both cultivation as well as other household activities during pregnancy. Excessive involvement in such activities during pregnancy does explain, at least in part, the reason for the observed low weight gain. Other reasons may include: (i) diseases such as malaria, anaemia, etc, (ii) physiological factors such as morning sickness, which include nausea and vomiting, (iii) psychological factors such as social pressure for example from family members about sex of the infant to be born and societal disrespect for pregnant unmarried women, (iv) poor access to health services, and (v) social factors including inadequate support from other household members (Jellife, 1998; Kramer, 1987).

The current study has found that maternal age has significant influence on birth weight. Other

workers have reported similar observation (Dawes & Grudzinskas, 1991). The observed high incidences of low birth weights among younger mothers are probably caused by poor foetal growth due to insufficient nutrient supply. Young mothers have higher nutrient needs than older ones as they are still growing. This high nutrient demand in young mothers is likely to bring about deprivation of nutrient supply to foetus leading to poor foetal growth (Naeye, 1981).

Our findings that male infants weighed more than female infants tend to agree with other studies (Banjete, 1986; Moller *et al.*, 1989). However, Dawes & Grudzinskas (1991) found no correlation between birth weight and sex of an infant. On the other hand, mean birth weight was 2.97 kg, which is somehow moderate but lower than 3.26 kg reported by Nyaruhucha & Msimbe (1993).

Infants born with birth lengths of less than 47 cm are considered short (Jelliffe, 1978). In this study, 33% of babies were below this cut-off point. Factors that may contribute to such condition include genetic make up of mothers and environmental conditions. For example, birth length is related to the maternal pre-pregnant BMI (Kirchengast & Hartmann, 1998) whereby mothers with low pre-pregnant body-mass-index (BMI) have greater possibility of having shorter infants.

Average gestational period in the present study was 36.96 weeks corresponding to average birth length of 46.96 cm. The results have emphasized that low gestational period is associated with low birth length. On the other hand, mean birth weight was 2.97 kg, which is somehow moderate but lower than 3.26 kg as reported by Nyaruhucha & Msimbe (1993). The results also showed that 7.8% of all babies had birth weights below 2.5 kg.

In conclusion, maternal weight gains in the second and third trimesters in Tanzanian women in Morogoro are lower than the expected values. It appears that despite of possibility of some physiological adaptations, which tend to protect the foetus when the woman is subjected to inadequate weight gain during pregnancy, weight gains in the second and third trimesters are important in determining the birth weight.

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